Report

DRAFT CONSULTATION BASIC ASSESSMENT REPORT: SITE CLEARANCE FOR PLANNING AND DESIGN OF PATROL ROADS AND FENCING BETWEEN RSA, SWAZILAND AND MOZAMBIQUE (BID H15/019)

Client:	Department of Public Works
Reference:	MD2264_R01_F01_RSA Swazi Moz BPR
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Enhancing Society Together

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Table of Contents

Royal HaskoningDHV

Table of Tables

Table of Figures

Appendices

Royal HaskoningDHV

Appendix I: Public Participation Documents
- **Appendix I1: Site notices**
- **Appendix I2: I&AP Database**
- **Appendix I3: Background Information Document**
- **Appendix I4: Draft Advert**
- **Appendix I5: Issues Trail**

Appendix J: Environmental Management Programme

Appendix K: Sensitivity Maps

Executive Summary

Background

The protection of the Republic of South Africa's borders serves to:

- prevent the illegal movement of people, goods (to avoid payment of duty) or contraband;
- prevent the movement of produce or livestock that may lead to the spread of infectious disease; and
- promote the lawful entry and exit of goods and people.

Achievement of the above three objectives is essential to South Africa's security, economic prosperity, and national sovereignty.

In order to ensure that the required infrastructure is constructed to enable the responsible organs of state to effectively execute their respective responsibilities towards the above objectives, the Department of Public Works (DPW) has commissioned the Planning and Design for Maintenance and / or Upgrade of the Patrol Roads and Fencing on the borders between South Africa, Swaziland and Mozambique.

Project Locality

The study area stretches from the Indian Ocean (immediately south of Ponta de Ouro) along the border with Mozambique to where the South African, Mozambique and Swaziland Borders meet in northern KZN, then along the entire length of the Swaziland – South African Border to the point where the Swaziland, Mozambique and South African borders once again meet at Zulu Crossing (immediately south of a settlement named Mbuzini) in the Mpumalanga Province. The project is restricted to the South African side of the international border – Figure I.

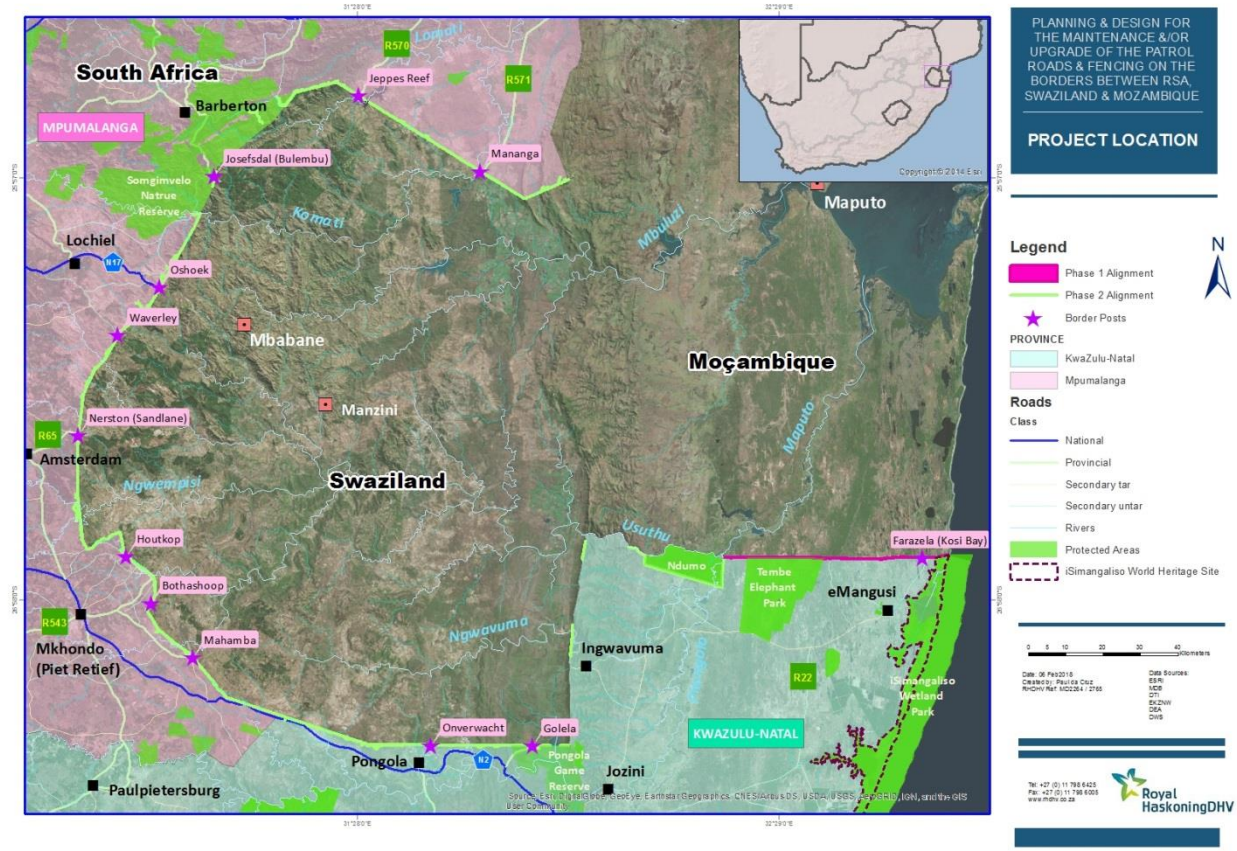


Figure I: Locality map

The total length of the project is approximately 524km and the environmental authorisation application will be divided into two phases:

- Phase 1: Prioritisation of km 0 to km 54
  From the high-water mark of the Indian Ocean near Kosi Bay (km 0) to the eastern boundary of the Ndumo Game Reserve (km 54) of the project due to this section of the route being a 'high risk' priority area where significant numbers of stolen vehicles are currently being trafficked into Mozambique from South Africa. This phase of the project is subject to a separate application process.

- Phase 2: km 54 to km 524
  This phase is divided into six main regions:

  i. **km 54 to km 82** - from the eastern boundary of the Ndumo Game Reserve, the route proceeds around the reserve and crosses the Phongolo River. Between km 78 to km 81, the route is aligned out of the 1:20 year flood line of the Usuthu River within the Usuthu Gorge Community Conservation Area (CCA). The southern Swaziland tripoint is situated at Abercorn Drift (km 81) in the Usuthu River, where the Mozambique–Swaziland Border along the Lebombo Mountains meets the river.

  ii. **km 82 to km 154** - the route then continues along the Lebombo Mountains through the Ekuhlehleni Pass and Cecil Macks Pass towards the Pongolapoort Dam. The nearest town is Ingwavuma.

  iii. **km 154 to km 252** – the route borders the Pongolapoort Dam and Pongola Nature Reserve (km 155 – km 168) with the Golela Border Post situated at km 163. The section between km 164 to km 187 leading up to the Onverwacht Border Post, detour roads have been proposed to patrol the border due to the site topography. The Sitilo River is crossed by the route at km 178. The Mahamba Border Post is situated at km 252 with the route crossing the following rivers: Manzawakho (km 191), Spekboom (km 214), Nyamane (km 230) and Mozane (km 242). Nearest towns include: Pongola, Ncotshane, Mkhwakhweni and Belgrade.

  iv. **km 252 to km 384** – the route crosses four other border posts i.e. Bothashoop (km 217), Emahlathini (km 287.5), Nerston (km 338) and Waverley (km 367) before reaching the Oshoek Border Post (km 384). There is a spear in the South African Border at km 296 and data on the international border from km 296 to km 307 is lacking. The following rivers are crossed by the route: Mhkondvo (km 257), Ndlozane (km 279), Hlelo (km 314.5), Ngwempisi (km 320), Mlambo (km 332), Usuthu (km 343), Metula (km 353), Mpuluzi (km 359.5) and Lusushwana (km 371.5).
  Nearest towns include: Piet Retief, Amsterdam, Empuluzi and Dundonald.

  v. **km 384 to km 464** – this part of the route traverses steep terrain and a large section of this portion of the route borders the Songimvelo Nature Reserve (km 406 – km 447). The Josefsdal Border Post is situated at km 416 and Jeppes Reef Border Post at km 463.5. Maanhaar, Barberton and Jeppes Reef are the closest towns to this section of the route with the Komati (km 406) and Lomati (km 430.5) rivers being crossed.

  vi. **km 464 to km 524** – this final section of the route proceeds around the Driekoppies Dam (km 466) and approaches the Mananga Border Post (km 500) before terminating at Zulu Crossing (km 524). The Mawewe Cattle / Game Project is within 2km of the route between (km 484 – km 494). Schoemansdal, Driekoppies, Schulzendal, Mgobode, Mananga and Mbuzini are the closest towns.

Affected District and Local Municipalities

Province	District Municipality	Local Municipality
KwaZulu-Natal	Umkhanyakude	Umhlabuyalingana & Jozini
	Zululand	uPhongolo
Mpumalanga	Gert Sibande	Mkhondo, Msugaligwa & Albert Luthuli
	Ehlanzeni	City of Mbombela & Nkomazi

Development Proposal

An application for environmental authorisation is being lodged for a fifty (50) meter wide assessment corridor (from the international boundary or existing fence or from the 1:20 year flood line of a river) except in sensitive areas (e.g. Protected Areas; Critical Biodiversity Areas and watercourses) where this corridor has been reduced to the absolute minimum width (between 10 – 15m) required for the development of border control infrastructure.

The proposed typical infrastructure that will be developed within this servitude (border patrol zone) will include the following components: three (3) fences, a 5.5m patrol road, a 10m detection zone and a total servitude width of 100ft (30.48m) – Figure II. A description of each of the infrastructure is provided below.

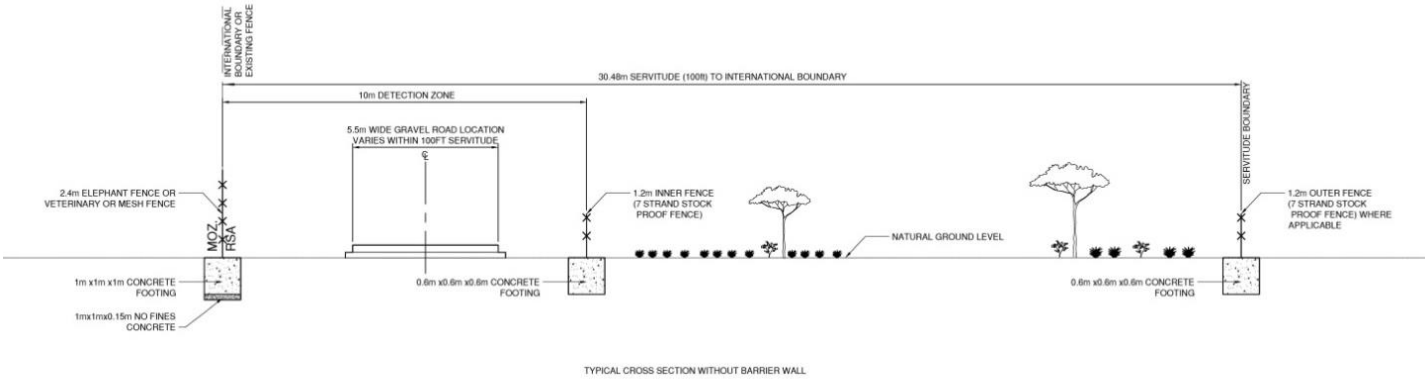


Figure II: Typical cross-section of the border patrol zone

- International border fence – Typically a 2.4m high elephant fence, or a 2.4m high game-proof fence or a 2.4m high mesh fence (ClearVu® or similar approved) located on the existing border fence position or on the international boundary. The 2.4m high elephant fence (to be installed along the KwaZulu-Natal / Mozambique Border) is a requirement from DAFF to prevent elephants and other wildlife from crossing into South Africa and spreading foot-and-mouth disease (FMD). The 2.4m high game-proof (veterinary) fence (to be installed along Swaziland / South African game reserves) is to prevent wildlife and cattle from crossing into South Africa and spreading FMD as required by DAFF.
- 10m wide detection zone - cleared of vegetation between the international border fence and the inner fence. This is a requirement by SANDF to provide protection for their staff patrolling the international boundary to provide them with a clear, uninterrupted view of the border.
- 1.5m high concrete barrier wall - along a portion of the RSA / Mozambique Border to prevent vehicle theft (part of a separate application for Environmental Authorisation – Phase 1). Also proposed for the section at Nkonjane along the Usuthu River.
- 5.5m wide border patrol road - typically within the detection zone. This will most likely be a gravel road but in very steep areas (mountainous terrain), the gravel road will be replaced by a concrete road. This

is a requirement by SANDF to allow for border patrol vehicles to travel along the international border. This road will also be used by DAFF staff to inspect the fence. In some areas, this road will be replaced by a 2m wide quad track.

- Inner 1.2m high stock-proof inner fence - 10m away from the international fence within South Africa. This purpose of this inner fence is to prevent animals (in South Africa) from grazing within the 10m detection zone. Animals grazing within this zone could spread FMD.
- Outer 1.2m high stock-proof outer fence – on the 100ft (30.48m) edge (optional, where viable).

In addition to the infrastructure within the 50m servitude, the following may also be applicable:

- Detour / contour roads - In areas where it is not possible to construct a border patrol road adjacent to the international boundary due to the topography or other conditions, a detour road will be constructed around the obstacle. The typical cross-section of the detour roads will consist of two (2) fences (optional, where viable) and a 5.5 to 7.9m wide gravel access road within a 13.49 road servitude.
- Access routes - The typical cross-section of the access routes to the border patrol zone will consist of a 5.5 to 7.9m wide gravel border patrol road within the road servitude of 13.49m and gates where required. It should be noted that no new access routes will be applied for. Existing access routes will be re-gravelled. Any upgrading or expansion or new access routes will have to undergo the appropriate environmental permitting if and when the need arises. The upgrading of access roads within Protected Areas will form part of the Reserve's Management Plan.
- Border markers / beacons - in mountainous areas where the topography is not suited to construct a fence.
- Structures within watercourses – culverts, concrete drifts, road bridges and vented concrete drifts (causeways).
- Construction camp / lay-down areas – It is proposed that these construction camps / lay-down areas be located at existing border posts and gates, transformed "brownfield" sites e.g. disused mill sites and forestry processing areas as well as within the 50m corridor in less sensitive areas. The construction camps / lay-down areas will not exceed the 20ha threshold for the clearing of indigenous vegetation. The location of the construction camps and lay-down areas will need to be approved by the Environmental Control Officer (ECO) prior to implementation.
- Borrow pits - Borrow pits along the route have been screened. During the detail design stage material requirements will be finalised through testing. As far as possible, existing sources of material will be considered. No borrow pits are being applied for in this application.

Legislative Context

In order to protect the environment and ensure that the development is undertaken in an environmentally responsible manner, there is a number of significant environmental legislation that needs to be considered during this study. The proposed development will trigger a number of activities in terms of the Environmental Impact Assessment (EIA) Regulations (2014) published under Government Notice No 982 of 4 December 2014 [as amended by Government Notice Regulation (GNR) 326 of 7 April 2017], in terms of Section 24(5) of the National Environmental Management Act (NEMA) (Act No 107 of 1998)(as amended) under:

- Listing Notice 1 (GNR 983 in GG 38282 of 4 December 2014) as amended in 2017 by GNR 327 of April 2017; and
- Listing Notice 3 (GN R984 in GG 38282 of 4 December 2014) as amended in 2017 by GNR 324 of April 2017.

The Listing Notice 3 activities are triggered as there are a number of environmentally sensitive geographical areas as defined in Listing Notice 3 for KwaZulu-Natal and Mpumalanga which are traversed by the proposed development, including World Heritage Sites, formally Protected Areas and Critical Biodiversity Areas.

The Applicant / Developer is not negated from complying with any other statutory requirements that have been identified and is applicable to the undertaking of the activity. Relevant key legislation that must be complied with includes *inter alia*:

- Provisions of the National Environmental Management Waste Act (Act No. 59 of 2008) (as amended);
- Provisions of the National Water Act, 1998 (Act No. 36 of 1998) (as amended);
- Provisions of the National Forests Act (Act No. 84 of 1998);
- Provisions of the National Environmental Management: Protected Areas Act (Act No. 57 of 2003) – NEM: PAA;
- Provisions KwaZulu-Natal Nature Conservation Ordinance (Ordinance No. 15 of 1974); and
- Mpumalanga Nature Conservation Act (Act No. 10 of 1998).

Project Need and Desirability

In the context of border security, the main challenges facing the various organs of the state (in terms of each of their respective mandate areas) include:

- Customs / Revenue Services / Home Affairs
  - Illegal movement of goods;
  - Illegal migration / crossing of the border; and
  - Absence of clearly marked border position to allow successful prosecution.
- DAFF
  - Inadequate fencing and resulting challenge for disease control.
- SANDF / SAPS
  - Criminal activity;
  - Inadequate fencing / barrier infrastructure; and
  - Poor access and patrol infrastructure, making it difficult to patrol and respond to incidents.
- Provincial Conservation Authorities (EKZNW and MTPA)
  - Illegal entry / trespassing.
  - Anti-poaching initiatives.

The proposed project will assist in fulfilling the constitutional mandate of a number of national and provincial governmental departments as well as the mandate of the SANDF in securing South Africa's borders, to protect its citizens and to prevent the spread of disease as well as the illegal movement of goods and people. The project is thus highly important at a national level.

The project is also aligned with strategic and spatial planning policies at the Provincial (KwaZulu-Natal and Mpumalanga) level. These policies include (but not limited to): Provincial Growth and Development Strategies (PGDS) of both KwaZulu-Natal and Mpumalanga; Umkhanyakude Municipality Spatial Development Framework (SDF); Zululand District SDF; Gert Sibande District SDF and Ehlanzeni District SDF.

Project Alternatives

In terms of the EIA Regulations 2014 (as amended in 2017) feasible alternatives are required to be considered as part of the environmental investigations. In addition, the obligation that alternatives are investigated is also a requirement of Section 24(4) of the NEMA (Act No. 107 of 1998) (as amended). An alternative in relation to a proposed activity refers to the different means of meeting the general purpose and requirements of the activity.

The various stages in the analysis of alternatives for the project are presented in Figure III below. Following the preliminary route determination process (done at a desktop level supported by a site visit), a desktop Environmental Screening Investigation (ESI) was conducted. Highly sensitive points / crossings (rivers and streams; wetlands and terrestrial habitats) were then identified where realignments were proposed.

Figure III: Stages in analysis of alternatives

The route was optimised following the ESI and realignment options proposed by the specialist team. The finalised preliminary route were then assessed by the specialist team and introduced to stakeholders for further comment. Comments provided by stakeholders / partners e.g. EKZNW and MTPA were then workshopped and included in the design. The current route for the border patrol infrastructure may also need to be revised based on comments received during the public participation process.

In the context of alternatives it is very important to note that the border control infrastructure is required to be placed immediately alongside the international boundary or existing fence or from the 1:20 year flood line or a river, as the primary aim of the infrastructure is to secure the border (in the case of fencing) and to allow the patrolling of the border (in the case of the border patrol road and associated infrastructure including the footpath that replaces the road along certain sections of the alignment and detour roads). It is thus technically not feasible to locate this infrastructure away from the border, as the purpose of securing the border and in particular the patrolling of the border which requires visibility of the border will not be achieved. In certain sections of the route, the nature of the terrain (where terrain is very steep) has necessitated the alignment of the border road away from the border for short sections.

In addition, there is existing border patrol infrastructure along the border (i.e. tracks, forestry roads gravel roads and public roads), and there is no value in considering an (new) alternative alignment away from the border – environmentally this would result in the transformation of “greenfield” areas which is much less preferable than widening the existing impacted footprint.

Should the development not proceed, the existing infrastructure will remain. The activities related to border control and border patrol will still be able to be undertaken by the relevant law enforcement agencies, as is currently the case due to the existence of the existing track and fence along the majority of the length of the alignment. However, the benefits in terms of improved law enforcement, improved ability to secure the international border and in terms of the ability of government agencies will continue to be compromised by infrastructure that in a state of disrepair in certain parts of the route, or which hinders the ability of the illegal movement to be prevented due to poor access and patrol infrastructure which makes it difficult to patrol and respond to incidents.

The upgrading of the border fence will also enable South Africa to retain its FMD-free zone status as recognised by the World Organisation for Animal Health (Office International des Epizooties).

Whilst there are unavoidable environmental impacts i.e. vegetation removal, impact of fencing on fauna, impact on watercourses and Protected Area expansion plans, the environmental benefits of the project cannot be underestimated. The project will provide a number of indirect biodiversity benefits (e.g. reduction of poaching, improved drainage and appropriately designed watercourse infrastructure, promote conservation initiatives i.e. CCAs as well as social benefits in the form of employment opportunities.

Key Issues and Impacts Identified

The following key issues have been raised as part of the engagement process with end users, partners and stakeholders on the project:

- 50m application corridor and servitude including the minimum amount of vegetation to be cleared in highly sensitive areas including Protected Areas and expansion areas, Centres of Endemism, sensitive faunal and floral habitats as well as aquatic habitats.
- Solutions to address actual challenges / threats.
- Potential impact of securing the border on the future development of the Lubombo Transfrontier Conservation Resources Area comprising the Usuthu-Tembe-Futi Corridor; Nsubane-Pongola and Songimvelo-Malolotja TFCAs and South Africa's International Obligations in terms of Protocols signed establishing the TFCAs. The erection of fences and decommissioning of fences in the long-term may have further residual impacts as well as financial implications.
- Impact of the project on the legal mandates of certain organs of state (e.g. conservation authorities in terms of conservation and protection of biodiversity) that are contradictory to the mandates of the end users on the project.
- The impact of increased veterinary control and isolation on conservation and wildlife (faunal) movement i.e. access to rivers and drinking points and reduction in carrying capacity.
- The creation of potential residual impacts relating to the phasing of construction activities (i.e. different infrastructure components being developed at different times).
- Potential impact of construction on the environment in the context of the encroachment of alien invasive plant species into the construction servitude and wider area.
- Location of construction camps and lay-down areas in relation to sensitive habitats within the study area.
- Hydrological and other impacts on wetlands and watercourses crossed.
- Biodiversity offsets related to natural habitat loss.
- Potential conservation gains of the project i.e. upgrading fencing in Protected Areas e.g. Ndumo Game Reserve and reducing poaching.
- Social issues relating to people being prevented from being able to move informally across the border once the infrastructure is developed, closure of public roads and accesses.
- Potential impact on archaeological, cultural and palaeontological resources.
- Maintenance of the infrastructure (and provision of budget for maintenance) during the operational phase of the project to avoid environmental impacts.

Biophysical Impacts and Associated Mitigation

Arguably the most significant of these biophysical impacts / issues relates to the loss of natural habitat through clearing to develop infrastructure within a linear alignment, as well as the physical destruction and / or modification of terrestrial and aquatic habitat, as well as flow modifications and erosion / sedimentation impacts and water quality impacts within the wetlands and watercourses crossed by the alignment. Based on the concerns raised by stakeholders in the context of habitat loss efforts have been made to limit the actual footprint of the developed infrastructure and the resultant area of loss of natural habitat. This has been done in a number of ways; firstly the 50m application corridor has been narrowed in the following areas of high environmental sensitivity:

- Protected Areas (Ndumo Game Reserve, Pongola Nature Reserve, Songimvelo Nature Reserve) – narrowed to 15m.
- Wetlands in the Witkoppies-Berbice area: between km 241 and km 242 the corridor has been narrowed on the eastern side of the road centreline to avoid impacting the riparian zone of the Mozana River (W42K-R05). Between km 242.5 and km 243 where the patrol road crosses, and runs close to the wetland W42K-W13, the corridor has been narrowed to 15m to avoid affecting this wetland unnecessarily. Around km 242, the corridor has similarly been narrowed, except in the vicinity of the outlets of wetlands W42K-W11 and W42K-W12, in order to allow for the recommendation that the patrol

road cross these wetlands at the point at which they narrow to minimise the area of wetland habitat that is transformed.
- Detour roads located in Protected Areas e.g. Songimvelo Nature Reserve, the corridor width has been narrowed to 15m i.e. 7.5m either side of the centreline.

The narrowing of the application corridor in these areas of high sensitivity will ensure that no development is permitted beyond the narrowed width.

Secondly, certain infrastructure components have been removed from the infrastructural configurations in certain sensitive areas, in particular fencing which will be responsible for further fragmentation away from the core 'patrol zone' located in direct proximity to the international border:
- The initial proposal of an elephant fence has been changed to a veterinary fence on the eastern and southern boundary of the Ndumo Game Reserve.
- No new infrastructure will be developed on the southern boundary of the Ndumo Game Reserve, except for the upgrading of the existing boundary fence. Pending a formal agreement between the EKZNW, DAFF and SANDF, the internal perimeter roads will be used to patrol the reserve boundary. A footpath will still be required on the outer side of the fence as the DAFF will need to inspect the fences whilst the SANDF would patrol using the internal roads within the reserve.
- Ndumo to Abercorn Drift along the Usuthu River - As an alternative to fencing this section of the Usuthu River, barriers (similar to those proposed along other sections of the Mozambique / KZN border) will be used to block any potential access to vehicles (in areas where the topography is conducive to illegal vehicle movement). The barriers must not impede wildlife access to the river. The fencing emphasis will shift from the Usuthu River to the maintenance of the Usuthu Gorge CCA fence, with all future fence patrol infrastructure to be internal to the CCA (forming part of the future proclaimed conservation area's infrastructure).
- Where the international border is defined by the middle of a river, border beacons / markers will as a minimum still be needed on the bank of the river (South African side).
- Upgrading of the D1841 may increase the risk of trafficking along this route. As a solution, an alternative access alignment to Nkonjane will be along the internal perimeter roads along the western boundary fence of the Ndumo Game Reserve.
- Access to the western boundary of the Pongola Nature Reserve *via* the P720 will be fenced and access controlled.
- Witkoppies-Berbice area:
  - A deviation of the patrol road around a highly sensitive floodplain wetland (W42K-W14) (associated with the Mozana River) and associated seepage wetland (W42K-W15_500m) has been included in the alignment between km 243-244. Accordingly, no road or footpath infrastructure must be aligned across these wetlands. Only the international border fence is aligned along the section of the international border that traverses the floodplain wetland W42K-W14, to avoid impacts on this wetland; no further fencing must be developed within these wetlands.
  - For the design of the international border fence that traverses the floodplain wetland W42K-W14, the following measures are specified:
    - The footprint of the fence must be limited to the fence footings within the wetland. These must be designed to accommodate flood flows and inundation for large parts of the year.
    - Due to the inundated nature of this wetland, it is recommended that a running track made from coarse stone material be constructed along the fence line to allow the movement of construction workers and equipment into this wetland, and to minimise damage to wetland substrate and vegetation. This running track must be fully removed from the wetland once construction of the fence is complete.
    - For the patrol road crossings of wetlands W42K-W11 and W42K-W12, it is strongly recommended that the patrol road be aligned to cross these wetlands at the point at which they

narrow (becoming channelised) to enter the Mozana River, thus minimising loss of functional wetland habitat (-27.181909°; 31.129403° for W42K-W11, -27.180944°; 31.128726° for W42K-W12). At these crossing points it is recommended that stone gabion basket structures be utilised to stabilise the headcuts (related to the drop in levels and exacerbated by cattle movement) that are present in the wetlands at these locations.

- A veterinary fence will be designed on the South African side of the border specifically the pan handle section of the nature reserve (km 420 – km 447) and an elephant fence will be incorporated into the detail design from the Josefsdal Border Post (Bulembu) km 390 to km 418.

Thirdly the clearing of (woody) vegetation has been limited to the patrol zone which is generally 10m – 15m in width. Other parts of the declared servitude will not be cleared of vegetation for the purposes of border control.

Fourthly, the proposed recommendations provided by the Ecologist in terms of border fence design and the associated impact on wildlife movement. These recommendations must be considered during the detail design stage.

Lastly in line with the mitigation hierarchy, a number of steps to avoid sensitive areas through specialist sensitivity analysis, realignment recommendations and site-specific watercourse crossing design considerations were provided to the Engineering team. These planning phase recommendations were incorporated (where practically) possible and agreed to as part of the final preliminary layout and design specifications. In this regard, the impact descriptions that follow take into account these recommendations, chief amongst which were the realignment recommendations.

Further to these design measures a comprehensive series of mitigation measures have been identified in the biodiversity and freshwater reports in order to reduce the biophysical impacts of the project to acceptable levels. These mitigation measures are directed at preventing the different types of biophysical impacts from materialising, including direct impacts such as physical transformation of habitat discussed above, but also indirect / secondary impacts, including downstream (hydrological) and adverse impacts on ecological processes such as loss of ecological connectivity and fragmentation. Site-specific impacts mitigation measures have been specified in certain freshwater and terrestrial habitats that are highly sensitive, including the Witkoppies-Berbice area and Protected Areas.

It should also be noted that according to the mitigation hierarchy, where it is not possible to avoid, minimise or rehabilitate, an offset maybe required to compensate for the residual negative effects that the project has on biodiversity including wetlands. A preliminary assessment of potential offset requirements suggests that biodiversity offsets may be warranted for this development project, given the potentially large extent of permanent transformation of threatened vegetation types involved. Whilst an offset is required, it is difficult to determine before the residual impacts have been fully understood and assessed. The extent of the area to target, together with the mechanisms and cost implications for doing so, will need to be investigated once confirmation for the need for an offset has been obtained from the Competent Authority (i.e. DEA).

Any offset recommendations specified as such by DEA must be adhered to in the development of the project. The DPW's commitment to funding infrastructural upgrades associated with the development of further conservation initiatives could potentially constitute a form of financial offset for loss of biodiversity associated with the project.

Conservation Planning Impacts and Association Mitigation

The other significant impact that was raised by stakeholders in the initial engagement process related to the potential of the project to significantly adversely affect the development of the Lubombo Transfrontier

Conservation and Resource Area (TFCA). The strengthening of the border control infrastructure, in particular the upgrading of much of the border to an elephant fence could be considered to be contrary to the wider objectives of the TFCA, which was established to restore the natural movement of fauna, in particular elephant populations between Protected Areas in South Africa and Mozambique as well as South Africa and Swaziland and could thus be considered to be a negative development in the context of cross-border conservation planning.

Re-establishing of free movement of fauna between the TFCAs (Usuthu-Tembe-Futi Corridor; Nsubane-Pongola and Songimvelo-Malolotja) remains a key objective of the TFCA development and is being actively pursued by the governments of South Africa, Mozambique and Swaziland (as per the *General Transfrontier and Resource Area Protocol, 22 June 2000*), with the intention of removing all fencing between the reserve components once the outer boundaries of the reserve components have been adequately secured. The required strengthening of the border fencing to fulfil the mandates of both the SANDF (security) and DAFF (livestock disease prevention) is arguably contrary to the key development outcome for the TFCA and blocks the fulfilling of EKZNW, MTPA and Peace Parks Foundation and the wider South African Government's mandate as specified by legislation (protocols) set up for the development of the TFCAs.

It was in this context of these apparently conflicting mandates that the Applicant hosted a meeting in early July 2018 between the two end users (SANDF and DAFF), EKZNW and representatives from the DEA's Transfrontier Conservation Division in order to find compromises and resolutions for the implementing of the Phase 1 and 2 projects. As an outcome of this meeting a number of resolutions were made that represented a compromise between the organs of state; importantly a resolution was made to replace the elephant fence along the eastern boundary of the Ndumo Game Reserve with a veterinary fence. In the section of the route around the Pongola Nature Reserve the design makes provision for the upgrade of a veterinary fence rather than an elephant fence as this is a TFCA (Nsubane-Pongola) as well.

It is noted that a fundamental understanding is required for the removal of constructed fences especially associated with TFCA and CCAs. There are many ways to plan and deal with areas where fencing may change or be removed in future, however due to uncertainty regarding Protected Area expansion plans and timeframes for implementation, these impacts cannot be adequately quantified and mitigated during this assessment. The DPW should undertake (outside of this EIA process) to support the EKZNW (wherever possible) in conservation initiatives as expansion of conservation areas along the border is a gain for conservation and security and could potentially provide an appropriate contribution to offsets.

Socio-Economic Impacts and Associated Mitigation

Social impacts related to the potential cessation of currently permitted 'informal' movement of people across the border at a number of locations would be able to be prevented by the retention of formal gates to allow cross-border informal movement to continue at these locations.

Other socio-cultural and socio-economic impacts that are anticipated to arise from the project development are largely positive in nature. The project is a large-scale infrastructure development project and will thus generate employment opportunities during the construction phase which will assist inhabitants of the project area to maintain their livelihoods, should local inhabitants be employed by the project. The infrastructure upgrades will also secure vulnerable sections of the border which is currently subject to a high degree of illegal movement of people and stolen goods, in particular stolen and hijacked vehicles. The infrastructure upgrades will enable a number of government departments, in particular the SANDF to more effectively perform their mandate which will assist in the securing of the border area which is subject to high levels of crime, much of which is related to the illegal cross-border activities.

Heritage and Paleontological Impacts and Associated Mitigation

The proposed project would have limited negative impacts on archaeological and palaeontological resources in the area provided that the mitigation measures that have been specified to ensure that archaeological or palaeontological resources be documented or protected should these be uncovered in the process of constructing the border patrol infrastructure are adhered to.

Operational Impacts

While construction-related impacts are to be addressed through best management practices and drafting of an Environmental Management Programme (EMPr) for the development project, there are a range of longer-term aspects that need to be addressed to ensure that operational-phase impacts are managed in such a way as to limit impacts on terrestrial and aquatic habitats. Operational-phase environmental impact / risk management and mitigation guidelines include:

- Maintenance of border patrol infrastructure i.e. road, stormwater infrastructure and fence;
- IAP control (must also be built in the Fence Maintenance Plan);
- Maintenance of the border detection zone;
- Erosion control; and
- Wildlife monitoring during patrols.

Summary of Negative and Positive Impacts

Impacts	Without Mitigation	With Mitigation
Planning Phase		
Impact on fauna and flora, watercourses, Protected Areas	High (-23)	Moderately Low (-5)
Impact on protected fauna and flora	Moderately High (-17)	Moderately Low (-6.5)
Impact on fauna and vegetation in and adjacent to the construction servitude	Moderate (-15)	Low (-3.5)
Impact on watercourses due to improper design of infrastructure	High (-24)	Moderately Low (-6.5)
Construction Phase		
Physical degradation of soils due to removal and compaction	Moderately Low (-5.25)	Low (-2)
Physical degradation due to soil: erosion as a result of exposed soil and topsoil	Moderately Low (-7.5)	Low (-2)
Soil pollution	Moderately Low (-7.5)	Low (-2)
Impacts associated with earthworks i.e. slope stability, cut and filling, construction in problem soils, hard rock etc.	Moderate (-11.5)	Moderately Low (-5)
Groundwater contamination (spillage of fuels, chemicals and lubricants; lack of ablution facilities; wash bay areas)	Moderate (-8.25)	Low (-2.5)
Physical destruction and / or modification of terrestrial habitats	High (-22)	Moderately Low (-7)
Indirect erosion, sedimentation impacts on terrestrial habitats	Moderately High (-15)	Low (-3.5)
Impact on biodiversity connectivity - alteration of ecological processes that are important for the maintenance of terrestrial biodiversity (flora and faunal species)	High (-23)	Moderate (-11.25)
Physical destruction and / or modification of aquatic habitats	High (-21)	Moderately High (-13)
Flow modification and erosion / sedimentation impacts	High (-20)	Moderately Low (-5.5)

Impacts	Without Mitigation	With Mitigation
Impact on water quality	Moderate (-8.25)	Low (-1.4)
Impact on archaeological (Early Stone Age, Middle Stone Age, Later Stone Age, Rock Art, historical sites) and cultural resources	Moderately High (-16.5)	Low (-1.2)
Impact on graves	Moderate (-11)	Low (-1.2)
Damaging impacts on palaeontological heritage occur during the construction phase which will modify the existing topography	Moderately Low (-5.5)	Low (-1)
Job creation and opportunities	Low (+3.5)	Moderately Low (+5.5)
Proliferation of social ills and issues such as crime, prostitution, the spread of HIV / AIDS, informal settlements etc. Lack of provision of ablutions that may lead to the creation of 'informal ablutions' within or close to surface water resources	Low (-4.5)	Low (-3)
Socio-economic benefits to the local area due to prevention of illegal cross border activities and the prevention of spread of livestock disease	Moderately Low (+6)	Moderate (+12)
Waste generation (demolished culverts, general construction rubble and hazardous waste (used oil, cement and concrete etc.).	Moderately Low (-7.5)	Low (-2)
Air quality (dust, emissions, odours)	Moderately Low (-7.5)	Low (-3)
Noise pollution from construction vehicles, construction staff and construction activities e.g. excavations, blasting and piling	Moderate (-8.25)	Low (-3.5)
Operational Phase Impacts		
Impacts relating to maintenance activities in terrestrial habitats i.e. proliferation of IAPs, clearance of vegetation to maintain the detection zone	High (-22)	Low (-3.5)
Indirect erosion, sedimentation and pollution impacts on terrestrial habitats	Moderately High (-15.75)	Low (-4)
Fauna trapped in fences, fragmentation of habitats, impeded mobility of wildlife, e.g. from accessing drinking water	Moderately High (-16.5)	Moderately Low (-7)
Positive impact on biodiversity features (especially within Protected Areas) by ensuring reduced occurrences of illegal activities such as poaching etc. removal of fences (e.g. TFCAs and merging of the Ndumo Game Reserve and the Usuthu CCA)	Moderately Low (+16)	Moderate (+8)
Impacts relating to maintenance activities in aquatic habitat i.e. proliferation of IAPs, clearance of vegetation to maintain the detection zone	Moderately High (-15)	Low (-4)
Flow modification, erosion / sedimentation impacts	Moderate (-9.75)	Low (-4.5)
Water quality	Moderately Low (-5)	Low (-1.2)

Conclusion and Recommendations

The project is of critical strategic importance on a national level and forms part of the National Government's obligations to secure the borders of South Africa and to protect its citizens from illegal activities as well as disease control.

This cBAR provides an assessment of both the potential negative impacts and benefits and anticipated as a result of the proposed project. The approach to impact mitigation was in line with the principles of the mitigation hierarchy and a number of steps were taken to ensure that impacts could be avoided or minimised as far as possible through pre-construction planning and design, sensitivity assessments, realignment recommendations and conceptual design recommendations.

The findings conclude that there are potential negative impacts that can be mitigated provided that the recommended mitigation and management measures contained within the EMPr are implemented.

The project, in the EAP's opinion, does not (for the majority of the project) pose a detrimental impact on the receiving environment and it inhabitants and can be mitigated significantly and where impacts cannot be mitigated a recommendation for offsets have been made. Therefore, the EAP recommends that the development / upgrading of proposed infrastructure associated with the Planning and Design for the Maintenance of the Patrol Roads and Fencing on the borders between South Africa, Swaziland and Mozambique be authorised.

Specific Recommendations to the Competent Authority

The following key conditions must be included as part of the authorisation:

a) The Applicant / Developer is not negated from complying with any other statutory requirements that is applicable to the undertaking of the activity. Relevant key legislation that must be complied with by the proponent includes *inter alia*:
   - Provisions of the National Environmental Management Waste Act (Act No. 59 of 2008) (as amended);
   - Provisions of the National Water Act, 1998 (Act No. 36 of 1998) (as amended);
   - Provisions of the National Forests Act (Act No. 84 of 1998);
   - Provisions of the National Environmental Management: Protected Areas Act (Act No. 57 of 2003) – NEM: PAA;
   - Provisions KwaZulu-Natal Nature Conservation Ordinance (Ordinance No. 15 of 1974); and
   - Mpumalanga Nature Conservation Act (Act No. 10 of 1998).

b) The Applicant / Developer must appoint a suitably experienced (independent) Environmental Control Officer (ECO) for the construction phase of the development that will have the responsibility to ensure that the mitigation / rehabilitation measures and recommendations are implemented and to ensure compliance with the provisions of the EMPr.

c) All supporting plans e.g. Spill Contingency Plan, Conceptual Stormwater Management Plan, Rehabilitation Plans (Terrestrial and Aquatic Habitat), Invasive Alien Plant Eradication and Control Method Statement) and Conceptual Construction Method Statements included in the EMPr must be complied with.

d) Plant search and rescue exercise: This entails:
   i. An ecologist undertaking site visits to target vegetation communities to record and count the number of protected plants and vegetation communities requiring a plant permit from EKZNW and MTPA or a licence from the provincial DAFF;
   ii. Compilation of a threatened and protected plant relocation and replacement protocol; and
   iii. Supervising the plant relocation or replacement exercise.

e) Conservation-important fauna search and recovery exercise: Due to the sheer extent of the project and the uncertainty in implementation, a search and recovery / walkthrough process before construction is strongly recommended for biodiversity "hotspots" based on the outcomes of the desktop fauna POC assessment. Most of the grassland, forest and wetland habitats with more intact vegetation could potentially harbour Red Data listed fauna and these areas will need to be the focus of search and recovery exercises. A programme to undertake such an exercise should be developed and

implemented prior to construction commencing on sections of new road / fence. This can be structured and undertaken in a phased-manner and aligned with the construction programme.

f) Pre-construction selection of site camps: the ecologist and ECO must be consulted to authorise the placement of construction camps and lay-down areas within the assessed 50m assessment corridor / study area.

g) Detailed Post-construction Rehabilitation Plan: A detailed Post-construction Terrestrial Vegetation / Habitat and Freshwater Resources Rehabilitation must be developed based on the guidelines provided in the conceptual rehabilitation plans. The plan must address the following issues in order to be implementable at site level:
   i. Identification and estimation of the location and extent of areas requiring revegetation;
   ii. Development of a detailed planting strategy and planting method (with spacing and densities) that is specific to different vegetation communities and sub-communities;
   iii. Review and finalisation of methods and equipment for IAP clearing;
   iv. Review and finalisation of slope / soil stabilisation measures and resources based on slope and soil types; and
   v. Bill of quantities and costs for all interventions (including re-vegetation).

h) Decision on biodiversity offset requirements: A preliminary assessment of potential offset requirements suggests that biodiversity offsets may be warranted for this development project, given the potentially large extent of permanent transformation of threatened vegetation types involved. An Offset Framework will need to be drafted during the detail design phase. Careful consideration needs to be given to ensure that that nett gains also be taken into account, such as improving the existing infrastructure with suitable stormwater management, introducing crossing where structures are inadequate etc. Given that the significance of impacts is likely to be higher in KZN, there could be a motivation to focus such an intervention in KZN although this would need to be discussed with the relevant conservation bodies. The extent of the area to target, together with the mechanisms and cost implications for doing so, will need to be investigated once confirmation for the need for an offset has been obtained from the regulating authorities.

i) All necessary permits, licences and approvals must be obtained prior to the commencement of construction.

j) A Phase Two Heritage Impact Assessment will be necessary in order to initiate a grave exhumation and reburial process – where necessary. This process will also include the application of a permit from the relevant Provincial Heritage Agency and extensive community consultations.

k) The specifications of the EMPr with respect to the following must be strictly adhered to:
   i. The procedure and environmental mitigation measures in the event of phasing (different timing) of infrastructural components;
   ii. The pre-construction assessment and ECO approval of the construction camp layouts, in consultation with the EKZNW and MTPA;
   iii. The pre-construction compilation of a species-specific alien plant management plan that covers both the construction and operational phases of the development; and
   iv. The compilation of an Operational Maintenance Management Plan and adherence to this plan.

l) All infrastructure configurations as detailed in this report must be strictly adhered to, in particular the infrastructure in the highly environmentally sensitive parts of the route. In such areas where the application corridor and servitude have been narrowed, no development beyond the narrowed application corridor must be permitted.

Acronyms

ASPT	Average Score Per Taxa
BA	Basic Assessment
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
BID	Background Information Document
CA	Competent Authority
CBA	Critical Biodiversity Area
CBAR	Consultation Basic Assessment Report
CCA	Community Conservation Area
CV	Curriculum Vitae
DAFF	Department of Agriculture, Fisheries and Forestry
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EDTEA	KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs
EIA	Environmental Impact Assessment
EKZNW	Ezemvelo KZN Wildlife
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
ESA	Ecological Support Area / Early Stone Age
GA	General Authorisation
GIS	Geographic Information System
GNR	Government Notice Regulation
HGM	Hydrogeomorphic Unit
HIA	Heritage Impact Assessment
I&AP	Interested and Affected Party
IAP	Alien Invasive Plant
IDP	Integrated Development Plan
IEM	Integrated Environmental Management
ITB	Ingonyama Trust Board
KZN	KwaZulu-Natal
LM	Local Municipality
LSA	Later Stone Age
MSA	Middle Stone Age
MSL	Mean Sea Level
NDP	National Development Programme
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NEM:AQA	National Environmental Management Air Quality Act (Act No. 39 of 2004)
NEM:BA	National Environmental Management Biodiversity Act (Act No. 10 of 2004)
NEM:PAA	National Environmental Management Protected Areas Act (Act No. 57 of 2003)
NEM:WA	National Environmental Management – Waste Act (Act No. 59 of 2008)
NFA	National Forests Act (Act No. 84 of 1998)
NGO	Non-Governmental Organisation
NHRA	National Heritage Resources Act (Act No. 25 of 1999)

NWA	National Water Act (Act No. 36 of 1998)
OHSA	Occupational Health and Safety Act (Act No 85 of 1993)
PES	Present Ecological State
PIA	Palaeontological Impact Assessment
PPE	Personnel Protective Equipment
PPP	Public Participation Process
PSDF	Provincial Spatial Development Framework
QDGS	Quarter Degree Grid Square
RA	Rock Art
REC	Recommended Ecological Category
RMO	Resource Management Objective
SACNASP	South African Council of Natural Science Professionals
SAHRA	South African Heritage Resource Agency
SANBI	South African National Biodiversity Institute
SASS	South African Scoring System
SCA	Systemic Conservation Assessments
SCP	Systematic Conservation Plan
SWMP	Stormwater Management Plan
ULM	Ulundi Local Municipality
VOC	Volatile Organic Compounds
WUA	Water Use Authorisation
ZDM	Zululand District Municipality

Glossary

Activity (Development)	An action either planned or existing that may result in environmental impacts through pollution or resource use. For the purposes of this report, the terms 'activity' and 'development' are freely interchanged.
Alternatives	Different means of meeting the general purpose and requirements of the activity, which may include site or location alternatives; alternatives to the type of activity being undertaken; the design or layout of the activity; the technology to be used in the activity and the operational aspects of the activity.
Applicant	The project proponent or developer responsible for submitting an environmental application to the relevant environmental authority for environmental authorisation.
Biodiversity	The diversity of animals, plants and other organisms found within and between ecosystems, habitats, and the ecological complexes.
Biodiversity Offset	Biodiversity offsets are conservation measures designed to remedy the residual negative impacts of development on biodiversity and ecological infrastructure, once the first three groups of measures in the mitigation sequence have been adequately and explicitly considered (i.e. to avoid, minimize and rehabilitate/ restore impacts). Offsets are the 'last resort' form of mitigation, only to be implemented if nothing else can mitigate the impact.
Buffer	A buffer is seen as an area that protects adjacent communities from unfavourable conditions. A buffer is usually an artificially imposed zone included in a management plan.
Construction	The building, erection or establishment of a facility, structure or infrastructure that is necessary for the undertaking of a listed or specified activity but excludes any modification, alteration or expansion of such a facility, structure or infrastructure and excluding the reconstruction of the same facility in the same location, with the same capacity and footprint.
Cumulative Impact	The impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.
Decommissioning	The demolition of a building, facility, structure or infrastructure.
Direct Impact	Impacts that are caused directly by the activity and generally occur at the same time and at the same place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally quantifiable.
Ecological Reserve	The water that is necessary to protect the water ecosystems of the water resource. It must be safeguarded and not used for other purposes. The Ecological Reserve specifies both the quantity and quality of water that must be left in the national water resource. The Ecological Reserve is determined for all major water resources in the different water management areas to ensure sustainable development.
Ecosystem	A dynamic system of plant, animal (including humans) and micro-organism communities and their non-living physical environment interacting as a functional unit. The basic structural unit of the biosphere, ecosystems are characterised by interdependent interaction between the component species and their physical surroundings. Each ecosystem occupies a space in which macro-scale conditions and interactions are relatively homogenous.
Environment	In terms of the National Environmental Management Act (NEMA) (Act No 107 of 1998) (as amended), "Environment" means the surroundings within which humans exist and that are made up of: i. the land, water and atmosphere of the earth; ii. micro-organisms, plants and animal life; iii. any part or combination of (i) and (ii), and the interrelationships among and between them; and

iv. the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and wellbeing.

Environmental Assessment	The generic term for all forms of environmental assessment for projects, plans, programmes or policies and includes methodologies or tools such as environmental impact assessments, strategic environmental assessments and risk assessments.
Environmental Authorisation	An authorisation issued by the competent authority in respect of a listed activity, or an activity which takes place within a sensitive environment.
Environmental Assessment Practitioner (EAP)	The individual responsible for planning, management and coordination of environmental impact assessments, strategic environmental assessments, environmental management programmes or any other appropriate environmental instrument introduced through the EIA Regulations.
Environmental Control Officer (ECO)	An individual nominated through the Client to be present on site to act on behalf of the Client in matters concerning the implementation and day to day monitoring of the EMPr and conditions stipulated by the authorities.
Environmental Impact	Change to the environment (biophysical, social and/ or economic), whether adverse or beneficial, wholly or partially, resulting from an organisation's activities, products or services.
Environmental Impact Assessment (EIA)	In relation to an application to which scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application as defined in NEMA.
Environmental Issue	A concern raised by a stakeholder, interested or affected parties about an existing or perceived environmental impact of an activity.
Environmental Management	Ensuring that environmental concerns are included in all stages of development, so that development is sustainable and does not exceed the carrying capacity of the environment.
Environmental Management Programme (EMPr)	A detailed plan of action prepared to ensure that recommendations for enhancing or ensuring positive impacts and limiting or preventing negative environmental impacts are implemented during the life cycle of a project. This EMPr focuses on the construction phase, operation (maintenance) phase and decommissioning phase of the proposed project.
Fatal Flaw	An event or condition that could cause an unanticipated problem and/or conflict which will could result in a development being rejected or stopped.
Groundwater	Water in the ground that is in the zone of saturation from which wells, springs, and groundwater runoff are supplied.
Hazardous Waste	Any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment and includes hazardous substances, materials or objects within business waste, residue deposits and residue stockpiles as outlined in the National Environmental Management: Waste Amendment Act (No 26 of 2014).Schedule 3: Category A – Hazardous Waste.
Hydrology	The science encompassing the behaviour of water as it occurs in the atmosphere, on the surface of the ground, and underground.
Indirect Impacts	Indirect or induced changes that may occur as a result of the activity. These types if impacts include all of the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity

Integrated Environmental Management	A philosophy that prescribes a code of practice for ensuring that environmental considerations are fully integrated into all stages of the development and decision-making process. The IEM philosophy (and principles) is interpreted as applying to the planning, assessment, implementation and management of any proposal (project, plan, programme or policy) or activity - at local, national and international level – that has a potentially significant effect on the environment. Implementation of this philosophy relies on the selection and application of appropriate tools for a particular proposal or activity. These may include environmental assessment tools (such as strategic environmental assessment and risk assessment), environmental management tools (such as monitoring, auditing and reporting) and decision-making tools (such as multi-criteria decision support systems or advisory councils).
Interested and Affected Party (I&AP)	Any person, group of persons or organisation interested in or affected by an activity; and any organ of state that may have jurisdiction over any aspect of the activity.
Method Statement	A method statement is a written submission by the Contractor to the Engineer in response to the specification or a request by the Engineer, setting out the plant, materials, labour and method the Contractor proposes using to carry out an activity, identified by the relevant specification or the Engineer when requesting a Method Statement. It contains sufficient detail to enable the Engineer to assess whether the Contractor's proposal is in accordance with the Specifications and/or will produce results in accordance with the Specifications.
Mitigate	The implementation of practical measures designed to avoid, reduce or remedy adverse impacts or enhance beneficial impacts of an action.
No-Go Option	In this instance the proposed activity would not take place, and the resulting environmental effects from taking no action are compared with the effects of permitting the proposed activity to go forward.
Pollution	The National Environmental Management Act, No. 107 of 1998 defines pollution to mean any change in the environment caused by – substances; radioactive or other waves; or noise, odours, dust or heat emitted from any activity, including the storage or treatment of waste or substances, construction and the provision of services, whether engaged in by any person or an organ of state, where that change has an adverse effect on human health or well-being or on the composition, resilience and productivity of natural or managed ecosystems, or on materials useful to people, or will have such an effect in the future.
Public Participation Process	A process in which potential interested and affected parties are given an opportunity to comment on, or raise issues relevant to, specific matters.
Re-use	To utilise articles from the waste stream again for a similar or a different purpose without changing the form of properties of the articles.
Rehabilitation	A measure aimed at reinstating an ecosystem to its original function and state (or as close as possible to its original function and state) following activities that have disrupted those functions.
Residual Impacts	Impacts that remain after the proponent has made all reasonable and practicable changes to the location, siting, scale, layout, technology and design of the proposed development, in consultation with the environmental assessment practitioner and specialists (including a biodiversity specialist), in order to avoid, minimize, and / or repair / restore negative impacts on, amongst others, biodiversity. That is, after consideration has been given to the first three measures in the mitigation hierarchy.
Sensitive Environments	Any environment identified as being sensitive to the impacts of the development.
Significance	Significance can be differentiated into impact magnitude and impact significance. Impact magnitude is the measurable change (i.e. magnitude, intensity, duration and likelihood). Impact significance is the value placed on the change by different affected parties (i.e. level of significance and acceptability). It is an anthropocentric concept, which makes use of value judgements and science-based criteria (i.e. biophysical, social and economic).

Stakeholder Engagement	The process of engagement between stakeholders (the proponent, authorities and I&APs) during the planning, assessment, implementation and/or management of proposals or activities.
Sustainable Development	Development which meets the needs of current generations without hindering future generations from meeting their own needs.
Visual Contrast	The degree to which the development would be congruent with the surrounding environment. It is based on whether or not the development would conform with the land use, settlement density, forms and patterns of elements that define the structure of the surrounding landscape.
Watercourse	Defined as: i. a river or spring; ii. a natural channel or depression in which water flows regularly or intermittently; iii. a wetland, lake or dam into which, or from which, water flows; and iv. any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse as defined in the National Water Act, 1998 (Act No. 36 of 1998) and a reference to a watercourse includes, where relevant, its bed and banks.
Water Pollution	The National Water Act, 36 of 1998 defined water pollution to be the direct or indirect alteration of the physical, chemical or biological properties of a water resource so as to make it – less fit for any beneficial purpose for which it may reasonably be expected to be used; or harmful or potentially harmful (aa) to the welfare, health or safety of human beings; (bb) to any aquatic or non-aquatic organisms; (cc) to the resource quality; or (dd) to property".
Wetland	Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

1 INTRODUCTION

1.1 Background

The protection of the Republic of South Africa's borders serves to:

- prevent the illegal movement of people, goods (to avoid payment of duty) or contraband;
- prevent the movement of produce or livestock that may lead to the spread of infectious disease; and
- promote the lawful entry and exit of goods and people.

Achievement of the above three objectives is essential to South Africa's security, economic prosperity, and national sovereignty.

In order to ensure that the required infrastructure is constructed to enable the responsible organs of state to effectively execute their respective responsibilities towards the above objectives, the Department of Public Works (DPW) has commissioned the Planning and Design for Maintenance and / or Upgrade of the Patrol Roads and Fencing on the borders between South Africa, Swaziland and Mozambique.

In the particular context of this section of the South Africa, Swaziland and Mozambique Border, the following have been identified as the priority focus of border security functions:

- To ensure that fences are erected to manage the particular risk associated with each section of the border. This includes:
  - Preventing movement of elephant (damaging disease-control fences).
  - Preventing movement of livestock.
  - Preventing the crossing of stolen vehicles.
  - Prevent the smuggling of contraband.
  - Control the movement of people, in line with the Department of Home Affair's directives.
- To ensure that the border is clearly marked, to avoid mistaken illegal crossing into South Africa and to enable prosecution in the case of illegal crossings.
- To ensure that patrol roads, tracks and associated infrastructure is available to monitor the border and to respond to cases of illegal crossings.
- To ensure appropriate access for the responsible Departments' personnel to the border patrol infrastructure. These include:
  - Officials from the Department of Agriculture, Forestry and Fisheries (DAFF), to monitor disease-control stock fences.
  - Personnel from the South African National Defence Force (SANDF), to guard and patrol the border.
  - Officials from Ezemvelo KwaZulu-Natal Wildlife (EKZNW), to guard and patrol Protected Areas under their jurisdiction.
  - Officials from Mpumalanga Tourism and Parks Agency (MTPA), to guard and patrol Protected Areas under their jurisdiction.

1.2 Overview of the Existing Challenges along the Border

In order to effectively respond to the range of security and control challenges that are being experienced by responsible Organs of the State, it is first and foremost important to clearly understand the nature and extent of such challenges – ***Text Box 1***.

Text Box 1: Border security and control challenges

Cross Border Business and Social Services Activities

At a number of positions along the border, especially in areas with higher population concentrations and where business and social infrastructure are situated in close proximity to the border (on either or both sides of the border), there is significant "informal" movement of people and basic consumer goods. This may take the form of school children from Swaziland attending school in South Africa, Swaziland citizens accessing health services or retail outlets within South Africa and "informal trading" of basic daily consumables at periodical markets along the Border.

Illegal Crossing of Border and Absence of Clearly Marked Border Position

At a few positions along the border between RSA and neighbouring Swaziland and Mozambique, there are presently no fences or clearly marked beacons showing the international boundary. Especially in inaccessible areas where patrol infrastructure and patrol activities are inadequate or absent, enforcement of border control is problematic. The absence of clear markings to show the position of the border in some areas makes it difficult to prove and prosecute alleged illegal crossings.

From observations during the site visits and assessment of aerial imagery, evidence was found of numerous well-used tracks connecting across the border in both populated and more remote areas. From this, it can be concluded that a lot of illegal movement takes place between RSA (KwaZulu-Natal and Mpumalanga) and neighbouring Mozambique and Swaziland. The amounts of undeclared and illegal goods that cross the border in both directions along with the foot traffic at these points are not known.

Disease Control

The concerns over control of animal movement across the border and by implication, challenges to disease control, are caused by the following:

- Absence of fencing (in inaccessible and challenging topography / terrain);
- Damage to fencing by elephant, specifically in the northern KZN / Mozambique section west of the Kosi Bay Port of Entry;
- Damage to fencing by vehicle theft and smuggling syndicates, specifically in the northern KZN / Mozambique section; and
- Vandalism and theft of fences by disgruntled residents as a result of land disputes, especially in the area around the eastern extent of Ndumo Game Reserve.

In above described areas, infected game and livestock at times come into contact with livestock from disease-free areas, posing great risk to surrounding stock owners and South Africa's agricultural export industry in general.

Criminal Activity

Challenges with illegal activities along the border relate mainly to movement of stolen goods (vehicles, crops, livestock, luxury goods etc.), contraband (drugs) and animal products obtained through poaching (mainly rhino) across the border from South Africa. This is without a doubt one of the biggest challenges that the proposed upgrade and / or construction of fencing and patrol roads are hoping to address.

Although further formal engagement and consultation is envisaged with entities such as organised agriculture, business and security sector representatives, initial information indicate the following:

- The movement of stolen vehicles across the border into neighbouring countries appear to be one of the biggest problems.
- The northern KZN section of the border appears to be area targeted most for illegal crossing. Apart from the area between Ndumo and Tembe, the area east of Tembe is specifically problematic.
- It is anticipated that if physical barriers are erected and patrol activities increased, that syndicates will start looking for alternative routes.
- Although the aim of this project is to focus on the border fence and patrol route, it is important to also consider limiting the number of access points to the border to points of entry only, subject to the following considerations:
  - What can be considered reasonable in terms of the needs of land-right holder and landowners?
  - Where public roads are no longer required, to have them de-proclaimed.
  - Where "informal" roads or tracks can be regarded as being in contravention of environmental and other legislation, to have access to them blocked with physical barriers and the roads or tracks rehabilitated.

1.3 Project Locality

The study area stretches from the Indian Ocean (immediately south of Ponta de Ouro) along the border with Mozambique to where the South African, Mozambique and Swaziland Borders meet in northern KZN, then along the entire length of the Swaziland – South African Border to the point where the Swaziland, Mozambique and South African borders once again meet at Zulu Crossing (immediately south of a settlement named Mbuzini) in the Mpumalanga Province. The project is restricted to the South African side of the international border - Figure 1.

The total length of the project is approximately 524km and the environmental authorisation application will be divided into two phases:

1.3.1 Phase 1: Prioritisation of km 0 to km 54

From the high water mark of the Indian Ocean near Kosi Bay (km 0) to the eastern boundary of the Ndumo Game Reserve (km 54) of the project due to this section of the route being a 'high risk' priority area where significant numbers of stolen vehicles are currently being trafficked into Mozambique from South Africa. This phase of the project is subject to a separate application process.

1.3.2 Phase 2: km 54 to km 524

This phase is divided into six main regions:

vii. **km 54 to km 82** - from the eastern boundary of the Ndumo Game Reserve, the route proceeds around the reserve and crosses the Phongolo River. Between km 78 to km 81, the route is aligned out of the 1:20 year flood line of the Usuthu River within the Usuthu Gorge Community Conservation Area (CCA). The southern Swaziland tripoint is situated at Abercorn Drift (km 81) in the Usuthu River, where the Mozambique–Swaziland Border along the Lebombo Mountains meets the river.

viii. **km 82 to km 154** - the route then continues along the Lebombo Mountains through the Ekuhlehleni Pass and Cecil Macks Pass towards the Pongolapoort Dam. The nearest town is Ingwavuma.

ix. **km 154 to km 252** – the route borders the Pongolapoort Dam and Pongola Nature Reserve (km 155 – km 168) with the Golela Border Post situated at km 163. The section between km 164 to km 187 leading up to the Onverwacht Border Post, detour roads have been proposed to patrol the border due to the site topography. The Sitilo River is crossed by the route at km 178. The Mahamba Border Post is situated at km 252 with the route crossing the following rivers: Manzawakho (km 191), Spekboom (km 214), Nyamane (km 230) and Mozane (km 242). Nearest towns include: Pongola, Ncotshane, Mkhwakhweni and Belgrade.

x. **km 252 to km 384** – the route crosses four other border posts i.e. Bothashoop (km 217), Emahlathini (km 287.5), Nerston (km 338) and Waverley (km 367) before reaching the Oshoek Border Post (km 384). There is a spear in the South African Border at km 296 and data on the international border from km 296 to km 307 is lacking. The following rivers are crossed by the route: Mhkondvo (km 257), Ndlozane (km 279), Hlelo (km 314.5), Ngwempisi (km 320), Mlambo (km 332), Usuthu (km 343), Metula (km 353), Mpuluzi (km 359.5) and Lusushwana (km 371.5).
Nearest towns include: Piet Retief, Amsterdam, Empuluzi and Dundonald.

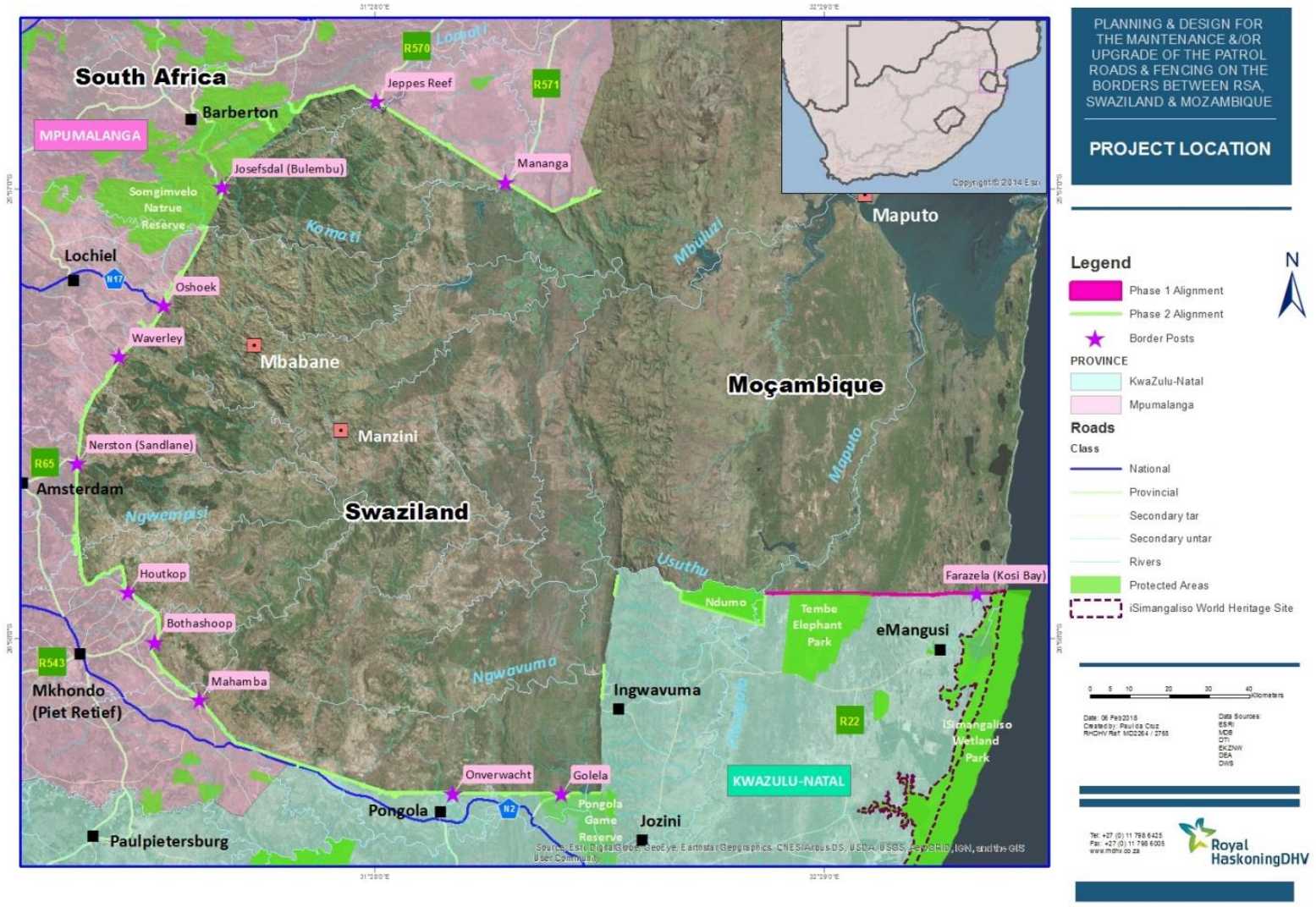


Figure 1: Locality map

xi. **km 384 to km 464** – this part of the route traverses steep terrain and a large section of this portion of the route borders the Songimvelo Nature Reserve (km 406 – km 447). The Josefsdal Border Post is situated at km 416 and Jeppes Reef Border Post at km 463.5. Maanhaar, Barberton and Jeppes Reef are the closest towns to this section of the route with the Komati (km 406) and Lomati (km 430.5) rivers being crossed.

xii. **km 464 to km 524** – this final section of the route proceeds around the Driekoppies Dam (km 466) and approaches the Mananga Border Post (km 500) before terminating at Zulu Crossing (km 524). The Mawewe Cattle / Game Project is within 2km of the route between (km 484 – km 494). Schoemansdal, Driekoppies, Schulzendal, Mgobode, Mananga and Mbuzini are the closest towns.

1.4 Development Proposal

The proposed project will comprise the construction of a patrol road along the South Africa and Mozambique / Swaziland Borders within the provinces of KwaZulu-Natal and Mpumalanga from Kosi Bay in the east to Mbuzini in the west.

The road is generally expected to comprise of a 5.5m wide road with 300mm wearing course cover. Where gradients are excessively steep for conventional road construction, the new alignment will deviate away from the border fence to follow the natural contours over the steep topography. In such areas a footpath, comprising a track cleared of all cover vegetation, will serve as the border patrol route.

The proposed route upgrade is to be accompanied by a new border fence which, depending on the specific needs of various sections of the route is likely to range from a 1.2m high stock-proof fence to a 2.4m elephant-proof fence.

The development proposal also makes provision for a detection / observation zone of 10m in width that will be cleared of all vegetation between the international border fence and the inner fence. This is a requirement by the SANDF to allow for patrol vehicles to travel along the international border. This cleared area will be entirely located within the declared servitude and within the application corridor, and the remaining area within the servitude and corridor respectively will not be cleared of vegetation, except in areas where an (optional) servitude fence is developed.

In addition to the above, the proposed border upgrade will necessitate the upgrade at regular intervals of the various ancillary routes providing direct access thereto. Certain sections of the route are characterised by extreme topography or alluvial plains and in such areas, it is anticipated the border will be marked only with regularly spaced beacons.

1.4.1 Application for Environmental Authorisation Corridor vs Servitude

An application for environmental authorisation is being lodged for a fifty (50) meter wide assessment corridor (from the international boundary or existing fence or from the 1:20 year flood line of a river) except in sensitive areas (e.g. Protected Areas; Critical Biodiversity Areas and watercourses) where this corridor has been reduced to the absolute minimum width (between 10 – 15m) required for the development of border control infrastructure. The 50m corridor has been applied to detour roads forming part of the application except where these detours roads are in Protected Areas (see below).

The 30.48m (or 100ft) servitude is the historical standard confirmed at the outset of the project by DPW to be the required servitude width along international border. This is purely a secure “right” to be registered to enable state entities to construct / install / maintain security and patrol infrastructure and to patrol the border. Any activities (development / clearing) inside this servitude will be subject to the EIA constraints that apply

at the time these activities are contemplated. The servitude will be approved in terms the Spatial Planning and Land Use Management Act (Act No. 16 of 1996) and registered in the Deeds Office.

The reason for the 50m corridor, for which Environmental Authorisation is being applied for, is based on the reality that slight deviations in the route alignment may occur upon detail design finalisation.

The 50m corridor will provide a measure of flexibility for the design, without the need to again apply for Environmental Authorisation if the draft alignment changes during detail design. It is not intended as an area for "blanket clearance of vegetation" or widening of the servitude width.

It is important to note that the application corridor has been narrowed in the following areas of high environmental sensitivity:

- Protected Areas i.e. Ndumo Game Reserve, Pongola Nature Reserve and Songimvelo Nature Reserve, the corridor has been narrowed to 15m.
- Wetlands in the Witkoppies-Berbice area: between km 241 and km 242 the corridor has been narrowed on the eastern side of the road centreline to avoid impacting the riparian zone of the Mozana River(W42K-R05). Between km 242.5 and km 243 where the patrol road crosses, and runs close to the wetland W42K-W13, the corridor has been narrowed to 15m to avoid affecting this wetland unnecessarily. Around km 242, the corridor has similarly been narrowed, except in the vicinity of the outlets of wetlands W42K-W11 and W42K-W12, in order to allow for the recommendation that the patrol road cross these wetlands at the point at which they narrow to minimise the area of wetland habitat that is transformed.
- Detour roads located in Protected Areas e.g. Songimvelo Nature Reserve, the corridor width has been narrowed to 15m i.e. 7.5m either side of the centreline.

1.5 Approach to the Study

1.5.1 Pre-application Consultation

A pre-application meeting and site visit (up to the KZN section of the route) was held with the Competent Authority (CA), the Department of Environmental Affairs (DEA) on 29 January 2018. Minutes of the meeting are included in ***Appendix A***.

Key issues / areas for discussion included the following:

- Application for Environmental Authorisation for a 50m corridor including infrastructure such as access and detour roads assessed outside of the 50m corridor;
- Assessment of alternatives;
- Specialist studies;
- Servitude / corridor and road reserve;
- Conceptual designs; and
- Offsets.

1.5.2 Basic Assessment Study

A Basic Assessment (BA) is the level of environmental assessment applied to activities listed in Listing Notices 1 and 3. A BA is applied to activities that are considered less likely to have significant environmental impacts and, therefore, unlikely to require a detailed Environmental Impact Assessment (EIA). The Consultation BA Report (cBAR) is a more concise analysis of the environmental impacts of the proposed activity / development than a Scoping and EIA Report.

The BA aims to achieve the following:

- Determine the policy and legislative context within which the proposed activity is undertaken and how the activity complies with and responds to the policy and legislative context;
- Describe the need and desirability of the proposed project;
- Identify the alternatives considered, including the activity, location, and technology alternatives;
- Undertake an impact and risk assessment process inclusive of reasonably foreseeable cumulative impacts (where applicable). The focus being; determining the geographical, physical, biological, social, economic, heritage and cultural sensitivity of the project and the risk of impact of the proposed activity on the these aspects to determine the nature, significance, consequence, extent, duration, and probability of the impacts occurring to; and the degree to which these impacts:
  - can be reversed;
  - may cause irreplaceable loss of resources; and
  - can be avoided, managed or mitigated.

This cBAR has been compiled in accordance with the stipulated requirements in GNR 326, Appendix 1 of the EIA Regulations, 2014 (as amended in 2017), which outlines the legislative BA process and requirements for assessment of outcomes, impacts and residual risks of the proposed development. The cBAR further incorporates the findings and recommendations of the specialist studies conducted for the project.

An Environmental Management Programme (EMPr) has been compiled according to Appendix 4 of GNR 326 of the EIA Regulations, 2014 (as amended in 2017) for the construction and rehabilitation phases of the project. The EMPr has been compiled as a stand-alone document from the cBAR and is submitted to the DEA along with the cBAR. The EMPr provides the actions for the management of identified environmental impacts emanating from the project and a detailed outline of the implementation programme to minimise and / or eliminate any anticipated negative environmental impacts and to enhance positive impacts. The EMPr provides strategies to be used to address the roles and responsibilities of environmental management personnel on site, and a framework for environmental compliance and monitoring.

1.5.3 Water Use Licence Application

In terms of Chapter 4 of the National Water Act (Act No. 36 of 1998) [NWA], activities and processes associated with the proposed project are required to be licenced by the Department of Water and Sanitation (DWS). The water uses as defined in section 21 of the NWA and included in (Table 1) will be applied for in terms of the NWA for the proposed project.

Table 1: Water uses associated with the project

Relevant Water Use	Description
Section 21 (c)	Impeding or diverting the flow of water in a watercourse
Section 21 (i)	Altering the bed, banks, course or characteristics of a watercourse

A pre-application meeting with the DWS took place on 22 February 2017. Minutes of the meeting are included in ***Appendix A***.

Key issues / areas for discussion included the following:

- Regulatory Authority for the WULA i.e. DWS KZN or DWS Mpumalanga;
- Acceptance of the methodology for freshwater resources assessment i.e. desktop assessment and flagging of water resources affected, based on sensitivity and the threat of development;
- Acceptance of the flood line delineation methodology;

- Department's specific requirements for a project of this nature.

1.6 Structure of the Consultation Basic Assessment Report (cBAR)

The cBAR is structured according to Appendix 1 of GNR 326 (Table 2):

Table 2: Structure of the BA report

Appendix 1: Content of Basic Assessment Reports	Chapter/Section
(a) details of i) the EAP who prepared the report; and ii) the expertise of the EAP to carry out an environmental impact assessment	Section 1.9
(b) The location of the activity (21 digit Surveyor General code, physical address and farm name where available, coordinates of the boundary of the property)	Appendix F
(c) A plan which locates the proposed activity or activities applied for as well as associated structures and infrastructure at an appropriate scale or, if it is – a linear activity, a description of the route of the activity.	Section 2 Appendix K – Sensitivity Map
(d) A description of the scope of the proposed activity, including – i) all listed and specified activities triggered and being applied for; and ii) a description of the activities to be undertaken including associated structures and infrastructure.	Section 3 Section 2
(e) A description of the policy and legislative context within which the development is proposed including – i) an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks, and instruments that are applicable to this activity and have been considered in the preparation of the report; and ii) how the proposed activity complies with and responds to the legislation and policy context, plans, guidelines, tools frameworks, and instruments.	Section 3
(f) A motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location.	Section 4
(g) A motivation for the preferred site, activity and technology alternative.	Section 5.5
(h) A full description of the process followed to reach the proposed preferred alternative within the site. i) details of all the alternatives considered; ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs; iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them; iv) the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; v) the impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts – (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated. vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives.	Section 5 (Alternatives) Section 5.4

Appendix 1: Content of Basic Assessment Reports	Chapter/Section
(i) A full description of the process undertaken to identify, assess and rank the impacts the activity will impose on the preferred location through the life of the activity including – i) a description of all environmental issues and risks that were identified during the environmental impact assessment process; and ii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.	Section 9
(j) An assessment of each identified potentially significant impact and risk including – a) cumulative impacts; b) the nature, significance and consequences of the impact and risk; c) the extent and duration of the impact and risk; d) the probability of the impact and risk occurring; e) the degree to which the impact and risk can be reversed; f) the degree to which the impact and risk may cause irreplaceable loss of resources; and g) the degree to which the impact and risk can be avoided, managed or mitigated.	Section 9.3
(k) Where applicable, a summary of the findings and impact management measures identified in any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final report.	Section 8
(l) An environmental impact statement which contains- i) a summary of the key findings of the environmental impact assessment; ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and iii) a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives.	Section 10
(m) Based on the assessment, and where applicable, impact management measures from specialist reports, the recording of the proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr.	Section 9.3 Appendix B
(n) Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation.	Section 10.6.1
(o) A description of any assumptions, uncertainties, and gaps in knowledge which relate to the assessment and mitigation measures proposed.	Section 10.5
(p) A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation.	Section 10.6
(q) Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required, the date on which the activity will be concluded, and the post construction monitoring requirements finalised.	Section 10.6.1
(r) An undertaking under oath or affirmation by the EAP in relation to: i) the correctness of the information provided in the reports; ii) the inclusion of comments and inputs from stakeholders and I&APs; iii) the inclusion of inputs and recommendations from the specialist reports where relevant; and any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected parties.	Section 10.7
(s) Where applicable, details of any financial provisions for the rehabilitation, closure, and on-going post decommissioning management of negative environmental impacts.	NA
(t) Any specific information that may be required by the competent authority.	NA

Appendix 1: Content of Basic Assessment Reports	Chapter/Section
(u) Any other matters required in terms of section 24(4)(a) and (b) of the Act.	NA

1.7 Specialist Assessment

To ensure the scientific rigour of the BA study, as well as a robust assessment of impacts, Royal HaskoningDHV commissioned a suite of specialist studies in order to comprehensively identify both potentially positive and negative environmental impacts (social and biophysical), associated with the project, and where possible to provide mitigation measures to reduce the potentially negative impacts and enhance the positive impacts (Table 3). The specialist studies can be found in ***Appendix C***.

Table 3: Specialist assessments conducted for the project

Specialist Study	Organisation	Appendix
Preliminary Geotechnical Assessment	Drennan Maud Pty Ltd	***Appendix C1***
Terrestrial Habitat Impact Assessment	Eco-Pulse Environmental Consulting Services	***Appendix C2***
Aquatic Ecological Impact Assessment (wetlands and rivers)	Eco-Pulse Environmental Consulting Services (Aquatics) Royal HaskoningDHV (Wetlands)[1]	***Appendix C3***
Heritage Impact Assessment	Active Heritage cc	***Appendix C4***
Desktop Palaeontology Assessment	Banzai Environmental	***Appendix C5***

1.7.1 Peer Review

In addition to the above, the EIA Regulations, 2014 (as amended in 2017) requires the Environmental Assessment Practitioner (EAP) to be independent, objective and have expertise in conducting EIAs. Such expertise should include knowledge of all relevant legislation and of any guidelines that have relevance to the proposed activity. To ensure a lack of bias and to ensure transparency an external technical peer review has been undertaken prior to the public review during the formal BA process. This peer review has been conducted by Catherine Smith of Gaia AE (***Appendix D***).

1.8 Details of the Project Applicant / Developer

The Applicant / Developer is the National Department of Public Works (DPW) and the details of the responsible person are listed Table 4 below.

Table 4: Applicant details

Applicant / Developer	Department of Public Works
Representative	Malusi Ganiso (Director: Town Planning Services)
Physical Address	CGO Building, 256 Madiba Street, Pretoria
Postal Address	Private Bag X65, Pretoria, 0001
Telephone	012 4061928

[1] *Peer reviewed by Doug McFarlane of Eco-Pulse Environmental Consulting Services.*

Applicant / Developer	Department of Public Works	
E-mail	malusi.ganiso@dpw.gov.za	

As with numerous other public facilities in South Africa (e.g. Police Stations), the Department of Public Works develops the infrastructure, but does not operationally use or occupy the developed infrastructure. This is the case in this project, where the border control infrastructure will be utilised by two other (national) organs of state:

- The SANDF which is responsible for securing the nation's border, and;
- The DAFF, which is responsible for preventing the spread of livestock disease into South Africa from neighbouring countries (amongst other mandates).

The proposed Border Management Agency (BMA) needs to be discussed in the context of the proposed development. The Department of Home Affairs (DHA) is in the process of establishing a Border Management Authority (BMA) which will assume border law enforcement functions at ports of entry and along the country's border line once it is operational. It is envisaged that the BMA will be established in 2018, pending the enactment of BMA legislation[2]. The establishment of the BMA is aimed at enhancing the management of the country's border environment through the implementation of an integrated approach to border management - Integrated Border Management Strategy (IBMS). The aim of this strategy is to implement a government-wide strategy to defend, protect, secure and manage South African borders more efficiently and effectively. The implementation of the IBMS will be the responsibility of various departments / organs of state that have a role to play in border management. The BMA project office will monitor the implementation of the strategy by the various departments / organs of state.

It is anticipated that the BMA will assume operational control of the border security functions along the international border once it is operational, with the two end users operating under its control.

Consultation has been undertaken with EKZNW and the MTPA, stakeholders and partner organs of state in the project. EKZNW is a very important organ of state in the context of border protection in the study area, as it manages a number of Protected Areas which are located adjacent to the international border along the Phase 1 and 2 alignments, and thus is indirectly responsible for the protection of the border. Following consultation with EKZNW as part of the Phase 1 and Phase 2 public participation processes, the need to integrate EKZNW into the planning of the project as a partner was raised. A consultation meeting was held between the Applicant (DPW), the end users (DAFF and SANDF) and EKZNW at which a number of resolutions were taken to include EKZNW in the integrated planning of the border control infrastructure along the Phase 1 and Phase 2 alignments, as part of the integrated border management approach that has been adopted by the DPW in the development of both the Phase 1 and Phase 2 projects. Accordingly the DPW resolved to include EKZNW as a partner on the project in order to ensure that the project does not negatively affect EKZNW's ability to perform its mandate in terms of Protected Area management and the protection of biodiversity.

1.9 Details of the Environmental Assessment Practitioner

The environmental team of Royal HaskoningDHV have been appointed as an independent Environmental Assessment Practitioner (EAP) to undertake the appropriate environmental studies for this proposed project (Table 5).

[2] *http://www.home-affairs.gov.za/files/KPIS_2018_2019/Annual%20Targets%202018/BMA/BMA%20Established.pdf.*

The professional team of Royal HaskoningDHV has considerable experience in the environmental management field. Royal HaskoningDHV been involved in and / or managed several of the largest EIAs undertaken in South Africa to date. A specialist area of focus is on the assessment of multi-faceted projects, including the establishment of linear developments (national and provincial roads, and power lines), mixed-use developments, bulk infrastructure and supply (e.g. wastewater treatment works, pipelines, landfills), electricity generation and transmission, urban, rural and township developments, environmental aspects of Local Integrated Development Plans, as well as general environmental planning, development and management.

Table 5: EAP details

Consultant	Royal HaskoningDHV	
Contact Persons	Prashika Reddy	Malcolm Roods
Postal Address	PO Box 867, Gallo Manor, 2191	
Telephone	087 352 1577	
E-mail	prashika.reddy@rhdhv.com	malcolm.roods@rhdhv.com
Qualification/s	BSc (Hons) Geography BSc (Hons) Botany	BA (Hons) Geography and Environmental Management, LLB
Expertise	Prashika Reddy is a Principal Associate with 16 years' experience in various environmental fields including: EIAs, EMPrs, PPP and environmental monitoring and audits. She is/has been part of numerous multi-faceted large-scale projects, including the establishment of linear developments (roads and power lines), industrial plants, electricity generation plants, mixed-use developments and mining projects. She is a Professional Natural Scientist (400133/10) with the South African Council for Natural Scientific Professions.	Malcolm Roods is a Principal specializing in Environmental Impact Assessments (EIA) for electricity supply (generation, transmission and distribution), road infrastructure, residential developments as well as water management projects. This builds on a broad government background, which has made him particularly flexible. His past experience includes 6 years public service which included policy development, environmental law reform and EIA reviews. His experience also includes more than 10 years of environmental consulting in the field of Impact Assessment and Authorisation Applications, with a focus on legislative requirements and business management. Since joining the company he has been involved with major EIA projects such as the Transnet New Multi Product Pipeline (NMPP), various Rand Water Pipeline projects, numerous Eskom Research, Generation, Transmission and Distribution projects, SANRAL road developments as well as undertook Independent Reviews of the EIA process for the National Department of Environmental Affairs, etc. to name but a few.

The Environmental Management and Planning Knowledge Group Profile for Royal HaskoningDHV and the Curriculum Vitae (CV) of the respective consultants can be found in ***Appendix E***.

2 PROJECT DESCRIPTION

2.1 Study Area

The proposed project is restricted to the South African side of the international border and the affected provinces are KwaZulu-Natal and Mpumalanga. Affected District and Local Municipalities are presented in Table 6 and Figure 2.

Table 6: Affected District and Local Municipalities

Province	District Municipality	Local Municipality
KwaZulu-Natal	Umkhanyakude	Umhlabuyalingana & Jozini
	Zululand	uPhongolo
Mpumalanga	Gert Sibande	Mkhondo, Msugaligwa & Albert Luthuli
	Ehlanzeni	City of Mbombela & Nkomazi

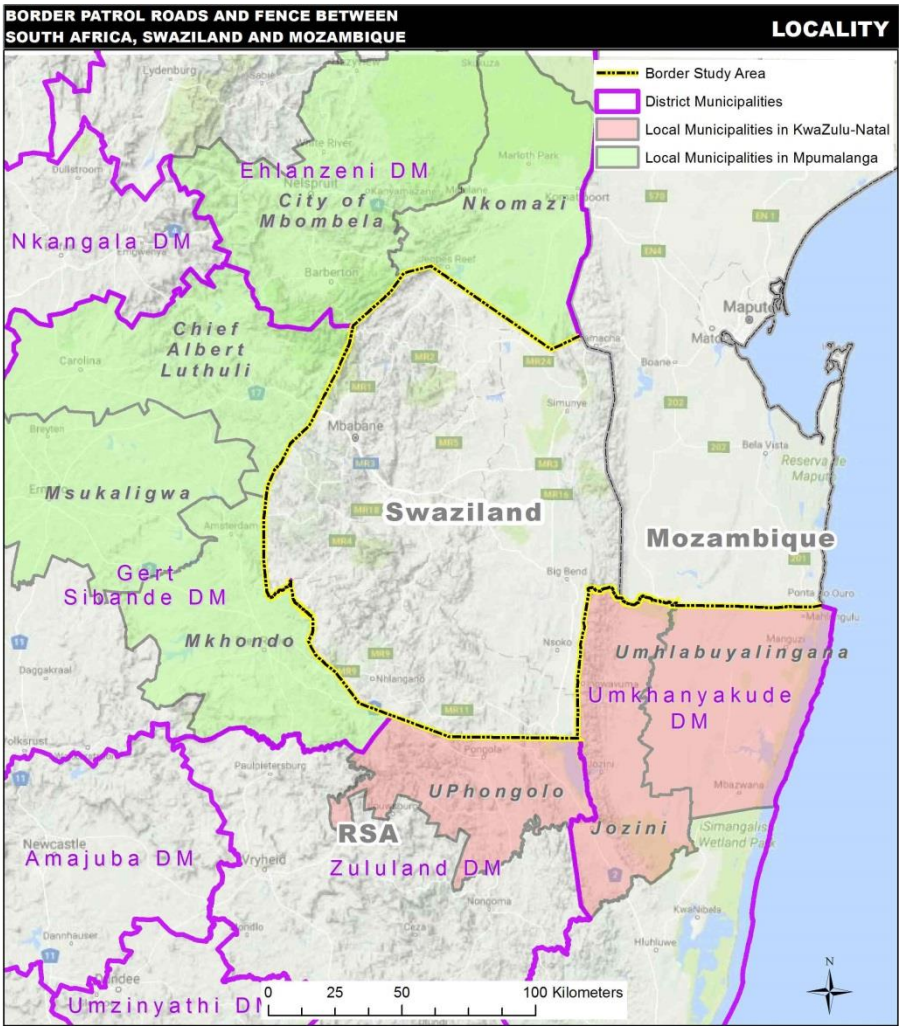


Figure 2: Affected District and Local municipalities

A list of all farms, portions, 21 digit Surveyor General codes, coordinates (every 50km and knick-points) are in ***Appendix F***.

2.2 Land Ownership

2.2.1 Land on the KZN – Swaziland / Mozambique Border

The majority of the land is registered in the name of the Ingonyama Trust Board (ITB). Parts of the ITB land have formally been proclaimed as heritage and conservation areas (including iSimangaliso Wetland Park, Tembe Elephant Reserve and Ndumo Game Reserve). The balance of land is registered in the name of the State and private entities, including individuals, property trusts and companies. Part of the state land around the Pongolapoort Dam is proclaimed as a conservation area under the management of EKZNW.

2.2.2 Land on the Mpumalanga – Swaziland Border

On the southern extent, the majority of properties are registered in the name of private entities, including individuals, property trusts and companies. Significant areas are being used for forestry plantations by private owners, Mondi and Sappi. The Songimvelo Nature Reserve (a proclaimed Protected Area) occurs along Mpumalanga's eastern boundary with Swaziland. Land in the northern extent is mainly registered in the name of the State, with a smaller section registered in the name of a Community Trust. Ownership of a large section of land up to Zulu Crossing consists of Unregistered State Land (Communal land held in Trust by the State).

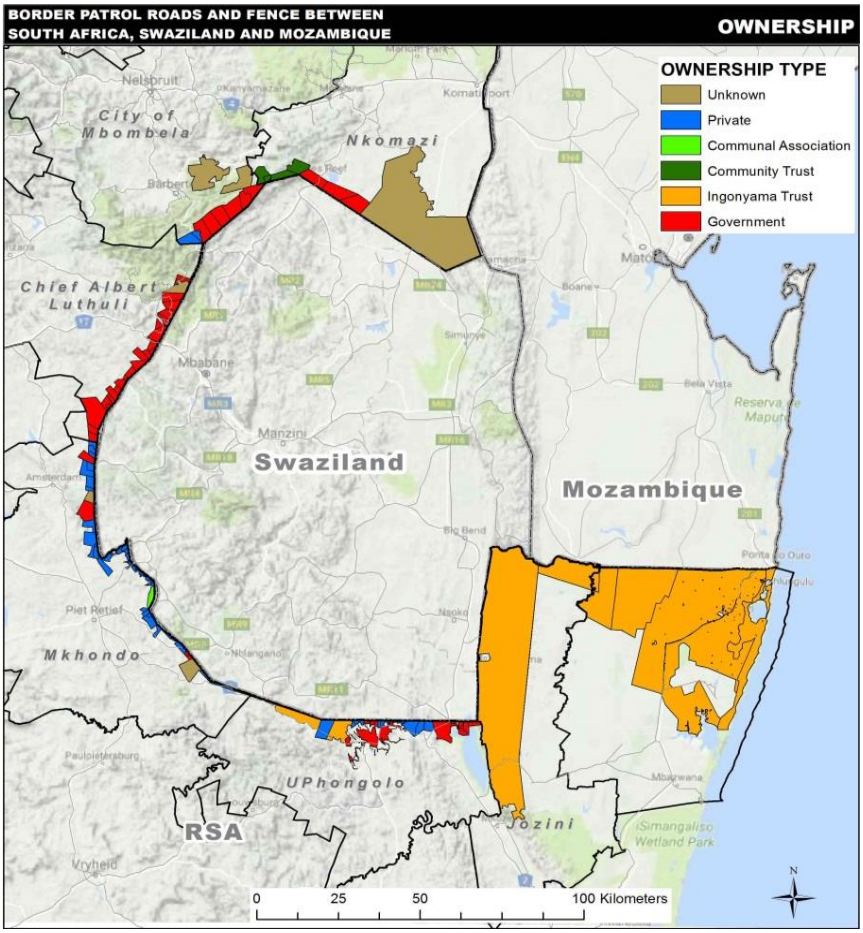


Figure 3: Land ownership

2.3 State of Existing Structures and Infrastructure

The Phase 2 alignment covers a very wide area with a variety of topographical (terrain) and land use types, and accordingly the existing border patrol infrastructure differs from area to area along the alignment.

In the far north-eastern part of the alignment (Ndumo area), no existing border control or patrol infrastructure exists along the international border with Mozambique that forms the northern perimeter of the Ndumo Game Reserve. This part of the international border is comprised of the Usuthu River, which is geomorphologically active, with its course accordingly shifting southwards in recent times.

In the Ndumo area, the border control infrastructure is proposed to be developed along the eastern, southern and western perimeters of the Ndumo Game Reserve. No existing patrol infrastructure exists on the outside of the reserve's border, except for an area between the reserve's entrance gate and the Phongolo River where a track runs close to the boundary of the reserve (Figure 4). It is important to note that the entire eastern perimeter fence of the Ndumo Game Reserve, and a portion of the southern perimeter from the reserve's south-eastern corner to the Phongolo River does not exist, having been removed by the local community during land invasions into this part of the reserve in the early 2000's. A patrol road did formerly occur on the inside of the fence in this area, but has subsequently become overgrown by vegetation and is disused.

West of the Phongolo River along the Ndumo Game Reserve's southern boundary, extending along the western boundary to the Usuthu River a perimeter fence exists and is maintained by the Reserve Management. An internal gravel road runs along the southern perimeter fence and most of the western perimeter fence, most of which forms part of the reserve's internal network of tourist roads. Near the Usuthu River the perimeter fence extends across the kuFuntani Pan wetland, but is damaged in places by flooding in the pan. A track extends across the pan, but is only able to be used when the pan is dry.

Figure 4: Ndumo Game Reserve fence and internal road

West of the Ndumo Game Reserve, the Usuthu River also forms the international border, flowing eastwards through the Usuthu Gorge from the Abercorn Drift area, and forming part of the northern boundary of the Usuthu Gorge Community Conservation Area (CCA). Apart from some old fencing in the vicinity of the Nkonjane Crossing Point of the Usuthu River, there are no fencing and no patrol roads along the section of the international border westwards along the Usuthu River to the point at which the international border (with Swaziland) deviates southwards from the Usuthu River, primarily due to the hilly and rugged nature of the terrain.

As the international border runs southwards from the Usuthu River towards the Ingwavuma area and further southwards to the area north-west of the town of Jozini, the international border with Swaziland runs along the top of the Lubombo Hills escarpment. No international border fence exists along the section of the border from the Usuthu River south to the point east of the Jozini Dam at which the border turns westwards. Due to the nature of the terrain, no dedicated patrol road is located along the international border in this area, however, along parts of the border – in the area north of the Ingwavuma River Gorge from the Mayaluka area southwards towards the Nkungwini area, and in the vicinity of Ingwavuma, and southwards to the Hlatikulu Nature Reserve - district roads run along the top of the escarpment, thus roughly following the alignment of the international border. The Ingwavuma River flows through the Lubombo Escarpment to the north of the town of Ingwavuma, and it should be noted that the Cecil Macks Pass road runs down into the valley from Ingwavuma, crossing into Swaziland with no presence of border control or immigration control infrastructure.

Figure 5: View north along the international border at the top of the Lubombo Escarpment, along where no fence exists

As the international border turns to run in an east-west alignment, an existing veterinary fence runs along the international border in the section of the border located to the east of the Jozini (Pongolapoort) Dam, (along the northern perimeter of the Phongolo Nature Reserve except along the cliffs that form part of the Lubombo Escarpment (Figure 5). No patrol road is located on the South African side of the border in the area to the east of the dam. The international border spans the dam, with no fencing erected across the dam. To the west of the dam, up to the Golela Border Post, a veterinary fence is located along the

international border, with no patrol road along the border. The perimeter fence of the Phongolo Nature Reserve is located slightly to the south of the international border, and an internal reserve road runs along this fence. West of the border post and the railway, an internal patrol road extends along the perimeter fence of the Phongolo Nature Reserve which is set back from the international border. This patrol road extends westwards to the western perimeter of the Phongolo Nature Reserve.

Westwards of the Phongolo Nature Reserve western boundary, the international border is located adjacent to privately-owned game farming properties and an existing veterinary fence runs along the length of the border. Internal tracks are located along parts of this section of the border where the terrain is not hilly. In the Sitilo area, the border is located adjacent to sugarcane farms and the veterinary fence extends westwards through this area (Figure 6). Existing farm tracks are located along much of the border in this area.

Figure 6: Existing international border fence and local farm track along the border in the Sitilo area

The border runs through further areas of game farming and sugarcane cultivation east and west of the Onverwacht Border Post, with internal roads on these properties running along the international border fence. To the north and north-west of the town of Pongola the international border runs through areas of communal tenure (former homeland areas) where the terrain becomes hilly and rugged (Figure 7). The existing veterinary fence extends along the border line into this area. Due to the hilly and rugged nature of the terrain there are no dedicated patrol roads located along this section of the border west to the Itselejuba Hospital, with the closest road infrastructure being local access roads that follow the contours in certain stretches of the border in this area. It should be noted that in the steeper river valleys in this section the fence spans the river bed without a dedicated fence river crossing structure in place, thus allowing easy access of people and livestock across the border in these areas.

Figure 7: Existing international border fence on steep ground north-west of Pongola

The international border runs north-west from Itselejuba, with the terrain in this area changing to be gently undulating. There is no patrol or other road infrastructure along the border fence line in this area except for the small section where the N2 national road runs immediately parallel to the border line, and on privately-owned farmland to the north-west of this section of the N2. In the Berbice area to the north-west, the international border fence takes the form of a 1.2m high veterinary fence. A road along the international border is generally not present in this area. In the Witkoppies and Sulphur Springs areas the international border follows the course of the Mozana River, but the above-mentioned fence is present along the South African side of the river (Figure 8).

The 1.2m high veterinary fence follows the border line north-west of the crossing of the Mozana River into higher-lying ground to the Mahamba Border Post with no patrol road along the border line in this section. North-west of Mahamba, small areas forestry plantations are located along the international border and certain of the forestry roads are aligned along the international border and 1.2m high stock-proof fence, but there is generally no border patrol or other roads along the border line in this area which is typically characterised by steep-rocky ground other than in areas of cultivation.

Figure 8: Existing international border fence in the Witkoppies area

To the south of the Bothashoop Border Post (directly east of Piet Retief) further forestry plantations are located along the border and forestry roads are aligned alongside the border in this section of the alignment, with the low veterinary fence still present. Further north within non-afforested areas only a fence is present in areas of hilly, rocky terrain.

In the area to the south and immediately north of the eMahlatini Border Post the Ndlozane River forms the border and no fence or road is present along this section of the border except for tracks on the border of cultivated fields or woodlots that abut the river. The area north of eMahlatini to Endhlazana becomes characterised by extensive forestry plantations and forestry roads are generally present along the border, along with the veterinary fence. As the border turns to run south-westwards, a district road is located along the border line. As the border turns north, the fence is present along the border, with road infrastructure along the border line limited to the forestry areas, and absent in the steep hilly terrain in the vicinity of the Hlelo River.

The current border fence and road does not follow the border along the 'spear' section of the route but cuts across the spear at its base to follow the shortest route. There is therefore no fence or road or clearing along the north-eastern side of the spear and on the south-western side of the spear, the border follows a forestry road up to the base of the spear (Figure 9).

Figure 9: Border follows a forestry road up to the base of the 'spear'

Forestry plantations are present in the area to the south of the Nerston Border Post. The same 1.2m high veterinary fence is present along the border, with the forestry roads slightly set back from the border line, especially where wetland areas are crossed (Figure 10). A similar situation exists to the north of the Nerston Border Post with forestry as the common land use except where rock outcroppings occur. A fence and (forestry) roads that are set back from the fence line are accordingly present. In places in this section of the alignment an old disused track is present in direct proximity to the fence line, but the useable roads are the forestry roads slightly set back from the border line.

Figure 10: International border fence and disused track in the area north of Nerston

In the Fernie area north-east to the Waverley Border Post the terrain becomes too rocky for forestry, and in these areas typically only a veterinary fence is present with no road infrastructure. This situation is repeated in the area to the north of the Waverley Border Post north to the Oshoek Border Post.

From Oshoek (km 384.4) to the Komati River (km 406.2) this area in general has a border fence and the typical condition is as shown in Figure 11.

Figure 11: Border fence condition from Oshoek to the Komati River

From the Komati River (km 406.2) to km 443 this is a mountainous area. Short areas have existing fence, especially around Josefsdal Border Post.

In the Lowveld to the north-west of the Jeppes Reef Border Post a 1.2m high veterinary fence is present along the border line with limited road infrastructure along the border line (Figure 12). This situation continues to the south-east of the border post to the Driekoppies Dam where a fence only is present. The fence does not extend across the dam. South-east of the Driekoppies Dam, areas under communal land tenure are encountered and cattle grazing areas are generally present in the area adjoining the international border. Accordingly, only a fence and no road infrastructure is present along the border from the dam south-east to the Magogeni and further to the Mgobode and Magudu areas up to the Mananga Border Post.

Figure 12: International border fence in the Jeppes Reef area, looking north-west to the higher ground

A border fence and no road infrastructure is present in the area to the south-east of the Mananga Border Post, and extending up onto the Mananga Escarpment to the east of the settlement with the same name, and east to the end of the Phase 2 alignment in the Mbuzini area. The presence of old culverts within wetlands along the fence line suggests that a patrol road was once present along the border, but which has become completely disused (Figure 13).

Figure 13: Old culvert structure and international fence in the Mananga area

2.4 Border Patrol Components and Infrastructure

The typical border patrol components include:

- Border patrol zone;
- Servitude;
- Fencing;
- Border markers;
- Detection zone;
- Border patrol roads including detour roads;
- Access roads to give access to the border patrol road; and
- International boundary.

2.4.1 Border Patrol Zone

The typical cross-section of the border patrol zone will consist of:

- A servitude width of 100ft (30.48m);
- International border fence (or border beacons in very mountainous areas);
- A 10m detection zone;
- A 5.5m patrol road where the topography allows for a vehicle to travel, or alternatively a footpath; and
- A potential second and third fence, i.e. the inner and outer fence.

The border patrol zone may be either aligned on the international boundary or existing fence or from the 1:20 year flood line of a river.

2.4.2 Servitude

Servitudes will typically be registered for the following widths:

- ***Border patrol zone:***
  - Typical width: a typical 100ft (30.48m) wide servitude along the border is proposed. However, the servitude could be less or more (not more than 30.48m) depending on the land-use, cost of land, topography of the landscape, environmental sensitive areas and geometry of the patrol road;
  - Minimum width: a minimum servitude of 10m is required where there is a proposed fence to allow for a 10m detection zone;
  - For the route determination, a typical 30.48m servitude was allocated which will be further refined during the stakeholder process, rights acquisition and registration of the servitude.
- ***Detour / contour roads:***
  - Where detour roads fall outside the 30.48m standard servitude and are not situated on state-owned property, these servitudes will typically be 13.49m wide.
- ***Access roads:***
  - Where there are dedicated access roads to the border, servitude of typically 13.49m wide will be registered.

2.4.3 Fences

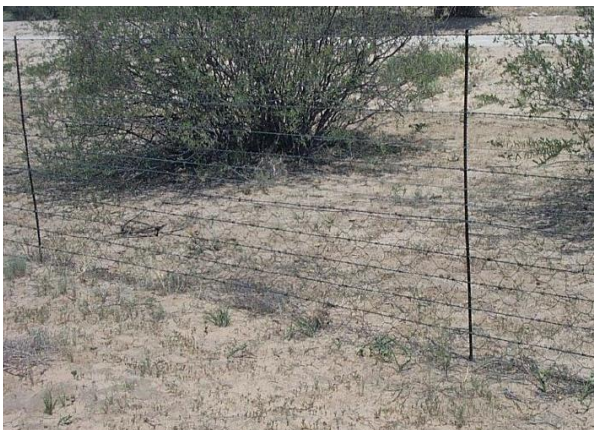
Typical fences recommended for the border patrol zone (Figure 14), include:

- International border fence (typically a 2.4m high elephant fence, or a 2.4m high game-proof fence or a 2.4m high mesh fence (ClearVu® or similar approved) located on the existing border fence position or on the international boundary.
- The 2.4m high elephant fence (to be installed along the KwaZulu-Natal / Mozambique Border) is a requirement from DAFF to prevent elephants and other wildlife from crossing into South Africa and spreading foot-and-mouth disease (FMD);

- The 2.4m high game-proof (veterinary) fence (to be installed along Swaziland / South Africa game reserves) is to prevent wildlife and cattle from crossing into South Africa and spreading FMD as required by DAFF;
- The 2.4m high mesh fence (ClearVu® or similar approved) will be used for 1km lengths on each side of the various border posts to prevent pedestrian crossings as required by SANDF.
- An inner fence of 1.2m high stock-proof fence 10m away from the international fence within South Africa. This purpose of this inner fence is to prevent South Africa animals from grazing within the 10m detection zone. Animals sneezing within the neighbouring countries could spread FMD with mucus onto the grass within the detection zone. Animals grazing within this zone, could then spread FMD;
- A servitude fence (typically a 1.2m high stock-proof fence) on the servitude edge at 100ft away from the international boundary;
- Electrification of the international border fence still needs to be finalised;
- Gates where required including gates along the access roads and where farm access to rivers or for other reasons, is required;
- Construction of a 1.5m high concrete barrier wall along a portion of Nkonjane to Abercorn Drift to prevent vehicle theft; and
- The cleared areas (3m wide) for the construction of the fences will be used as footpaths to inspect the fences by DAFF staff.

Typical elephant fence (2.4m high)

Typical game proof fence (2.4m high)



Typical 1.2m stock proof fence

Typical ClearVu® or similar approved (2.4m high)

Figure 14: Typical fences

2.4.4 Border Markers

Border markers will be installed in very mountainous areas along the Swaziland Border where there is limited access to inspect and maintain a fence and the topography is not suited for the installation of a fence e.g. along the Lebombo Mountains in KwaZulu-Natal and Swaziland (Figure 15).

Figure 15: Typical border marker along mountainous areas

2.4.5 Detection Zone

A 10m wide detection zone (cleared of vegetation) between the international border fence is required by the SANDF to provide protection for their staff patrolling the international boundary to provide them with a clear, uninterrupted view of the area (Figure 16). The detection zone also assists in limiting the spread of FMD as animals are restricted from grazing in this area.

Figure 16: Typical detection zone

2.4.6 Border Patrol Roads

The following road types are applicable to the project:

- ***Border patrol road***
  The border patrol roads are roads along the international border. Where the topography does not allow for a route along the border, the road is aligned along the closest position along a contour alignment, in which instance it is referred to as a detour / contour road. Both the border patrol road and detour / contour roads are identified to be used for patrolling purposes.

  These patrol roads may include any of the following:
  - Existing patrol tracks and roads;
  - Public roads, where public roads are aligned close enough to the border to fulfil the patrol purpose;
  - Farm roads, Protected Areas or forestry roads, where the alignments are suitable for use as patrol roads.

  Border patrol roads are typically a 5.5m wide gravel road constructed within the 100ft servitude (typically within the detection zone). This is a requirement by SANDF to allow for border patrol vehicles to travel along the international border. This road will also be used by DAFF staff to inspect the fence. In some areas, this road will be replaced by a 2m wide quad bike track (gravel), a 5m wide concrete road or a 1.5m wide pedestrian walkway / foot path (earth).

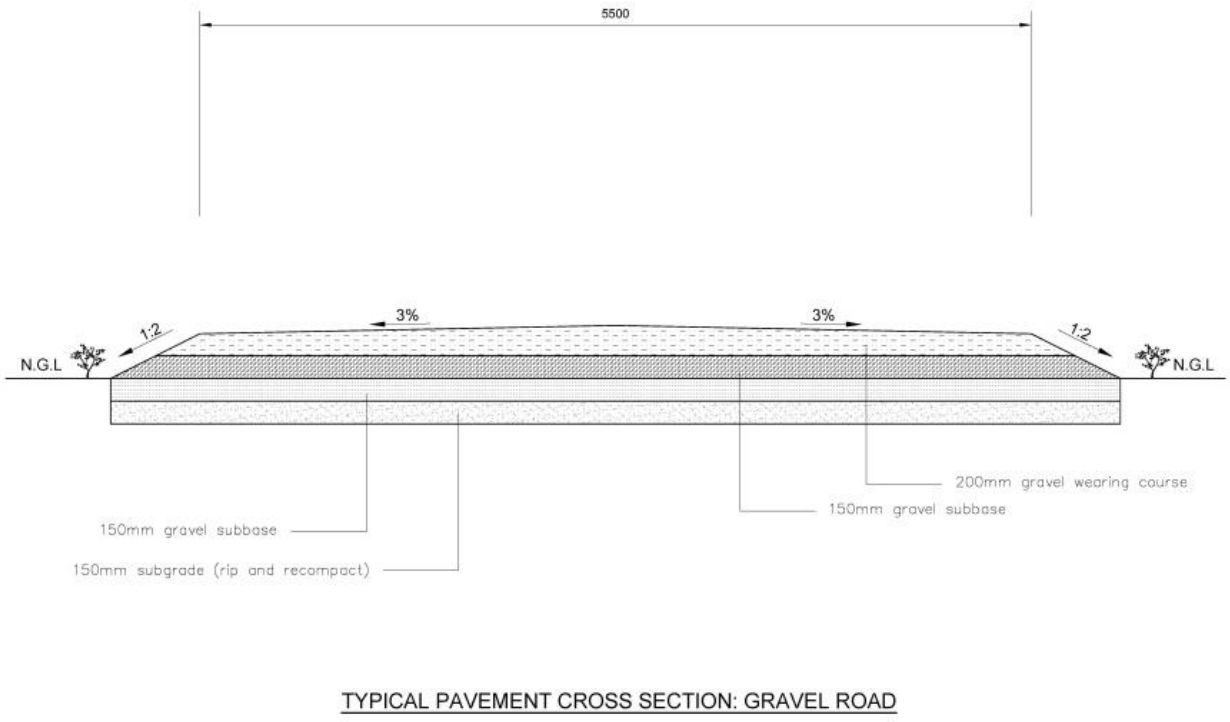


Figure 17: Typical pavement cross-section - gravel road

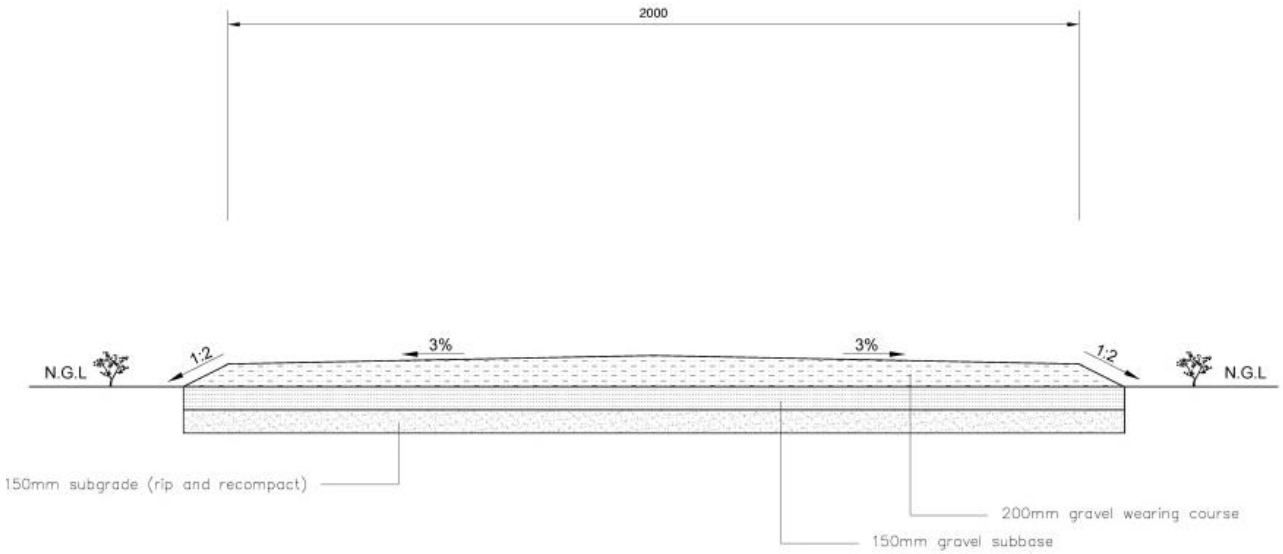


Figure 18: Typical pavement cross-section – quad bike track

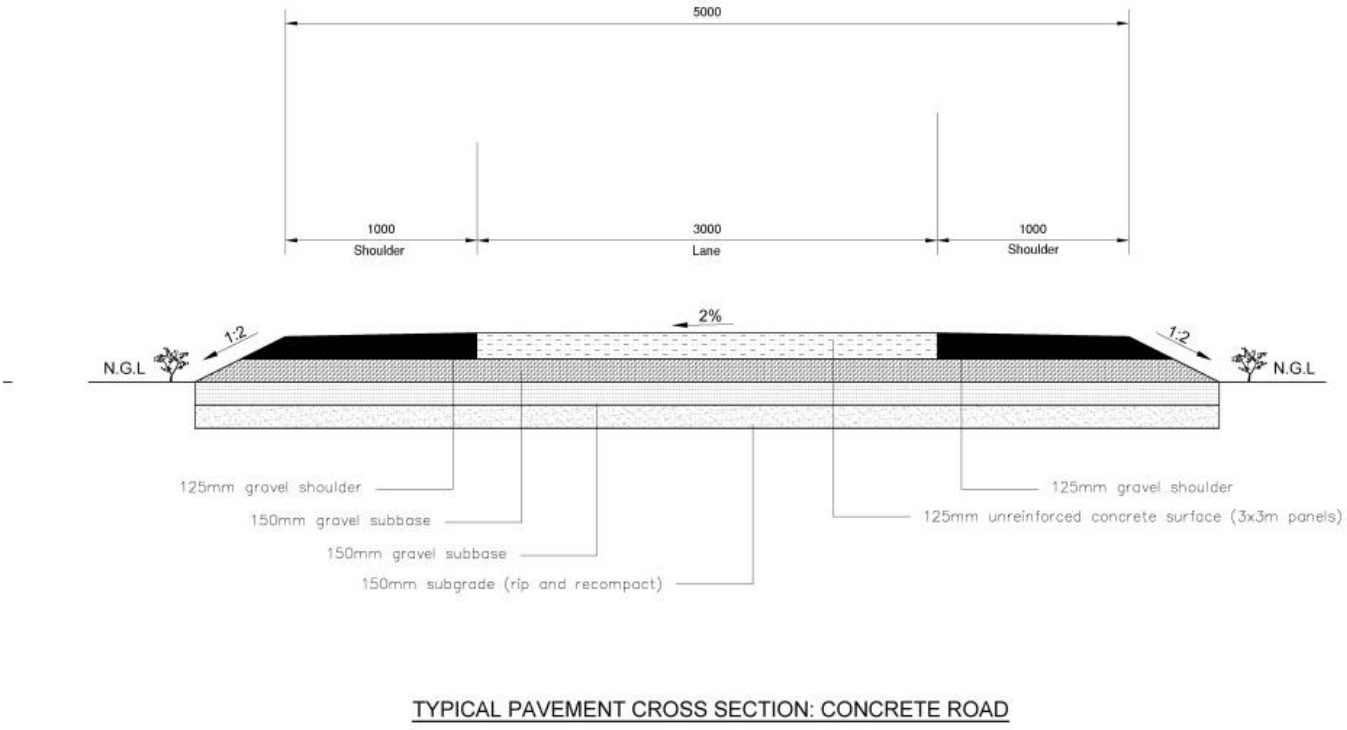


Figure 19: Typical pavement cross-section – concrete road

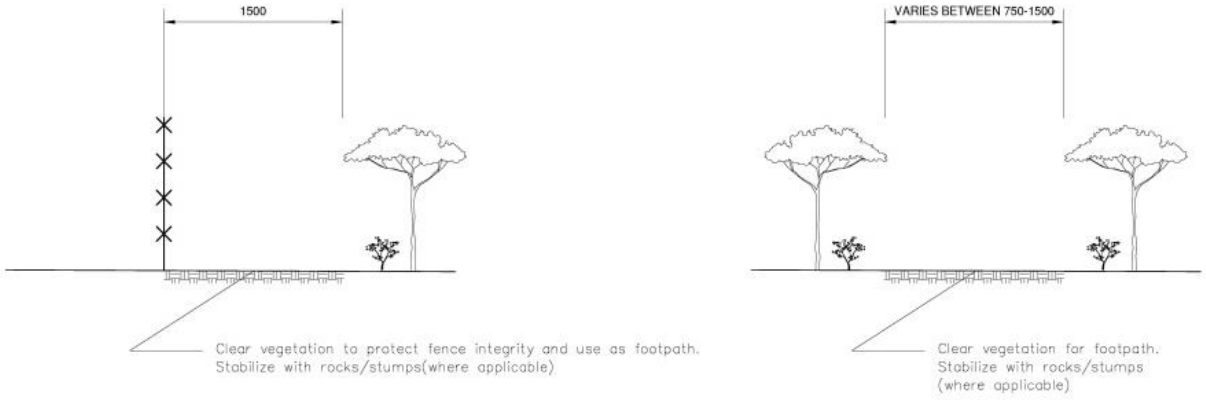


Figure 20: Typical pavement cross-sections – footpaths

- ***Access routes***
  These are the routes that will provide access to the various parts of the border (i.e. to the border patrol roads). Similarly, these access routes may include any of the following:
  - Existing public roads (proclaimed roads with allocated road numbers);
  - Rural "informal public" roads (not formally proclaimed), but that fulfil the function of "public roads" in the sense that they provide access to rural homesteads in communal land / trust land areas;
  - Existing farm roads, Protected Area or forestry roads, where the alignments are suitable for use as access routes; and
  - New "greenfield" alignments.

  For the purposes of securing the rights for the DPW to use roads for patrol or access purposes, the existing rights were determined i.e. where roads are proclaimed (or can be argued to already fulfil a "public road" function) and where not.

  Some of the access routes are also further defined as dedicated access roads where typically servitude or right of way will have to be registered on these routes. These are where:
  - The access route is not a public road and is situated on private property (e.g. farm or forestry land) and (in addition to the right that is held by the owner(s) of the property), will fulfil the purpose of providing access to the border or patrolling of the border by state entities (DAFF and SANDF);
  - The access route is not a public road, or considered to be fulfilling a "public road" function, on land owned by the Ingonyama Trust or other community trusts and where such road will fulfil the purpose of providing access to the border or patrolling of the border by state entities (DAFF and SANDF);
  - The access route has a road number (has at some stage been declared or proclaimed as a public road), but is no longer fulfilling / desirable to fulfil a public road function (e.g. where DPW does not

want to encourage access to the international border via use of this route). These are alignments proposed to be de-proclaimed and replaced with servitudes in favour of the state.

The typical cross-section of the access routes to the border patrol zone will consist of a 5.5 to 7.9m wide gravel border patrol road within the road servitude of 13.49m and gates where required.

It should be noted that no new access routes will be applied for. Existing access routes will be re-gravelled. Any upgrading or expansion or new access routes will have to undergo the appropriate environmental permitting if and when the need arises. The upgrading of access roads within Protected Areas will form part of the Reserve's Management Plan.

- ***Detour / contour roads***
  In areas where it is not possible to construct a border patrol road adjacent to the international boundary due to the topography or other conditions (e.g. wetlands), a detour / contour road will be constructed around the obstacle. The typical cross-section of the contour roads will consist of two (2) fences, a 5.5 to 7.9m wide gravel access road, and a total road servitude width of 13.49m as follow:
  - Fences of 1.2m high stock-proof fence on the edge of the servitude (where required);
  - A 5.5 to 7.9m wide gravel border patrol road within the 15m servitude;
  - A 13.49 m wide road servitude; and
  - Gates where required.

2.4.7 Structures

The following structures will be installed in the project:
- Pipe culverts and concrete box culverts for stormwater drainage under the various roads;
- Concrete drifts and vented concrete drifts (causeways) over the streams;
- Road bridges over certain larger rivers; and
- A wooden bridge over Lake kuZilonde (applicable to Phase 1).

Various structural configurations have been proposed along the patrol road. These structural solutions are based on a preliminary route and will need to be refined during the detail design phase. All alternatives will be constructed from cast-in-situ or precast concrete. The concrete structures are the most durable, require minimal maintenance and provide a design life >75 years.

The list of these configurations is indicated below with a brief description following. Typical General Arrangement drawings for each structural type as referenced below are attached in ***Appendix G***. Each stream / river crossing at the patrol road has been reviewed and preliminarily designed. A table summarizing the results is shown in ***Appendix G***. The results include location number / chainage, type of structure, sizing information, design flood period and flow and preliminary cost.

- Drift - the drift will consist of a concrete slab that is prepared for vehicles to cross a river. A maximum flood depth over the drift from the design flow rate should be limited to 100mm. It is recommended that cut-off walls be incorporated at both up and down stream of the drift to prevent undermining by erosion.

- Vented drift (causeway) - The vented drift will consist of a concrete slab that is prepared for vehicles to cross a river and includes a series of pipes or square boxes which allow for small flows to travel underneath the road without over topping. A maximum flood depth over the vented drift from the design flow rate should be limited to 100mm. It is recommended that a minimum diameter / opening height or width be 900mm. This reduces the potential for siltation blocking of the culverts and reduces potential for debris blocking. It is recommended that cut-off walls be incorporated at both up and down stream of the vented drift to prevent undermining by erosion and protect the roadway.

- Culverts / series of culverts – culverts will consist of cast-in situ concrete boxes. Concrete box cell width / heights will vary from 1.2m to 3.6m depending on the vertical profile of the road levels above natural ground level. Culverts will be used where a drift type structure is not warranted. Apron slabs with cut-off walls along with gabion mattresses will be used to prevent erosion and undermining of the culverts which will protect the roadway. A series of culverts will likely be used in low-lying flood plain areas.

- Pipe culverts / series of pipe culverts - pipe culverts will consist of precast concrete pipes 900-1200mm in diameter. Pipe culverts will be used in low flow catchments compared to box culverts and where a drift type structure is not warranted. It is recommended that a minimum diameter be 900mm. This reduces the potential for siltation blocking of the culverts and reduces potential for debris blocking. End treatments to the pipe ends will be used to prevent erosion and undermining of the culverts which will protect the roadway. A series of pipe culverts will likely be used in low-lying flood plain areas.

- Bridges - both single-span and multi-span, will be used in large catchment areas with high peak flow rates. These bridges could either be designed as low-level or high level, depending on their importance. The bridges will be constructed from cast-in situ concrete and have spans varying between 10 to 15m. Pier and abutment foundations will need to be determined after a geotechnical investigation has been completed and will either be spread footings or piled. Gabion mattresses will be used where required for erosion protection.

- Flood Gate Systems - when the patrol road and associated drainage structure is not adjacent to the fence line, a fence / flood gate system will be required. The general arrangement drawing for this system shows 4 potential options which depend on the width of the stream / river and peak flow rate. The actual type of fence used at each stream / river location will be investigated further during detailed design.

2.5 Typical Cross-sections of the Border Control Zone

The typical cross-sections are provided in Figure 21 to Figure 23 and ***Appendix G*.**

The typical cross-section indicated in Figure 21 will apply to the majority international boundary from km 54 – km 524 except for the section between Nkonjane and Abercorn Drift and mountainous terrain.

In the Nkonjane and Abercorn Drift area, it is proposed, as an alternative to fencing this section of the Usuthu River, to have barriers (similar to those proposed along other sections of the Mozambique / KZN border) to block any potential access to vehicles (in areas where the topography is conducive to illegal vehicle movement) - Figure 22. A design solution will need to be developed during the detailed design stage to deal with the rocky conditions to ensure that these barriers can be securely anchored so as to achieve the desired security over the long-term. The barriers must not impede wildlife access to the river.

In mountainous areas e.g. Lebombo Mountains, certain portions of the route in the Mpumalanga section, border markers will be constructed at typically 250m spacing in lieu of a fence. A 2m wide quad bike track or a 1.5m wide pedestrian walkway / foot path where necessary will be constructed (Figure 23).

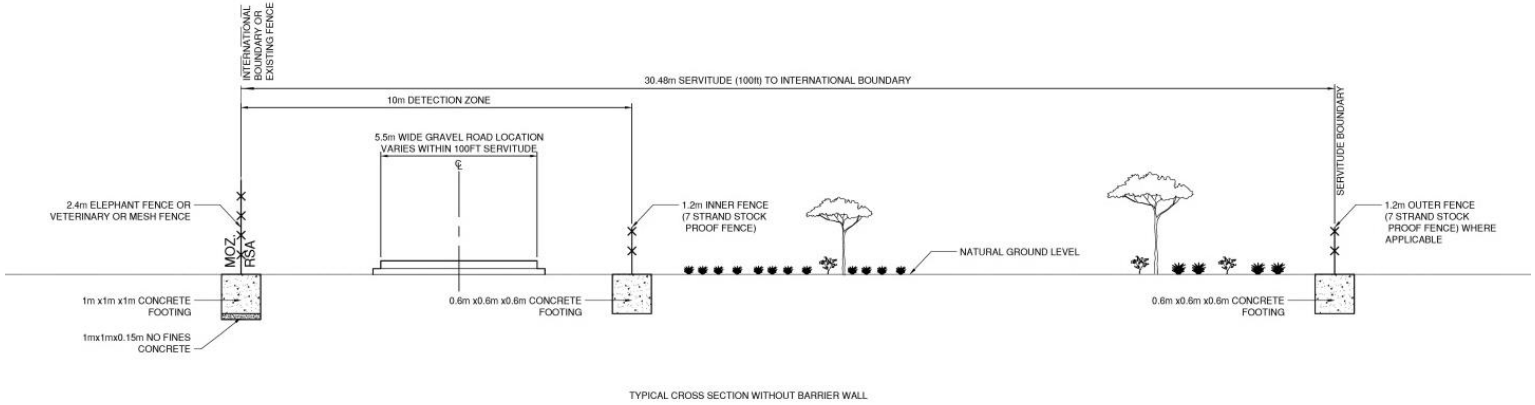


Figure 21: Typical cross-section – border patrol zone

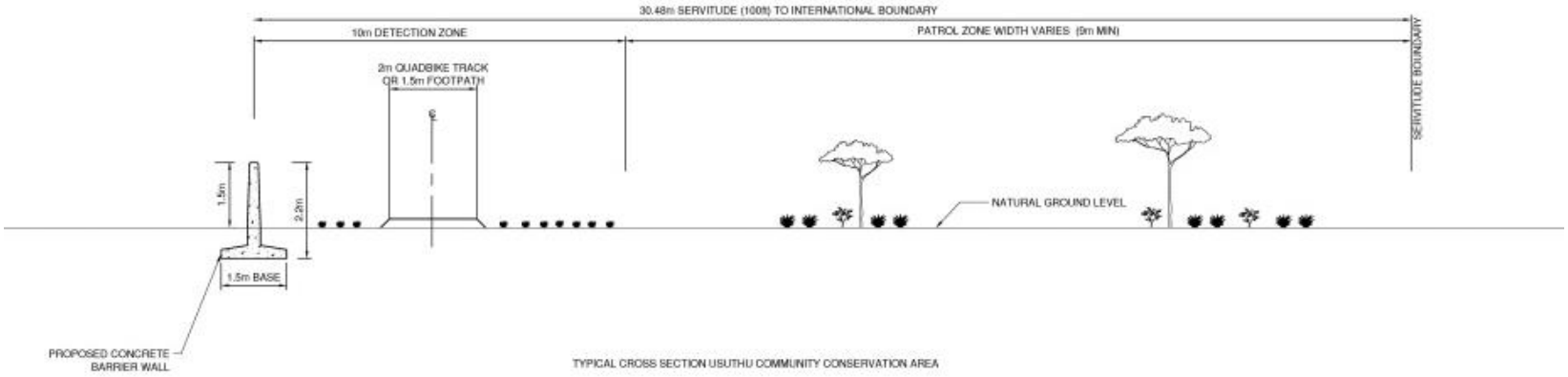


Figure 22: Typical cross-section – Usuthu CCA

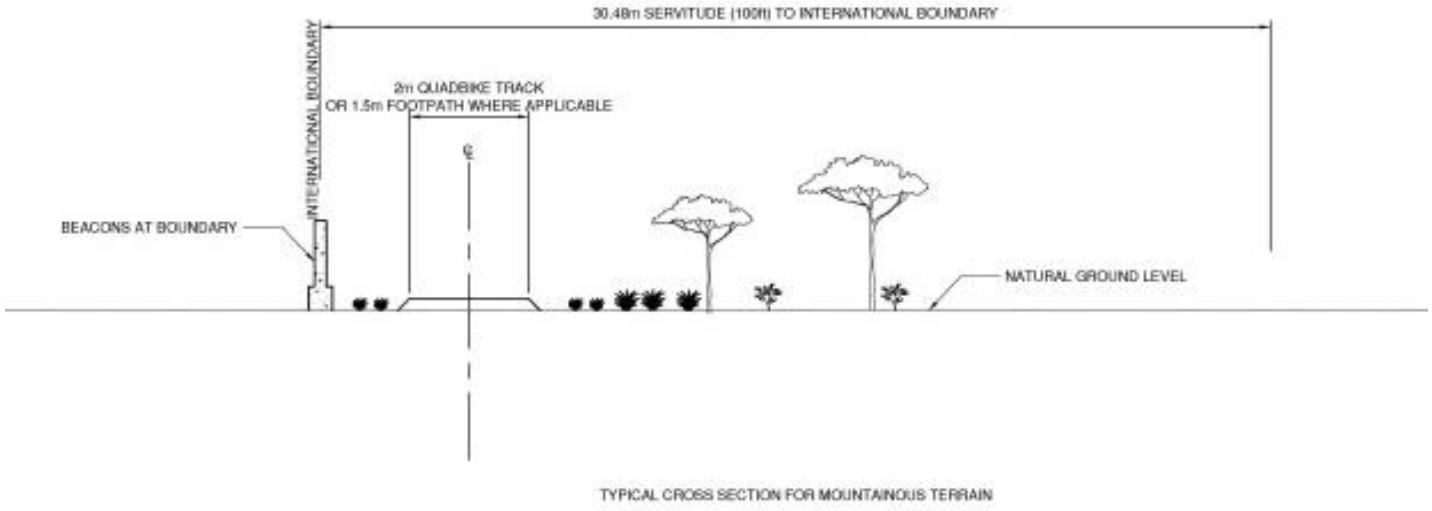


Figure 23: Typical cross-section for mountainous terrain

2.6 Effective Width of Transformation

The effective width of transformation for each of the development classes indicated above are summarised in Table 7 below.

Table 7: Summary of proposed development types and associated activities

Type	Proposed Development	Effective width of transformation	Rationale
Border Patrol Road	Existing Road – 5.5m gravel road	0m	Based on the assumption that an existing road will not cause additional direct loss of habitat
	Existing Track – 5m gravel road	3.5m	Based on the assumption that an existing track will typically result in additional disturbance of 3.5m Existing tracks are typically 2-3m wide and will be formalised to 5.5m gravel roads
	No Road – 2m quad bike track	3m	Based on the assumption that a quad bike track will result in new disturbance of 3m through currently untransformed habitat
	No Road – 5.5m gravel road	5.5m	Based on the assumption that a 5.5m gravel road will result in new disturbance of 5.5m through currently untransformed habitat
Border Control Fence	Existing Fence - veterinary fence	10 - 13m	Based on the assumption that the additional disturbance will only be associated with the clearing of habitat for the sake of a detection zone along the fence. The fence itself will generally occupy existing disturbed areas where the current fence is aligned
	Existing Fence – Clearview fence		
	Existing Fence – elephant fence		
	Existing Fence – mesh fence		
	No Existing Fence – elephant fence	13m	Based on the assumption that the new disturbance associated with the construction of the fence itself and clearing of habitat for the sake of a detection zone of the fence
	No Existing Fence – veterinary fence		
	Part Existing Fence – veterinary fence		

The effective width of transformation is further linked to the absolute minimum width required in sensitive areas for the development of border control infrastructure.

2.7 Borrow Pits

Borrow pits along the route have been screened. During the detail design stage material requirements will be finalised through testing. As far as possible, existing sources of material will be considered.

No borrow pits are being applied for in this application.

2.8 Water for Construction

Water for construction purposes will be sourced from municipal sources. Where municipal sources are unavailable, the Contractor will apply for and register the water use required at the appropriate time.

2.9 Construction Camps / Lay-down Areas

Construction camps / lay-down areas will be required during the construction phase of the project. It is proposed that these construction camps / lay-down areas be located at existing border posts and gates, transformed “brownfield” sites e.g. disused mill sites and forestry processing areas as well as within the 50m corridor in less sensitive areas. The construction camps / lay-down areas will not exceed the 20ha threshold for the clearing of indigenous vegetation.

The location of the construction camps and lay-down areas will need to be approved by the Environmental Control Officer (ECO) prior to implementation.

2.10 Storage of Dangerous Goods (Fuel)

Fuel storage on site (combined capacity of all consecutive sites) will not exceed 80m^3 on brownfield sites or 30m^3 in sensitive geographical areas. Hazardous storage and refuelling areas must be bunded prior to their use on site during the construction period following the appropriate SANS codes (SANS 10131:2004). The bund wall must be high enough to contain at least 110% of any stored volume.

3 ENVIRONMENTAL LEGISLATIVE CONTEXT

In order to protect the environment and ensure that the development is undertaken in an environmentally responsible manner, there is a number of significant environmental legislation that needs to be considered during this study.

This section outlines the legislation that is applicable to the proposed project and has been considered in the preparation of this report.

Table 8: Key legislation considered

Acts	Objectives, Important Aspects, Associated Notices and Regulations
National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended	***Objectives:*** To provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state. ***Relevant Notices and Regulations:*** • Environmental Impact Assessment Regulations, 2014 (GNR 982 in GG 38282 of 4 December 2014) as amended in GNR 326 of 2017 • Listing Notice 1 (GNR 983 in GG 38282 of 4 December 2014) as amended in GNR 327 of 2017 • Listing Notice 2 (GNR 984 in GG 38282 of 4 December 2014) as amended in GNR 325 of 2017 • Listing Notice 3 (GNR 985 in GG 38282 of 4 December 2014) as amended in GNR 324 of 2017 ***Relevance to the proposed project:*** • Development must be socially, environmentally and economically sustainable. • Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated; the social, economic and environmental impacts of activities including disadvantages and benefits, must be considered, assessed and evaluated and decisions must be appropriate in the light of such consideration. • 'Polluter Pays' principle. • Any activity that is proposed and which is listed in the NEMA EIA Regulations 2014 (as amended in 2017), requires environmental authorisation.

<table>
<tr><th>Acts</th><th>Objectives, Important Aspects, Associated Notices and Regulations</th></tr>
<tr><td></td><td>
Listed Activity(ies) & Applicability:
A full description of the listed activities and applicability to the project is provided in Appendix H. Below is a summary of the listed activities.
<table>
<tr><th>Listing Notice</th><th>Activity Number</th><th>Applicability</th></tr>
<tr><td rowspan="3">1 (GNR 327)</td><td>12</td><td>Infrastructure (e.g. fence, road, culverts, drifts, bridges, causeways) will be constructed within watercourses or within 32m of watercourses</td></tr>
<tr><td>19</td><td>Construction of infrastructure (e.g. fence, road, culverts, drifts, bridges, causeways) within watercourses resulting in the infilling or depositing or the excavation, removal or moving of material of more than 10m^3 from a watercourse</td></tr>
<tr><td>48</td><td>Existing infrastructure (e.g. fence, road, culverts, drifts, bridges, causeways) may be expanded by 100m^2 within watercourses or within 32m of watercourses</td></tr>
<tr><td rowspan="5">3 (GNR 324)</td><td>4</td><td>Applicable to the 5.5m wide road constructed in sensitive geographical areas i.e. Protected Areas, CBAs, within 10km from National Parks or World Heritage Sites and 5km from Protected Areas</td></tr>
<tr><td>12</td><td>Removal of indigenous vegetation within the 50m corridor in sensitive geographical areas</td></tr>
<tr><td>14</td><td>Construction of infrastructure (e.g. fence, road, culverts, drifts, bridges, causeways) within watercourses or 32m of a watercourse in sensitive geographical areas</td></tr>
<tr><td>18</td><td>Widening of the border patrol road within sensitive geographical areas</td></tr>
<tr><td>23</td><td>Expansion of existing infrastructure (e.g. fence, road, culverts, drifts, bridges, causeways) within watercourses or within 32m of watercourses in sensitive geographical areas</td></tr>
</table>
</td></tr>
<tr><td>National Water Act (Act No. 36 of 1998) (as amended)</td><td>
Objectives:
The National Water Act (NWA) is a legal framework for the effective and sustainable management of water resources in South Africa. Central to the NWA is recognition that water is a scarce resource in the country which belongs to all the people of South Africa and needs to be managed in a sustainable manner to benefit all members of society. The NWA places a strong emphasis on the protection of water resources in South Africa, especially against its exploitation, and the insurance that there is water for social and economic development in the country for present and future generations.
</td></tr>
</table>

Acts	Objectives, Important Aspects, Associated Notices and Regulations
	Relevance to the proposed project: • Sustainable protection, use, development and conservation of water resources – including aquatic ecosystems. • Defines 11 water uses and provides licencing procedures. ***Notices and Regulations:*** • General Authorisation in terms of Section 39 of the National Water Act (Act No. 36 of 1998, Water Uses Section 21 (a) and (b) (GN in GG 40243 of 02 September 2016). • General Authorisation in terms of Section 39 of the National Water Act (Act No. 36 of 1998, Water Uses Section 21 (c) and (i) (GN in GG 40229 of 26 August 2016). ***Water uses triggered:*** As the proposed development involves the direct and indirect crossing of rivers and wetlands, a Water Use Licence is required in terms of Section 21 (c) and (i) of the NWA: • Section 21 (c) - *impeding or diverting the flow of water in a watercourse* (applicable for the construction within watercourses); and • Section 21 (i) - *altering the bed, banks, course or characteristics of a watercourse* (applicable for the construction within watercourses).
National Forests Act (Act No. 84 of 1998)	***Purposes:*** The purposes of this Act are to: promote the sustainable management and development of forests for the benefit of all; create the conditions necessary to restructure forestry in State forests; provide special measures for the protection of certain forests and trees; promote the sustainable use of forests for environmental, economic, educational, recreational, cultural, health and spiritual purposes. ***Notices and Regulations:*** In terms of the NFA and Government Notice 1339 of 6 August 1976 (promulgated under the Forest Act, 1984 (Act No. 122 of 1984) for protected tree species, the removal, relocation or pruning of any protected plants will require a licence. ***Relevance to the proposed project:*** • *The Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that: 'no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.*

Acts	Objectives, Important Aspects, Associated Notices and Regulations
	Permitting requirements: A licence will have to be obtained from the Department of Agriculture, Forestry and Fisheries. (DAFF) for the rescue and relocation of protected trees potentially impacted during construction.

3.1 Other Relevant Acts, Guidelines, Department Policies and Environmental Management Instruments

Acts / Guidelines / Policies / Environmental Management Instruments	Considerations
The Constitution (No. 108 of 1996)	Chapter 2 – Bill of Right Section 24 – Environmental Rights
KZN Nature Conservation Ordinance (Ordinance No. 15 of 1974)	Protected indigenous plants in general are controlled under the relevant provincial Ordinances or Acts dealing with nature conservation. In KwaZulu-Natal the relevant statute is the 1974 Provincial Nature Conservation Ordinance. In terms of this Ordinance, a permit must be obtained from *eZemvelo* KZN Wildlife to remove or destroy any plants listed in the Ordinance.
Mpumalanga Nature Conservation Act (Act No. 10 of 1998)	A permit must be obtained from the Mpumalanga Tourism and Parks Agency to remove or destroy any indigenous plants or vegetation.
National Environmental Management Biodiversity Act (Act No. 10 of 2004) and Regulations: • **Threatened or protected species (GN 388)** • **Lists of species that are threatened or protected (GN 389)** • **Alien and invasive species regulations (GNR 506)** • **Publication of exempted alien species (GNR 509)** • **Publication of National list of invasive species (GNR 507)** • **Publication of prohibited alien species (GNR 508)**	Provide for the protection of species and ecosystems that warrant national protection and the sustainable use of indigenous biological resources.
National Environmental Management: Protected Areas Act (Act No. 57 of 2003) – NEM:PAA **GN R1061 of 28 October 2005: Regulations for the proper administration of Special Nature Reserves, National Parks and World Heritage Sites**	Creates a legal framework and management system for all Protected Areas in South Africa as well as establishing the South African National Parks (SANParks) as a statutory board. Each conservation area will have its own set of land use restrictions or regulations that stem either from generic restrictions under NEM:PAA, or customized regulations for individual Protected Areas. No development, construction or farming may be permitted in a nature reserve or world heritage site without the prior written approval of the management authority.
National Environmental Management: Waste Act (Act No. 59 of 2008)	Section 17 - Every attempt must be made to reduce, recycle or re-use all waste before it is disposed. Section 25 - All waste (general and hazardous) generated during construction must only be disposed of at appropriately licenced waste disposal sites.

Acts / Guidelines / Policies / Environmental Management Instruments	Considerations
National Environmental Management: Air Quality Act (Act No. 39 of 2004)	Section 32 - Control of dust. Section 34 - Control of noise. Section 35 - Control of offensive odours.
Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)	Section 22 - Application for a mining permit / right. Section 39 - Environmental management programme and environmental management plan.
National Heritage Resources Act (Act No. 25 of 1999)	Section 34 – No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority. Section 35 – No person may, without a permit issued by the responsible heritage resources authority destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site. Section 36 – No person may, without a permit issued by the South African Heritage Resource Agency (SAHRA) or a provincial heritage resources authority destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority. “Grave” is widely defined in the Act to include the contents, headstone or other marker of such a place, and any other structure on or associated with such place. Section 38 - types of development that require the Applicant / Developer to contact the relevant heritage authority, to determine the need for a heritage or palaeontological impact assessment.
Occupational Health and Safety Act (Act No. 85 of 1993)	Section 8 - General duties of employers to their employees. Section 9 - General duties of employers and self-employed persons to persons other than their employees.
Construction Regulations (2014)	Contractors must comply with the Construction Regulations which lay out the framework for construction related activities.
National Veld and Forest Fire Act, 1998 (Act No. 101 of 1998)	Chapter 4 – Veld Fire Prevention through firebreaks - places a duty on owners to prepare and maintain firebreaks. An owner whose land is subject to a risk of veld fire whose land or any part of it coincides with the border of the Republic, must prepare and maintain a firebreak on his or her land as close as possible to that border.
Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)	The objects of this Act are to provide for the conservation of the natural agricultural resources of the Republic by • the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or • destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants. Section 5 details measures for the prohibition of the spreading of weeds.

Acts / Guidelines / Policies / Environmental Management Instruments	Considerations
Spatial Planning and Land Use Management Act, (Act No. 16 of 2013)	The primary object of the Act is to provide for a uniform, effective and comprehensive system of spatial planning and land use management in South Africa that promotes social and economic inclusion. The Act sets out the spatial planning system in South Africa, including spatial development frameworks at varying levels of government in South Africa. SDFs interpret and represent the spatial development vision of the responsible sphere of government / authority, guiding infrastructure development in a spatial context.
World Heritage Convention Act, 1999 (No, 49 of 1999)	The Act provides for the incorporation of the World Heritage Convention into South African law; the enforcement and implementation of the World Heritage Convention in South Africa; the recognition and establishment of World Heritage Sites.
General Trans-Frontier Conservation and Resource Area Protocol (signed in Durban on the 22 June, 2000)	Article 2 of the Protocol sets out the Transfrontier Conservation and Resource Area Objectives, of which the primary objectives are: ▪ to create an enabling framework to facilitate economic development which is ecologically and financially sustainable ▪ the development of joint strategies (including regional funding strategies) for transfrontier ecological planning and resource management for TFCA's; and ▪ the involvement of communities in and adjacent to the TFCAs consultation representation and participation on TFCA Management.
Lubombo Ndumu-Tembe-Futi Transfrontier Conservation and Resource Area Protocol (signed in Durban on the 22 June, 2000) **Lubombo Pongola-Nsubane Transfrontier Conservation and Resource Area Protocol (signed in Durban on the 22 June, 2006)**	Article 2 of the Protocols sets out the Transfrontier Conservation and Resource Area Objectives specific to these TFCA, of which the key objectives are: ▪ To realise economic returns from tourism activities within the area while safeguarding its ecological integrity and to promote sustainable socio-economic development of the area; ▪ To address the needs and aspirations of local com unities by ensuring their direct participation in and / or ownership of and / or derivation or benefit from any programmes or initiatives that are undertaken in the area; ▪ To protect depleted, threatened, rare or endangered species and populations in the area and, in particular, to preserve habitats in the area considered critical for the survival of such species; ▪ To prevent outside activities from detrimentally affecting the Area by identifying such threats and undertaking appropriate action to remove or mitigate such threats; and ▪ To investigate options for the facilitation of cross-border movement, the positioning of fences, and the possible creation of visa-free areas or reserves.
Strategy on Buffer Zones for National Parks (Government Gazette Notice No 35020 of 28 February 2012, GN 106 of 2012) KwaZulu-Natal Provincial Spatial Development Strategy Mpumalanga Provincial Growth and Development Strategy Umkhanyakude District Municipality SDF & IDP (2017) Zululand District Municipality SDF Gert Sibande District Municipality SDF	

Acts / Guidelines / Policies / Environmental Management Instruments	Considerations
Ehlanzeni District Municipality SDF	

3.2 Sustainable Development

The principle of Sustainable Development has been established in the Constitution of the Republic of South Africa (Act No. 108 of 1996) and given effect by NEMA. Section 1(29) of NEMA states that sustainable development means the integration of social, economic and environmental factors into the planning, implementation and decision-making process so as to ensure that development serves present and future generations.

Therefore, Sustainable Development requires that:

- The disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- The disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided, or where it cannot be altogether avoided, is minimised and remedied;
- Waste is avoided, or where it cannot be altogether avoided, minimised and re-used or recycled where possible and otherwise disposed of in a responsible manner;
- A risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and
- Negative impacts on the environment and on people's environmental rights be anticipated; and, prevented and where they cannot altogether be prevented, are minimised and remedied.

3.3 Climate Change Consideration

The proposed project will take into account energy efficient technologies and consider international best practice in terms of the construction methodologies and management of finite resources.

Since climate change concerns include unpredictability and severity in weather patterns, the provision of basic human needs, such as road infrastructure, is considered critical.

4 PROJECT NEED AND DESIRABILITY

4.1 Project Need

South Africa has approximately 4 800km of land border and 2 800km of coastline border that needs to be secured. The financial impact of illegal imports, smuggling, theft of vehicles and other similar illegal activities on the economy is enormous. The contribution of this project's deliverables towards protection of South Africa's borders serves to:

- prevent the illegal movement of people, goods (to avoid payment of duty) or contraband;
- prevent the movement of produce or livestock that may lead to the spread of infectious disease; and
- promote the lawful entry and exit of goods and people.

In the context of border security, the main challenges facing the various organs of the state (in terms of each of their respective mandate areas) include:

- Customs / Revenue Services / Home Affairs
  - Illegal movement of goods;
  - Illegal migration / crossing of the border; and
  - Absence of clearly marked border position to allow successful prosecution.
- DAFF
  - Inadequate fencing and resulting challenge for disease control.
- SANDF / SAPS
  - Criminal activity;
  - Inadequate fencing / barrier infrastructure; and
  - Poor access and patrol infrastructure, making it difficult to patrol and respond to incidents.
- Provincial Conservation Authorities (EKZNW and MTPA)
  - Illegal entry / trespassing.
  - Anti-poaching initiatives.

The proposed project will assist in fulfilling the constitutional mandate of a number of national and provincial governmental departments as well as the mandate of the SANDF in securing South Africa's borders, to protect its citizens and to prevent the spread of disease as well as the illegal movement of goods and people. The project is thus highly important at a national level.

4.2 Project Alignment with Strategic and Spatial Planning Policies

4.2.1 Provincial Spatial Planning

In terms of Provincial Strategic and Spatial Planning Policies, the Provincial Growth and Development Strategies (PGDS) of both KwaZulu-Natal and Mpumalanga indicate goals and objectives relating to spatial planning and the need for the preparation of Spatial Development Frameworks at a local municipal level. A summary of the relevant sections of these provincial reports is given below.

The KwaZulu-Natal Provincial Spatial Development Strategy (PSDS) has been developed in order to achieve its goals and objectives in a targeted and spatially co-ordinated manner. The Provincial Spatial Development Strategy sets out to:

- Be the spatial expression of the Provincial Growth and Development Strategy (PGDS) and provide spatial context for proposed strategic interventions;
- Provides a set of normative principles or departure points that guide the Province's approach to dealing with socio-economic issues that are manifested spatially;

- Provide a basis for informed consensus on the province's spatial priorities by providing a map giving guidance for the future spatial development of the Province based on Broad Provincial Spatial Planning Categories (BPSPCs) and a series of other relevant features;
- Assist to prioritise and align where government directs its investment and development initiatives to ensure sustainable and maximum impact;
- Capitalise on complementarities and facilitate consistent and focused decision making;
- Guide municipal integrated development plans (IDPs), spatial development frameworks (SDFs) and provincial and municipal framework plans (i.e. sub-SDF spatial plans); with normative principles, approach and content;
- Provide clear intent to the private sector about desired development directions; and
- Increase predictability in the development environment.

The envisaged spatial vision for KwaZulu-Natal is summarised as follow:

> *"Optimal and responsible utilisation of human and environmental resources, building on addressing need and maximising opportunities toward greater spatial equity and sustainability in development."*

The PSDS indicates the following proposed areas of intervention (Figure 24):

- Social investment areas;
- Priority conservation areas;
- Economic support areas;
- Economic value adding areas;
- Biodiversity Priority Area 1;
- Agricultural investment areas; and
- Mandated service delivery areas.

The proposed upgrade of border patrol roads and fencing can be considered as aligning with the KwaZulu-Natal provincial spatial guiding principles in relation to protection of the environment and promotion of sustainable development. Proposals in the PSDS do not include any particular economic value adding or agricultural investment in the study area, but do indicate broad areas for social investment, service delivery, conservation, biodiversity and an economic support area in close proximity to the Mozambique Border along the coast.

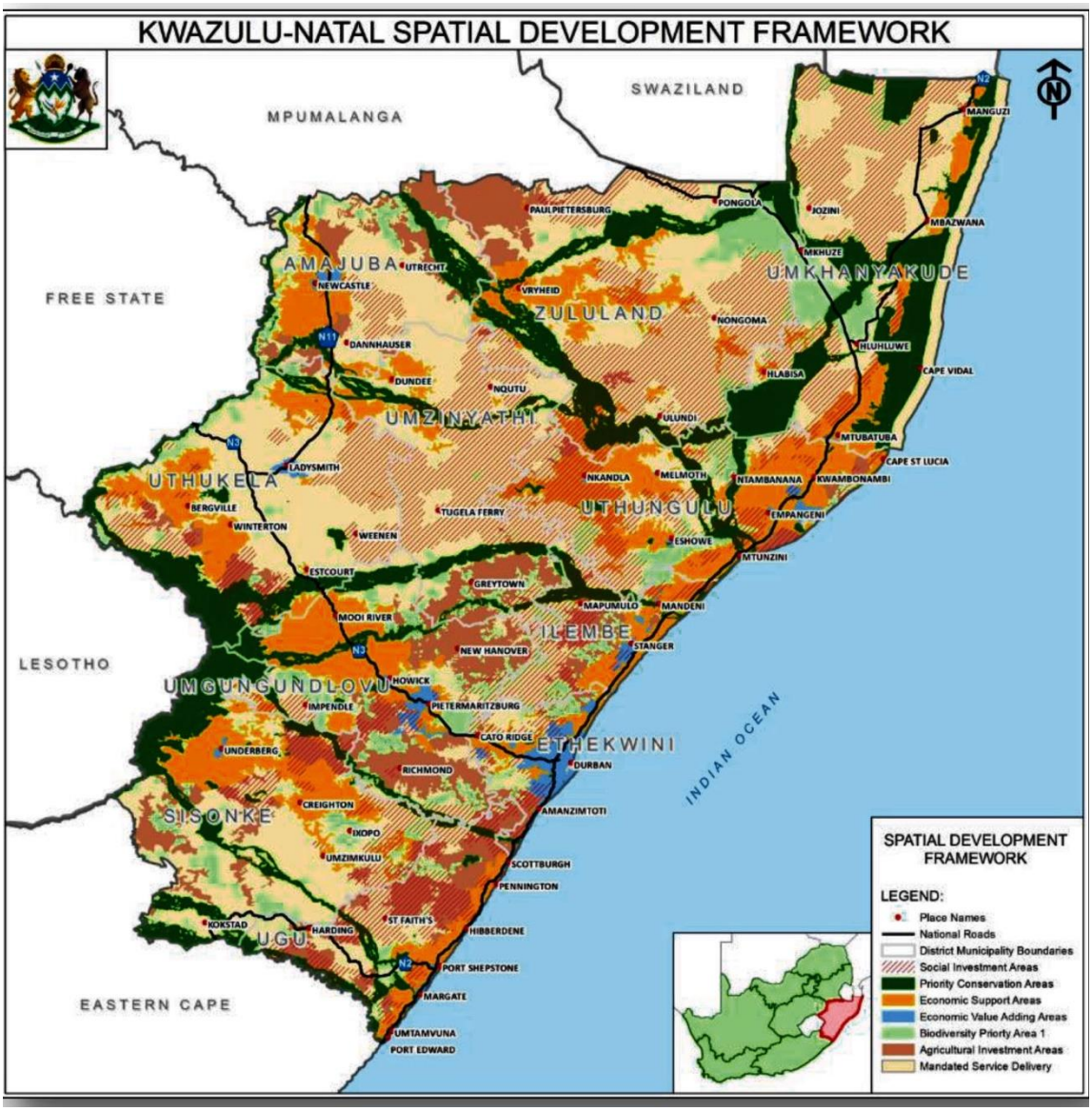


Figure 24: KZN Provincial Spatial Development Plan extract

The Mpumalanga Provincial Growth and Development Strategy contains the following vision:

"Reconstruction, development and sustainable growth; with employment and redistribution."

The strategy lists the following Key Development Priorities:

- Key Development Priority 1: Economic development.
- Key Development Priority 2: Development infrastructure.
- Key Development Priority 3: Social development.
- Key Development Priority 4: Sustainable environmental development.
- Key Development Priority 5: Good governance.
- Key Development Priority 6: Human resource development.

The Spatial Development Framework for the province indicates the following proposed areas of intervention (Figure 25):

- Forestry areas.

- Protected / conservancy areas.
- Ecological corridors.
- Secondary nodes: Malelane, Komatipoort, Barberton and Piet Retief.
- Tertiary and tourism nodes.
- National corridors including the N2, N17 and N4.
- Provincial corridors linking the N4 to the Swaziland Border.

The proposed upgrade of border patrol roads and fencing can be considered as aligning with the provincial key development priorities in relation to sustainable environmental and spatial development. Proposals impacting on the study area include protection of conservation and forestry areas, while focussing on investment along proposed transportation corridors.

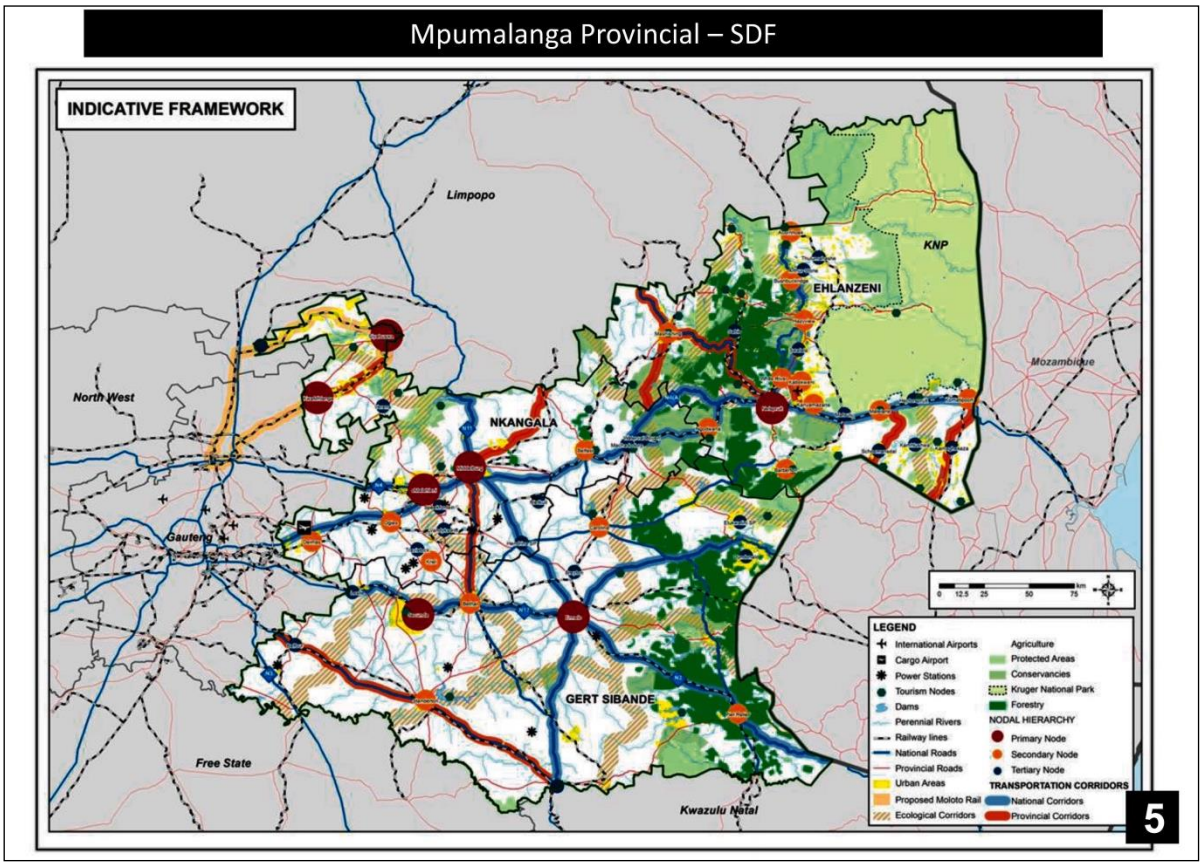


Figure 25: Mpumalanga Provincial Spatial Development Plan extract

4.2.2 Municipal Spatial Planning

4.2.2.1 Umkhanyakude District Municipality – KwaZulu-Natal Province (comprising Jozini and Umhlabuyalingana Local Municipalities)

- ***Strategic location as border district:***
  - Mozambique, Botswana, Swaziland, Zimbabwe and South Africa have agreed to build one of the largest ports, 30km from Kosi Bay, including associated urban expansion. This border area is dominated by strategic natural heritage projects (Ndumo Game Reserve and Tembe Elephant Park, Kosi Bay, and other similar natural resources).

- Lavumisa and Ponta de Ouro border posts: movement of people (including migrants) and cargo between the three countries, linking to South Africa's premier ports at Richards Bay and Durban Harbours.
- Three Transfrontier Conservation Areas (TFCAs): conservation and biodiversity value (particularly with regard to species migration) and important economic opportunities with the international recognition given to the TFCAs / Peace Parks concept:
    - Nsubane-Pongola TCFA which covers the Jozini Dam area and links Umkhanyakude and Zululand District Municipalities and Swaziland;
    - Usuthu-Tembe-Futi TFCA; and
    - Kosi Bay-Ponta de Ouro TFCA which links to Mozambique.
- Influx of people due to war in Mozambique and the factional conflicts in KZN (1970 and 1980) - destruction of natural resources and major pressures on conservation areas for resources to supplement survival strategies.
- Establishment of Northern Regional Consultative forum (NRCF), including Umkhanyakude, Uthungulu, Zululand, Gert Sibande, Lavumisa (Swaziland) and Bela Vista (Mozambique) to strengthen and align Local and Regional Development.
- High-risk areas for malaria infection are along the borders of Mozambique and Swaziland. Increased movement in and out of the SA borders possibly has an effect on these changes in malaria incidence.
- Migration – between South Africa, Mozambique and Swaziland - exhibited circular movements between SA and their home countries.
- Area is part of the strategic initiatives for social and economic development involving South Africa, Mozambique and Swaziland namely the Lubombo Spatial Development Initiative and the proposed Transfrontier Peace Park involving Mozambique.

- ***Proposals:***
    - N2 corridor – Durban to Mpumalanga and main road to Swaziland: movement corridor with a secondary function as a tourism route.
    - Border heritage corridor: Cecil Macks Pass – Ingwavuma – Bambanani – Ngwanase – Kosi Bay: potential primary investment link.
    - Tertiary investment link - road along the top of the Lebombo's north of Jozini, through Hlathikhulu Forest area following the Swaziland Border past Gwaliweni to Ingwavuma.
    - Catalytic projects:
        - Lubombo TFCA;
        - Ndumo Game Reserve; and
        - Secondary hospital serving northern parts of the district municipality, Swaziland and Mozambique.
    - Infrastructure: Jozini hydro-electric power plant, potential to sell electricity to the national grid, Mozambique and Swaziland. Issues of land claims and the allocation of water resources from DWS have hampered the project which would take about 4 years to complete.

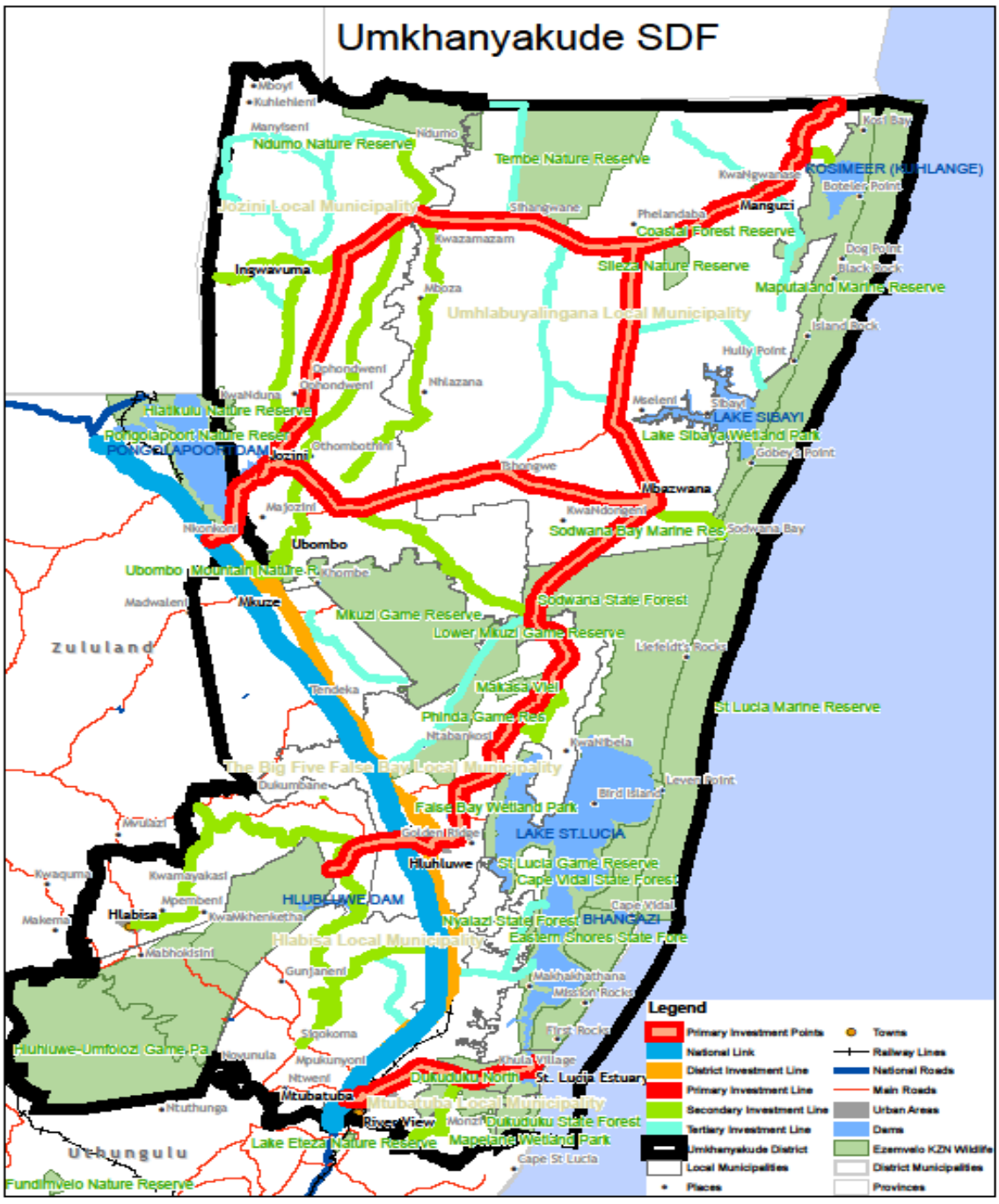


Figure 26: Umkhanyakude Municipal Spatial Development Framework extract

The proposed upgrade of border patrol roads and fencing can assist in promoting the objectives of the Umkhanyakude District Municipality's spatial development framework proposals by assisting with the protection of vital heritage and conservation / biodiversity projects located along the border, while encouraging social and economic investment and tourism opportunities in line with the Lubombo Spatial Development Initiative and Transfrontier Peace Park and Conservation Areas. Proposed conservation projects highlight the importance of secure fencing for the protection of animals and the environment, while proposed economic development initiatives will require more secure fencing and patrolling to prevent and

control illegal activities along the border and at border crossings. Transfrontier parks will require special border control considerations.

4.2.2.2. Zululand District Municipality – KwaZulu-Natal Province (Comprising uPhongolo Local Municipality)

- ***Tourism potential*** - Pongolapoort Dam, also known as Lake Jozini.

- ***Economic possibilities*** - tourism and economic opportunities linked to the sugarcane industry. Golela has the closest sugar mill to the sugarcane farmers in the southern parts of Swaziland.
  - Golela Border Post: situated near the Pongolapoort Dam - operation of the post on a 24-hour basis needs to be negotiated and managed. This will allow for ease of movement and an increased volume of tourism and freight traffic through the region.
  - Onverwacht Border Post: situated directly north of Pongola and Ncotshane - special arrangements for ease of cross-border movement should be made with sugarcane farmers, to increase economic opportunities for South Africa.

  Conservation: Nsubane-Pongola TFCA and Resource Protocol Areas – coordination needs to address aspects such as people crossing the border, management of the park on the two sides of the international border, prevention of animal diseases crossing over the international border etc.
  Although this initiative has been developed and planned for a number of years, finalisation of management areas to be included and management structures to coordinate international implementation has been delayed drastically.

- ***Concerns*** - Illegal border crossings.

- ***Job creation:***
  - Agriculture - facilitating relations between Swaziland and the TSB Sugar Mill.
  - Public Works LED - development and upgrading of the border posts.

- ***Proposals:***
  - Corridor: N207 - Movement Corridor Freight Route - north connection to Swaziland.
  - Projects: The Golela Border Post is being upgraded by the DPW. A large number of medium density residential units are being developed. From this, small economic and tourism opportunities will arise, as the 24-hour border post, and the envisaged additional residents to the area will increase the need for services and basic goods in the area.

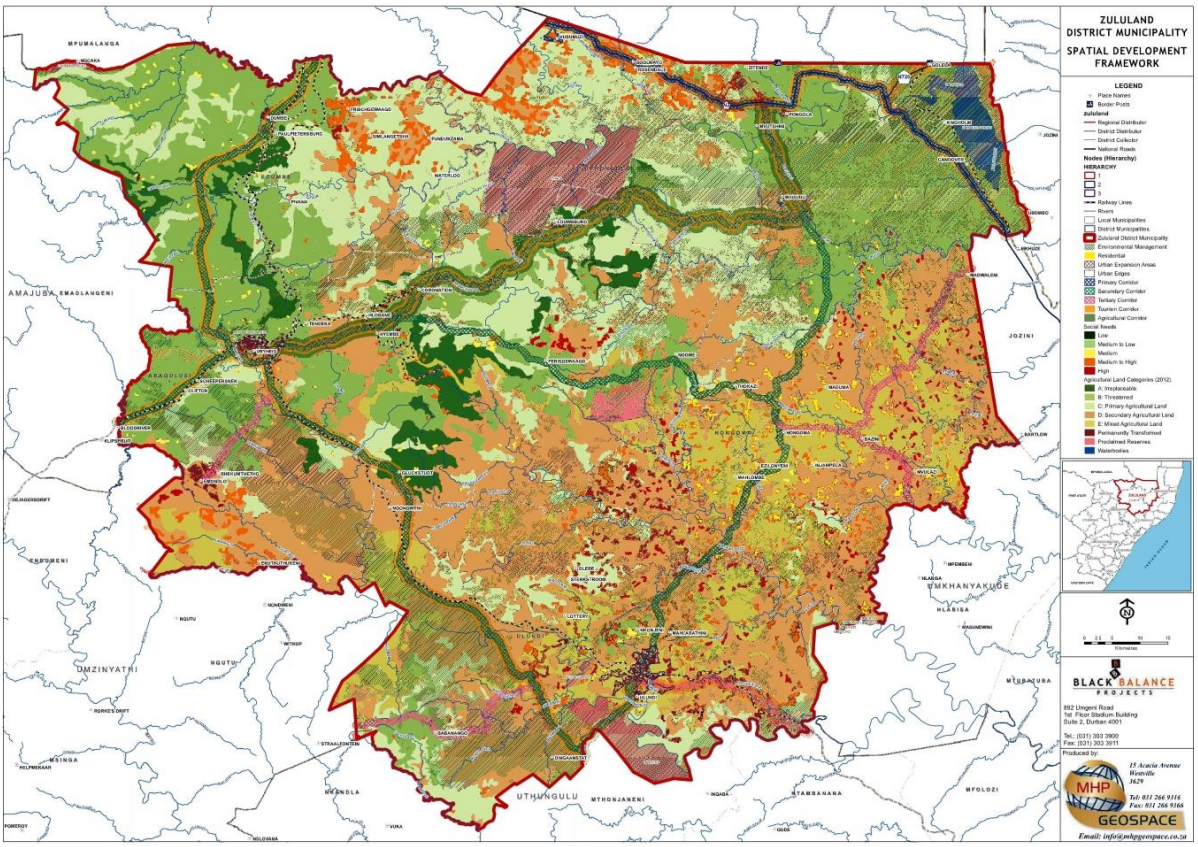


Figure 27: Zululand District Spatial Development Framework extract

The proposed upgrade of border patrol roads and fencing is aligned with the proposals of the Zululand District Municipality's spatial development framework proposals by assisting with the protection of the – Nsubane-Pongola Transfrontier Conservation and Resource Protocol Areas, and promotion of economic and tourism potential along identified corridors linked with upgrade of border posts and expansion of their facilities. Reduction in illegal border crossings will also assist in protection of the environment and focussing of economic development to the benefit of local residents.

4.2.2.3 Gert Sibande District Municipality – Mpumalanga Province (comprising Chief Albert Luthuli and Mkhondo Local Municipalities)

- ***Description of current situation:***
  - Soil and vegetation degradation is being exacerbated by incorrect land use practices in communal areas. The areas of greatest concern occur along the north-eastern border with Swaziland, namely Empuluzi, Elukwathini, Ekulindeni and Eerstehoek.
  - Settlements (Tjakastad, Elukwathini, Ekulindeni, Lochiel, Fernie, Empuluzi, Mooiplaas, Amsterdam / KwaThandeka and Driefontein) are located in close proximity to Swaziland.
  - The N17 is an important freight corridor for the transportation of timber, agricultural produce and coal, as well as goods from Richards Bay. Given the importance of the road as an international link between Gauteng and Swaziland, SANRAL is in the process of upgrading the entire route as a continuous toll road.
  - Huge challenges in terms of basic infrastructure and services provision - former homeland areas, informal settlements and areas bordering onto Swaziland in the eastern parts of the District. These areas are characterised by high population densities, high levels of unemployment and poverty, and

poor social and physical infrastructure. Severe levels of poverty experienced by many communities also act as a barrier to the sustainable provision of infrastructure (limited affordability).

- ***Proposals:***
  - Upgrade border posts – to facilitate trade and other economic opportunities.
  - Economic Development Corridor - The R33 Corridor which extends along the eastern border where it runs parallel to the border with Swaziland. It also gives access to a number of border posts with Swaziland, including Oshoek, Sicunusa, Gege and Mahamba.
    - Thorough maintenance and upgrading of all link roads to Swaziland Border Posts.
    - Branding of corridor to improve tourism. Links to prominent tourism destinations in the eastern parts of Swaziland, including, amongst others, the Piggs Peak Casino Complex, Ezulweni Nature Reserve, Mahamba Gorge, and the Lavumisa-Jozini Tourism Complex.

- ***SDF Proposals***: Primary Transnational Development Corridors and cross-border infrastructure connections - A link between Ermelo and Swaziland.
  - Proposed tourism route (i.e. The Mpumalanga Route), which should take visitors from Johannesburg through Mpumalanga, via Swaziland (or Mozambique), to the Coast at St Lucia or Durban.
  - Proposed Bio-Park - upgrading of the Songimvelo Game Reserve and linking it to the adjacent Malolotja Nature Reserve in Swaziland as part of the Lubombo Transfrontier Initiative - establishment of the Songimvelo-Malolotja Transfrontier Park with Swaziland.

- ***Development concept*** - Optimising interaction between South Africa and Swaziland via seven border posts.

- ***Promote forestry*** - within and along the identified Primary Tourism Corridor.

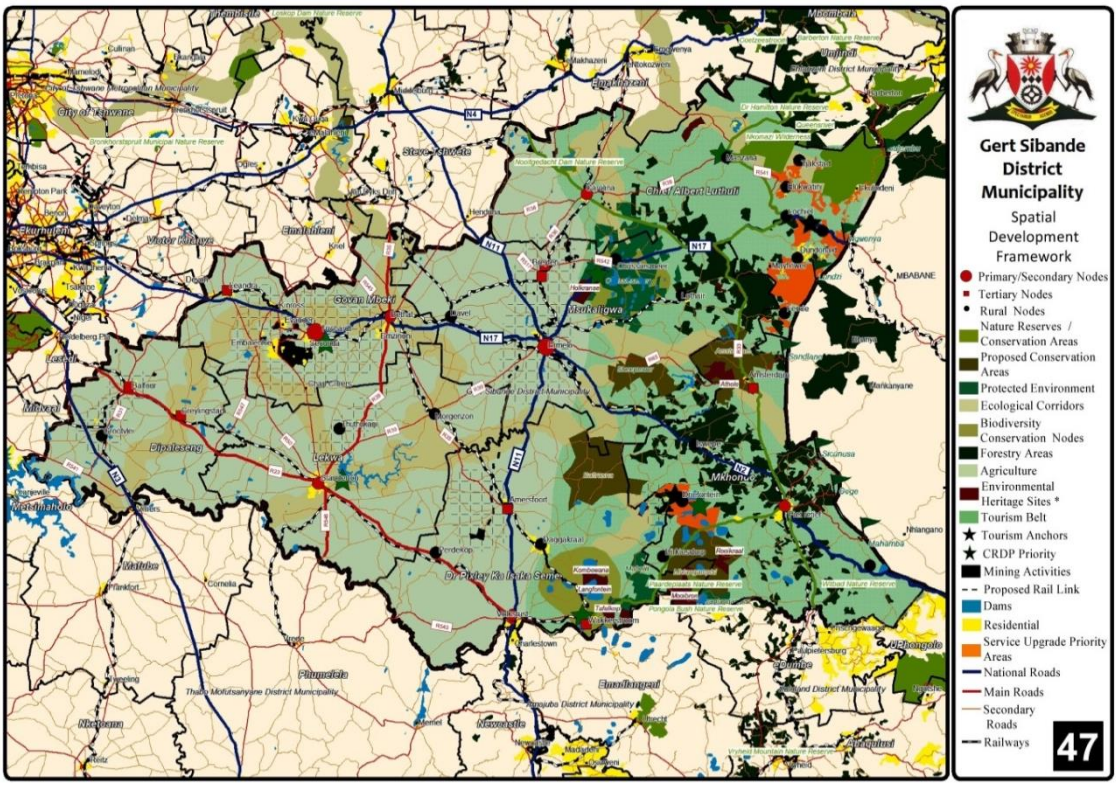


Figure 28: Gert Sibande District Spatial Development Framework extract

The proposed upgrade of border patrol roads and fencing are aligned with the Gert Sibande District Municipality's spatial development framework proposals by assisting with the promotion of economic and tourism potential along the Economic Development Corridor and protection of forestry, the Bio-park / Transfrontier Park and other conservation areas.

Certain rural settlement areas adjacent to the border are characterised by high population growth rates, and high levels of unemployment and poverty. These communities' survival strategies could have a negative impact on the environment and on the security of the border and border posts. The main road linking South Africa to the capital of Swaziland, Mbabane, cuts through this area, with resulting high levels of movement of goods and people.

4.2.2.4 Ehlanzeni District Municipality – Mpumalanga Province (comprising Mbombela and Nkomazi Local Municipalities)

- ***Description of current situation:***
  - Four border posts offer a number of opportunities, but also pose serious threats in terms of influx and migration.
  - Existing tourism attractions:
    - Gaza TFCA with Mozambique; and
    - Songimvelo-Malalotja TFCA with Swaziland.

- ***Proposals:***
  - Agro-processing potential: diversification in fruit processing as well as export growth in processed products via the Maputo harbour.
  - Tourism: need to develop innovative approaches to recapture this core market by developing Trans-country tourism initiatives through Mpumalanga Tourism Authority. Tourism Border Post Campaigns include the Lebombo Border Post.
  - Economic strategy - Formalization and Upgrading of the Mbuzini Border Post.

- ***Spatial and Economic Development Initiatives:***
  - The N4 toll road is the major east-west road through the area and forms the backbone of the Maputo Corridor. Momentum must be increased towards the realization of the set objectives of the Corridor, specifically the border post project which is still lagging behind. Investment targets the provision of infrastructure, agriculture, mining, energy, chemicals, tourism and manufacturing sectors.
  - The Tourism and Biodiversity Corridor - includes parts of south-eastern Mpumalanga, northern Swaziland and southern Mozambique and is closely associated with the Maputo Corridor Spatial Initiative. It promotes the utilisation of the undeveloped tourism development potential in rural areas that house the poor communities. It also coordinates and integrates with agricultural-led developments forming part of the Komati River Basin Development programme.
    - The listing of the potential World Heritage Site for the Barberton Mountainlands area by the SA National World Heritage Committee and now awaiting the development of a funding proposal – *formalised in July 2018*.
    - The Songimvelo-Malolotja TFCA, which would form the core of a future World Heritage Site.

- ***Possible corridors for investigation:***
  - Nkomazi Local Municipality: along the R571: Komatipoort to Swaziland.
  - City of Mbombela (Umjindi) Local Municipality: along the R88: Kaapmuiden-Barberton-Swaziland.

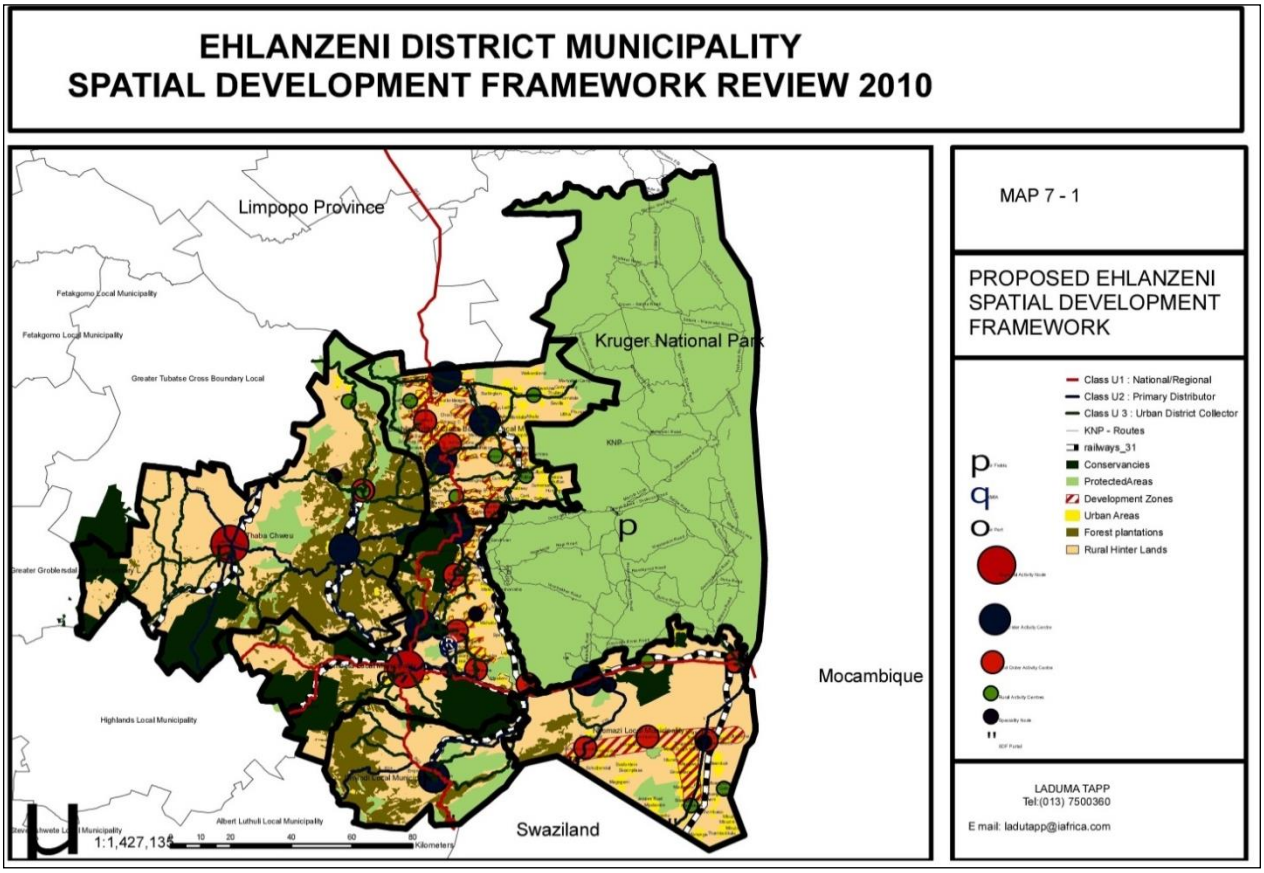


Figure 29: Ehlanzeni District Spatial Development Framework extract

The proposed upgrade of border patrol roads and fencing will assist in promoting the objectives of the Ehlanzeni District Municipality's spatial development framework proposals by promotion of economic and tourism potential along the various identified activity and development corridors, including the Lubombo Spatial Development initiatives and protection of the tourism and biodiversity corridor.

High volumes of migration and population movement across the borders, as well as increasing trade (including that of an agricultural nature) between South Africa, Swaziland and Mozambique as a result of the various spatial development initiatives, create the need for upgrading of border facilities to deal with the increased human and vehicular traffic.

Proposed conservation projects situated on the border, highlight the importance of secure fencing. Proposed economic development initiatives and increased movement of goods between countries, will require more secure fencing and patrolling to prevent illegal activities along the border.

4.3 Project Advantages and Disadvantages

The proposed development will occur within an area (from the international boundary or existing fence or from the 1:20 year flood line of a river) within which an existing infrastructural footprint exists. This existing developed footprint will be increased, resulting in the cumulative loss of natural habitat.

The strengthening of the border control infrastructure, could be considered to be contrary to the wider objectives of conservation commitments e.g. TFCA, which was established to restore the natural movement

of fauna between Protected Areas in South Africa, Swaziland and Mozambique and could thus be considered to be a negative development in the context of cross-border conservation planning.

A number of other priorities, including the prevention of livestock-borne disease, the prevention of illegal movement of people and prevention of illegal activities, including poaching are perceived as more important priorities currently than the facilitation of the free movement of fauna. Should the geo-political context change in the future, consideration should be given to enabling the movement of fauna, including mega fauna, through portions of the fence that are located adjacent to Protected Areas within the design of the infrastructure.

These negative environmental (biophysical and conservation planning) impacts are offset by the positive socio-economic impacts that will materialise of employment generation (albeit short-term) and improved safety and security in the local area, as well as through the minimised prospects for livestock-borne disease transmission that would adversely impact on subsistence cattle ranging which is key to the socio-cultural wellbeing of the area.

In addition, the positive impact on Protected Areas will provide environmental benefits to those Protected Areas by lessening illegal activities (i.e. poaching) that are currently impacting the fauna within them.

Lastly, environmental impacts will be minimised and mitigated by certain design measures as discussed in this report and offsets for loss of terrestrial and freshwater habitat as recommended in the biodiversity and freshwater studies.

In this context, the benefits of the proposed development will outweigh the negative aspects of it, and must be considered a key national infrastructural development requirement.

4.4 Socio-economic Value

Table 9: Socio-economic details

Description	Details
What is the expected capital value of the activity on completion?	R 5.2 billion
What is the expected yearly income that will be generated by or as a result of the activity?	N/A
Will the activity contribute to service infrastructure?	No. Security Infrastructure
Is the activity a public amenity?	It will contribute to fencing infrastructure of iSimangaliso, (this is not part of Phase 2 scope) Ndumo, Pongola Dam Nature Reserve and Songimvelo Nature Reserve It will contribute to security and disease control service infrastructure
How many new employment opportunities will be created in the development phase of the activity?	6606
What is the expected value of the employment opportunities during the development phase?	R1 billion (20%)
What percentage of this will accrue to previously disadvantaged individuals?	40%
How many permanent new employment opportunities will be created during the operational phase of the activity?	None, status quo remains

Description	Details
What is the expected current value of the employment opportunities during the first 10 years?	NA
What percentage of this will accrue to previously disadvantaged individuals?	NA

5 PROJECT ALTERNATIVES

In terms of the EIA Regulations 2014 (as amended in 2017) feasible alternatives are required to be considered as part of the environmental investigations. In addition, the obligation that alternatives are investigated is also a requirement of Section 24(4) of the NEMA (Act No. 107 of 1998) (as amended).

An alternative in relation to a proposed activity refers to the different means of meeting the general purpose and requirements of the activity which may include alternatives to:

- the property on which or location where it is proposed to undertake the activity;
- the type of activity to be undertaken;
- the design or layout of the activity;
- the technology to be used in the activity;
- the operational aspects of the activity; and
- the option of not implementing the activity.

The various stages in the analysis of alternatives for the project are presented in Figure 30 below. Following the preliminary route determination process (done at a desktop level supported by a site visit), a desktop Environmental Screening Investigation (ESI) was conducted.

Figure 30: Stages in analysis of alternatives[3]

5.1 Desktop Environmental Screening Investigation (ESI)

The key objective of the ESI was to identify key environmental sensitivities at a desktop level and propose preliminary route realignment and design recommendations that adequately cater for environmental constraints and sensitivities, which is in line with the concept and principles of the impact 'mitigation hierarchy' that requires an Applicant / Developer to first try and avoid impacts where practically and technically feasible, before considering other mitigation options such as onsite mitigation, rehabilitation of disturbed areas and biodiversity offsets as a last resort.

[3] *World Bank. 1996. Adapted from Analysis of Alternatives in Environmental Assessment.*

This culminated in the integration of relevant ecological, freshwater conservation and land cover data to provide a composite preliminary environmental sensitivity map for the study area (Figure 31).

Refer to ***Appendix B2*** (*Desktop Aquatic and Terrestrial Ecological Sensitivity Assessment).*

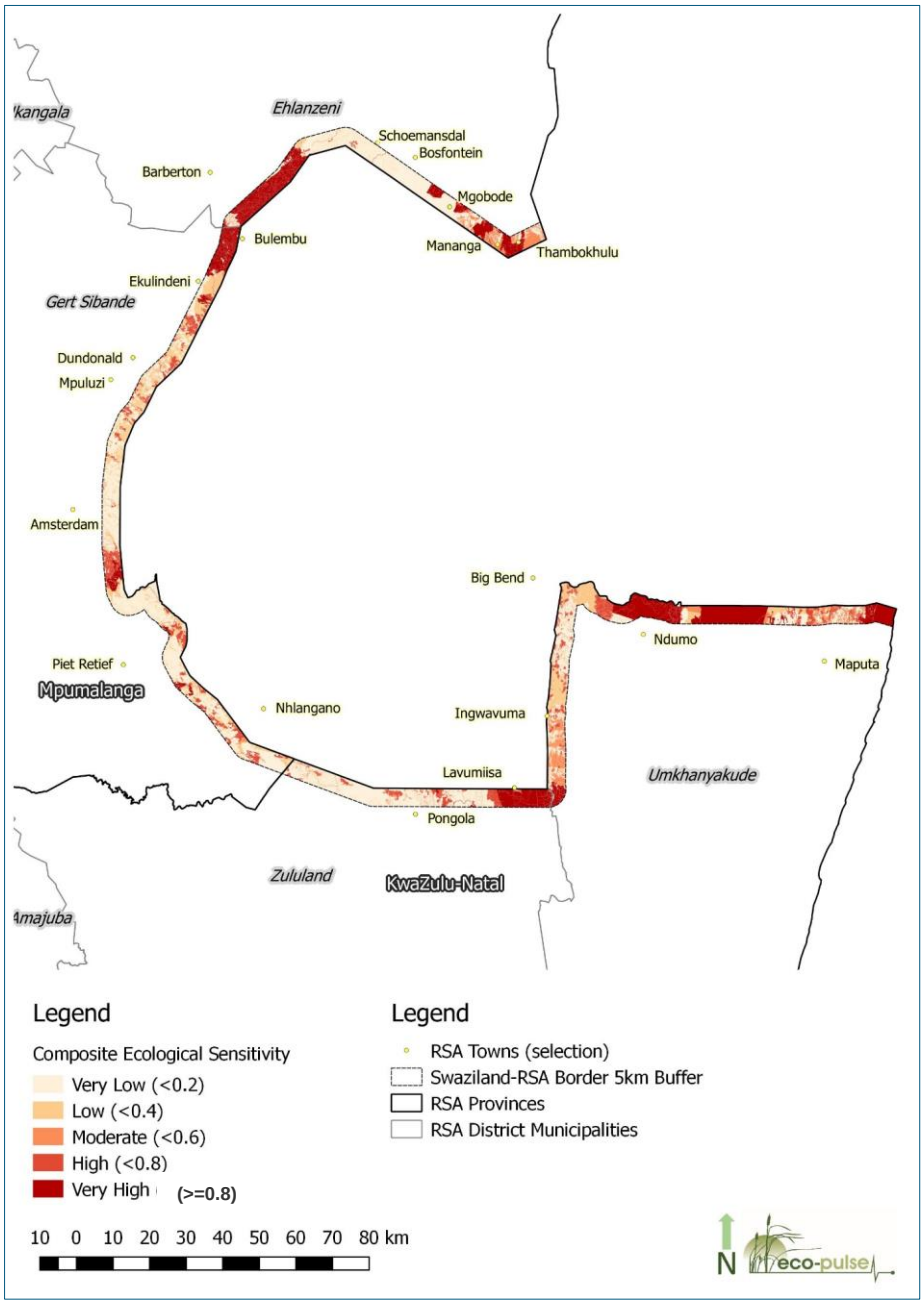


Figure 31: Composite preliminary ecological sensitivity map

In line with the first tiers of the mitigation hierarchy to avoid or minimise environmental impacts, the following key environmental considerations were recommended in order of priority:

- Avoid as far as practically possible all areas mapped as 'High' or 'Very High' sensitivity, unless an existing road network can be used through these areas.

- Areas mapped as 'Moderately' sensitive should ideally be avoided as far as possible unless an existing road network can be used. If these need to be traversed, careful road planning and mitigation measures needs to be implemented to minimise impacts to these areas. This will need to be informed by aquatic and / or terrestrial specialist assessments and mitigation measures recommended as a result thereof.
- Where large sensitive ('High' or 'Very High') areas are unavoidable due their location and extent in relation to the border, low impact methods for traversing these areas should be considered that still meet the requirements to patrol / monitor these areas. This may include:
  - Foot patrol roads.
  - Horseback patrols.
  - Motorcycle or quad bike patrol routes.
- In Protected Areas, collaborating with park management / support staff to patrol protected and access control areas should be further explored.
- Where impacts are unavoidable, it is important to note that offsets may be deemed relevant as a means of compensating for the significant loss of important and / or sensitive ecosystems, if and where incurred. Whilst the idea of offsetting development activities as a means of compensation for biodiversity loss is gaining traction, there are many inherent risks associated with this approach. As such, it is important to ensure that alternative options are first investigated before offsets are considered, which is in line with the concept and principles contained in the mitigation hierarchy.

5.2 Review of Proposed Alignment and Recommendations for Realignment to Avoid Sensitive Areas

The second step in the analysis recognises that due to the sheer number of watercourses and terrestrial habitats potentially impacted by the border infrastructure project, it is not practical for all areas to be assessed at a high level of detail as this will be both unnecessary based on the relatively low-risk of the project and will take a significant amount of time (and in the end also be very costly). Key areas along the proposed border infrastructure alignment were prioritized by the specialist team for field verification. This flagging process was informed by the initial sensitivity assessment (described in Section 5.1 above) and refined based on additional desktop mapping once the preliminary route alignment was provided.

5.2.1 Rivers and Streams

The following section details realignments and site-specific design recommendations for rivers and streams prioritised and assessed during field investigations. The general location of watercourses assessed during field investigations are shown in Figure 32. Points / crossings where no realignments are considered necessary are indicated as green points in Figure 32 whilst those points / crossing where realignments have been proposed are indicated as red points in Figure 32.

This section focuses on those points / crossings where realignments were proposed - Table 10. For a full description, refer to ***Appendix B2*** (*Preliminary Freshwater and Terrestrial Habitat Assessment Report to Inform Re-alignments and No-Go Alternatives).*

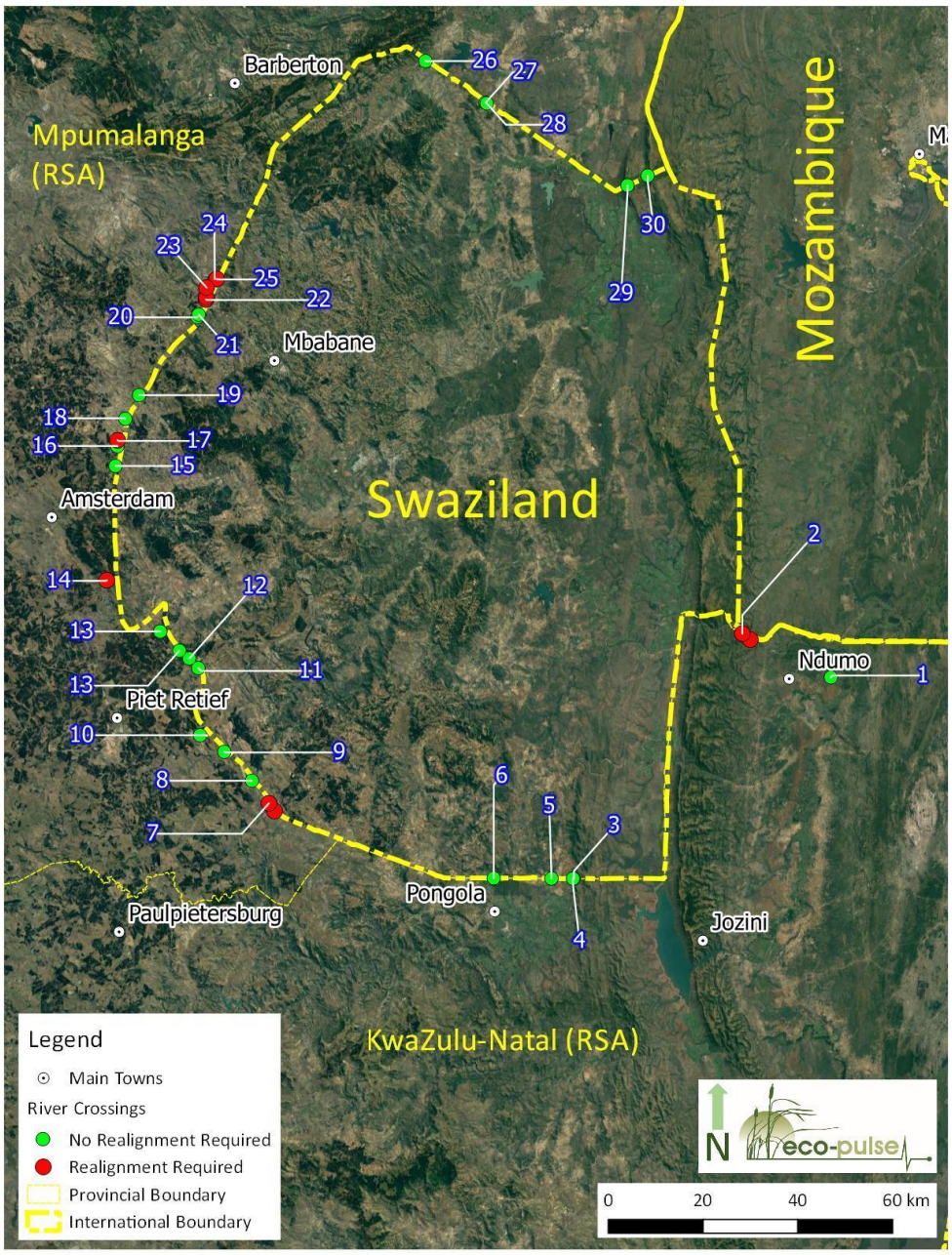


Figure 32: Map showing the distribution of watercourses prioritised and visited including watercourses where realignments were proposed

Table 10: Realignment recommendations (rivers and streams)

Chainage	Location Coordinates	Nature of Upgrade	Alignment Considerations	Design Consideration	Feedback from Design Team
River crossing 2 km 78.2 - 82.0	Start: Lat: -26.86030944 Long: 32.1593073 End: Lat: -26.84865104 Long: 32.14215601	New gravel road	Consider rather using an existing track to the south-west of the proposed alignment (Figure 33).	The proposed alignment runs outside the riparian zone along the Usuthu River. Whilst such an alignment is not particularly problematic from an aquatic perspective, the proposed alignment is not supported from a terrestrial perspective.	Refer to section 5.4.3.
River crossing 7 km 240.8 – 244.2	Lat: -27.18788974 Long: 31.13839859 Lat: -27.17305619 Long: 31.12639403	New gravel road	This is a section where the river runs parallel and too close to a river (Mozane River) with highly erodible banks. Realign this section to avoid steep eroding river banks, whilst also addressing wetland-related concerns as illustrated in Figure 34.	▪ Road to stay away from the river as far as practical but to also integrate realignments proposed in order to limit wetland impacts. ▪ Realignment should be further informed by flood line determination along this reach of the river. ▪ Recommend use of a series of portal or box culverts to cross the small river linked with the realigned road section. ▪ The culverts should span the entire active channel and match the bank height.	Proposed realignment was accepted by the Engineering team. Note was also made that the farming community also actively patrol this area and had indicated a willingness to contribute towards improved fence design to address their security concerns.
River crossing 14 km 319.2	Lat: -26.74649774 Long: 30.77865912	Existing track to 2m track	Realign the planned road infrastructure such that it completely avoids the delineated riparian zone (Figure 35). Two realignment options are provided.	No specific design recommendations.	Proposed realignment recommendations were acceptable to the Engineering team.
River crossing 17 km 348.8	Lat: -26.47810042 Long: 30.80150112	Partial track to 5m ravel road	A minor realignment is recommended to avoid steep and eroding bank on the approach to the river crossing (Figure 36).	A box or pipe culvert is recommended at the river crossing. The culvert must span the entire width of the active channel and also match the bank height.	Realignment has been accepted by the Engineering team.

Chainage	Location Coordinates	Nature of Upgrade	Alignment Considerations	Design Consideration	Feedback from Design Team
			The recommendation entails moving the road infrastructure by 20 – 30m to the west.		
River crossing 22 km 384.8	Lat: -26.20707436 Long: 30.9914465	Partial track to gravel road	A minor realignment that makes use of a historic river crossing is recommended. The realignment is highly favoured over establishment of a new crossing point (Figure 37).	▪ A few large box culverts are recommended for use at the river crossing. ▪ The culvert must span the entire active channel and match the bank height.	Engineering team agreed that the historic river crossing point would be used.
River crossing 23 km 385.3 - 387.2	Start: Lat: -26.20301615 Long: 30.99210312 Stop: Lat: -26.18426794 Long: 30.99252111	New gravel road, Existing track to gravel road, and Partial track to gravel road	Realign the new access road such that it makes use of the existing road which links with the main road (Figure 38). This motivation for this realignment is primarily to avoid impacts to intact terrestrial habitat but will also reduce the number of new river crossings required.	▪ Given that the river is typically narrow and characterised by steep banks and steep valley side, box culverts are generally recommended. ▪ The culvert should span the entire active channel and match the bank height. ▪ The smaller river crossing (km 386) will also require a single or two large box culverts.	The Engineering team recognised that terrain makes road construction difficult in this area. The realignment was accepted by the Engineering team.
River crossing 25 km 389.7	Lat: -26.16753946 Long: 31.01424046	New gravel road	To avoid disturbing a sensitive undercut river bank realign the road infrastructure by approximately 75m to the west (downstream) of the planned crossing point (Figure 39).	▪ A single or a few large box culverts are recommended for use at the river crossing. ▪ The culvert must span the entire active channel and match the bank height.	Proposed realignment was accepted by the Engineering team.

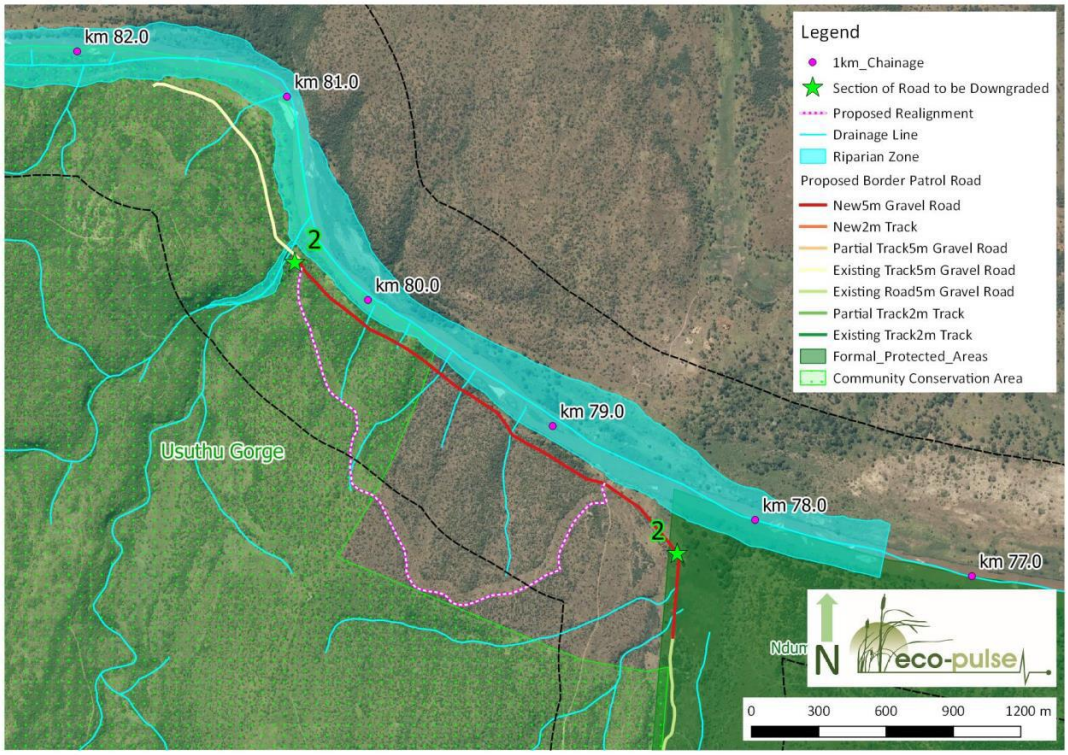


Figure 33: Map showing the proposed gravel road along the right bank of the Usuthu River (river crossing 2)

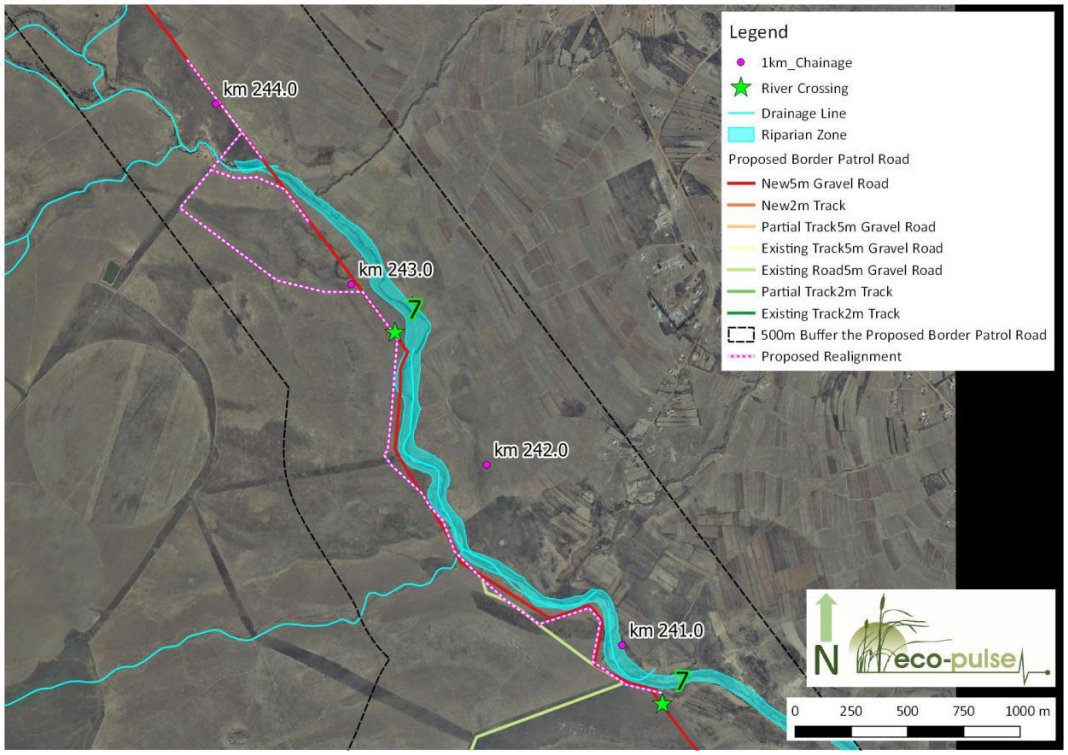


Figure 34: Map showing the proposed realignment between km240.8 and km244.2 (river crossing 7)

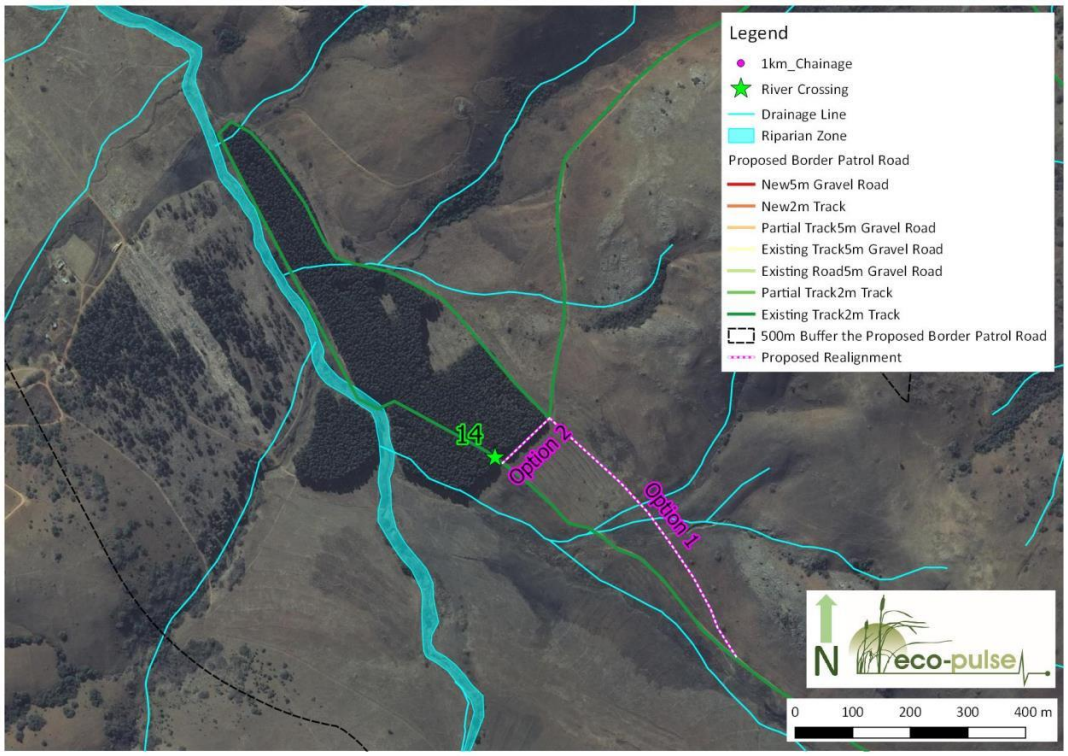


Figure 35: Map showing the proposed realignment at river crossing 14

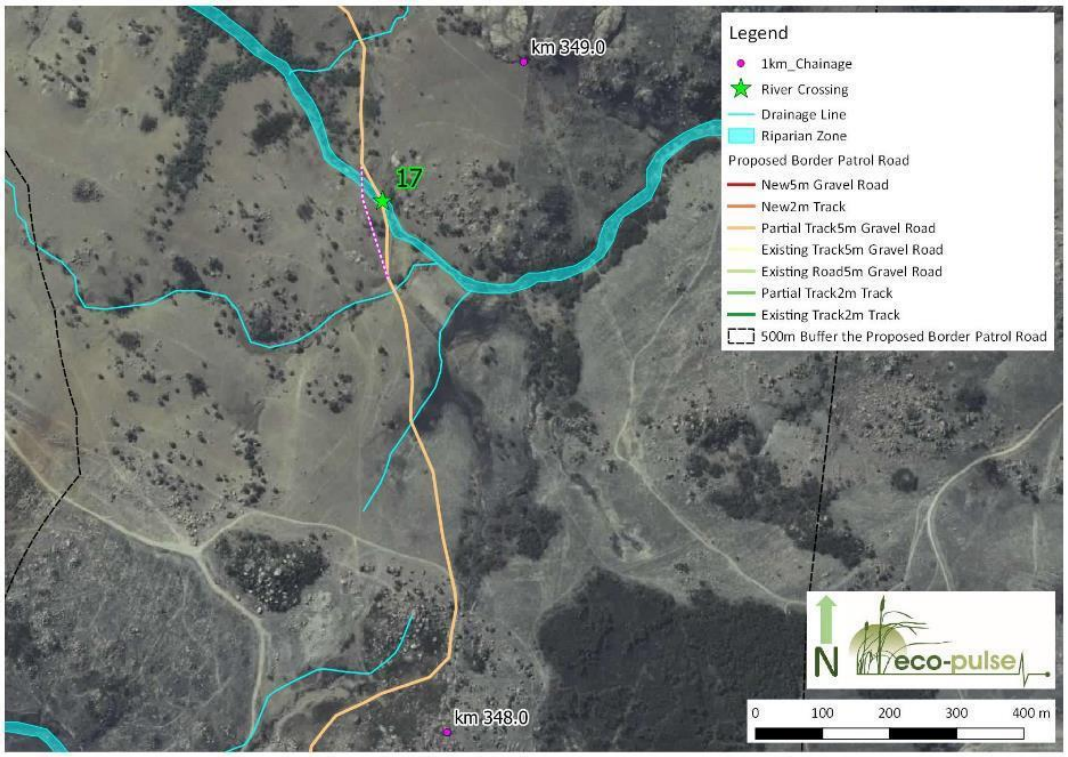


Figure 36: Map showing the proposed alignment of the gravel road at river crossing 17

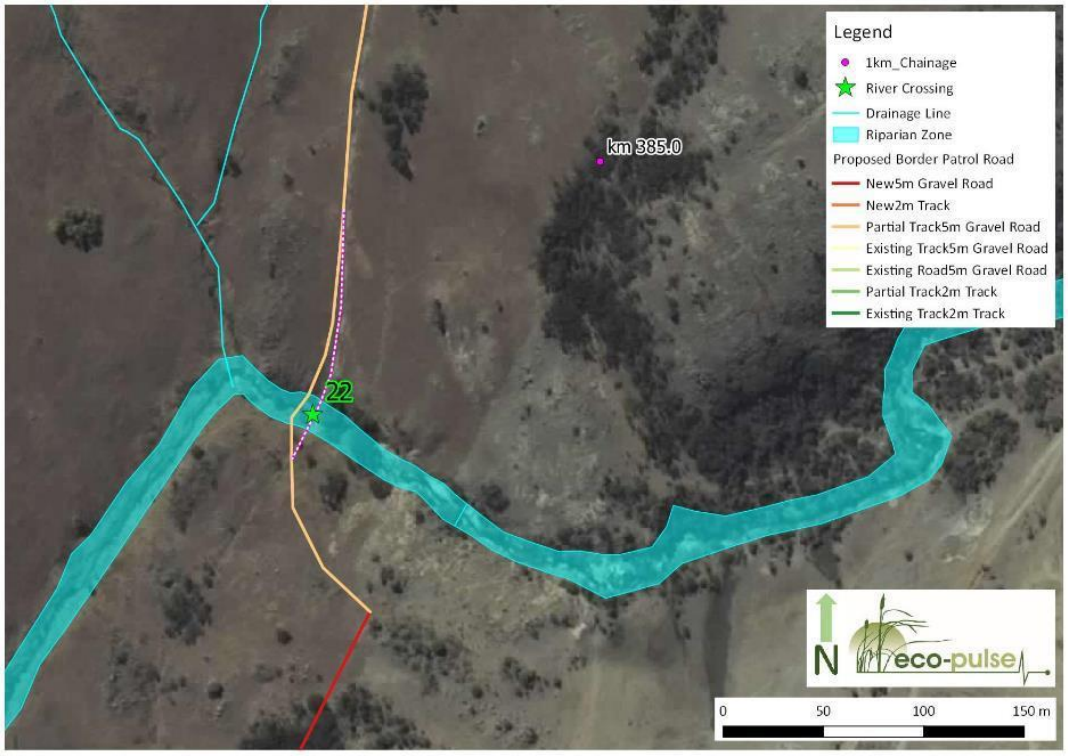


Figure 37: Map showing the proposed realignment of the road at river crossing 22

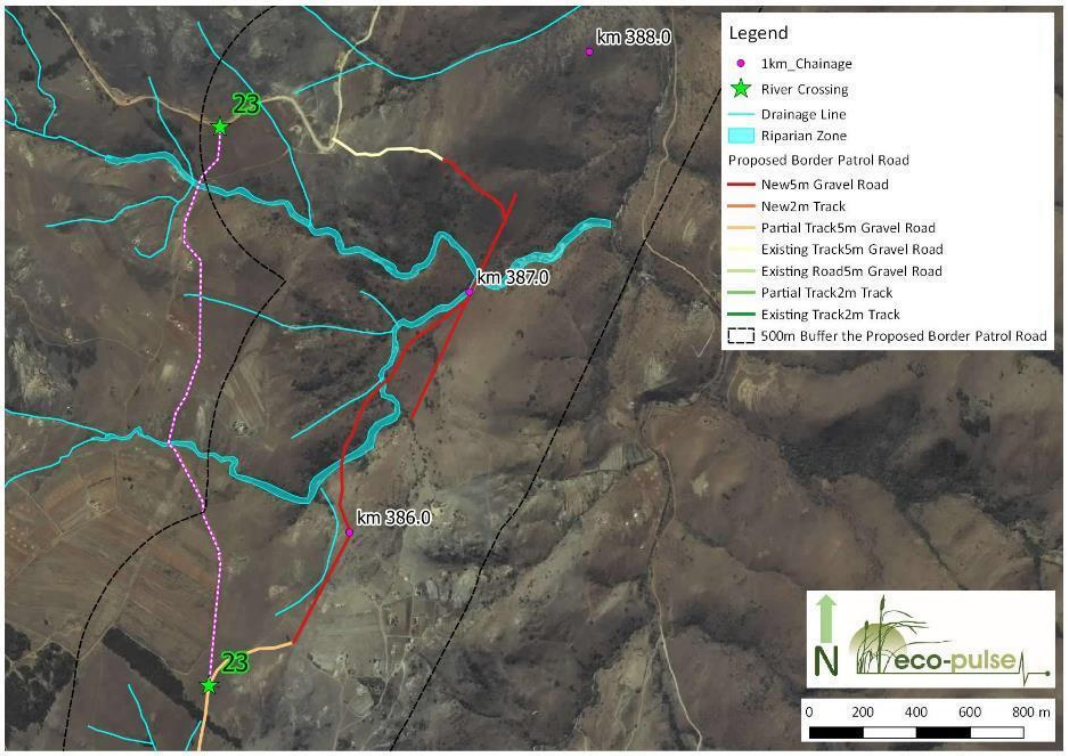


Figure 38: Map showing the proposed road realignment between km385 - 387.2 (river crossing 23)

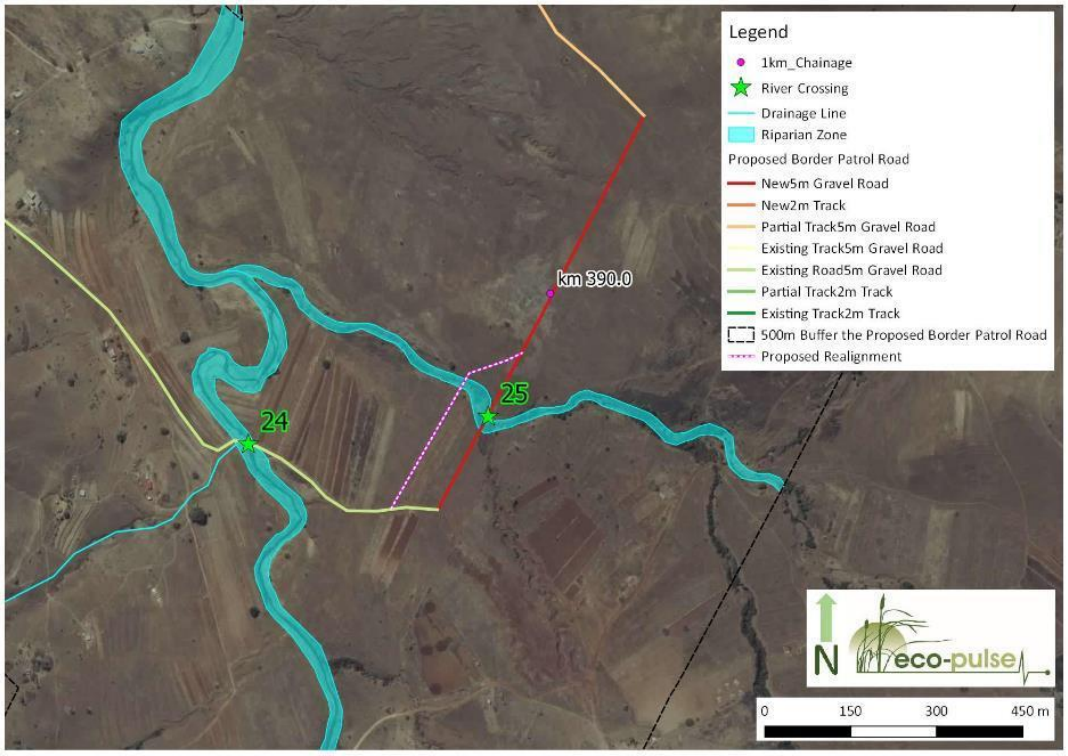


Figure 39: Map showing the proposed road realignment at river crossing 25

5.2.2 Wetlands

The following section proposes realignments and site-specific design recommendations for wetlands associated with the proposed alignment - Figure 40 and Table 11.

A high density of wetlands is located in a part of the border alignment located to the south-east of Piet Retief (Mkhondo) in the Sulphur Springs-Berbice area. These wetlands are located within the flat topography of the wider valley bottom of the Mozana River, and the terrain setting is conducive to the development of extensive unchannelled valley bottom and seep wetlands on the valley footslopes.

Lake kuZilonde, swamp forests (km 10.7 – 11.2 and km 12.45 – 12.9) and Sandy Maputaland Coastal Plain Wetlands (km 3 – 30) are dealt with in the Phase 1 application.

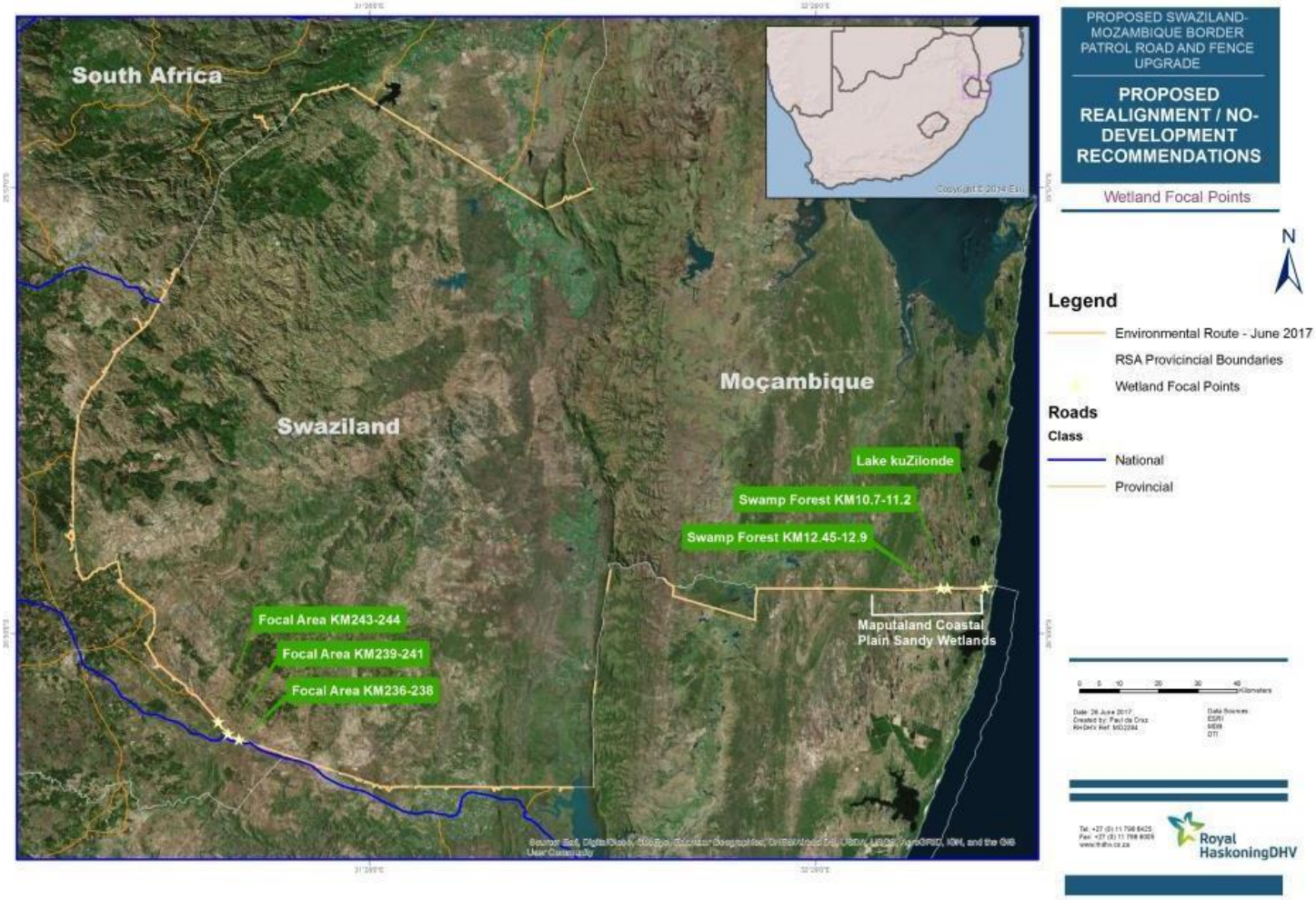


Figure 40: Map showing the location of wetlands for which specific recommendations have been provided

Table 11: Realignment recommendations (wetlands)

Chainage	Location Coordinates	Nature of Upgrade	Alignment Considerations	Design Consideration	Feedback from Design Team
Wetland focus location km236 – 238	Start: 27°12'37.90"S, 31°10'34.14"E End: 27°12'15.40"S, 31° 9'25.96"E	New 5m gravel road	Potential alignment was proposed in order to avoid the impact on sensitive wetlands through the use of existing farm tracks located away from the international border. Following further investigations, the proposed realignment was not considered necessary, provided design recommendation detailed below are adhered to (Figure 41).	▪ The proposed gravel road must be aligned as close to the international boundary fence line as possible, as a raised bund within the wetland along the fence line is adversely affecting the hydrology of the wetland. If the road is to be set back from the fence to allow for a detection zone, the berm must be removed from the detection zone area and the ground restored to a natural level. ▪ Design measures to include the retention of diffuse flow at both the surface and at sub-soil level (e.g. small pipe culverts and freely draining aggregate in the foundation of the road) placed across the width of the wetland must be included in the design of the wetland crossing.	Design recommendations will be considered and accommodated as far as possible during detailed planning.
Wetland focus location km239 – 241.5	Start: 27°11'59.80"S 31° 8'55.49"E Stop: 27°10'54.96"S 31° 8'0.77"E	New gravel road	A potential alignment was proposed, in order to avoid the impact on sensitive wetlands through the use of existing farm tracks and a part of the N2 highway located away from the international border (Figure 42). Following further investigation, realignment recommendations were withdrawn subject to implementation of specific design considerations.	▪ Along most of the width of the wetland, a raised track / berm and associated parallel-running shallow drain was historically constructed within the wetland. The berm and drain have adversely affected the hydrology of the wetland, capturing diffuse surface flow and concentrating surface flow into parts of the wetland. ▪ The proposed 5m gravel road must be aligned as close to the international boundary fence line as possible, in order to 'replace' the berm and associated drain. If the road is to be set back from the fence to allow for a detection zone, the berm and drain must be removed and infilled from the detection zone area and the ground restored to a natural level.	Design recommendations will be considered and accommodated as far as possible during detailed planning.

Chainage	Location Coordinates	Nature of Upgrade	Alignment Considerations	Design Consideration	Feedback from Design Team
				▪ Where the drain is located outside of the road footprint excess wetland substrate must be used to fill the drain to natural ground level. ▪ Design measures to include the retention of diffuse surface flow must be included in the design of the wetland crossing. It is recommended that small pipe culverts be placed at a minimum of 5m width across the length of the wetland crossing to maintain diffuse flow into the downstream wetland. ▪ Fencing Design: Fencing design must take into consideration the presence of shrinking / swelling (vertic) soils within this wetland.	
Wetland focus location km241.7 – 243	27°10'57.14"S 31° 7'46.46"E to 27°10'16.06"S 31° 7'27.95"E	New 5m gravel road	Three sensitive valley bottom wetlands are located in this part of the route, with large areas of intact wetland habitat. However, these wetlands all become narrow and channelised as they cross drain into the Mozane River valley bottom. The proposed border patrol road must be located as close as possible to the Mozane River (but not within the flood line of the river, or too close that the road becomes vulnerable to lateral erosion of the river banks) so as to cross these wetlands at their narrowest point and to avoid impact on wider areas of wetland habitat located to the west of the border (Figure 43).	▪ It is recommended that a river-type crossing design be used to cross the three wetland outflow points, as intermittent spate flows within the channels are likely to be experienced. It is recommended that a few large box culverts that must span the entire active channel and match the bank height be utilised. ▪ At the outflow of the wetland at km241.8 a headcut (27°10'51.49"S, 31° 7'42.64"E) within the outflow channel that is being driven by cattle trampling is present at the crossing point. The presence of this headcut must be taken into consideration in the crossing design and should be rehabilitated (use of a gabion rehabilitation structure is proposed) as part of the crossing design. Gabions must also be used where necessary to secure eroded banks at the crossing points.	Design recommendations will be considered and accommodated as far as possible during detailed planning.

Chainage	Location Coordinates	Nature of Upgrade	Alignment Considerations	Design Consideration	Feedback from Design Team
				▪ A similar headcut and associated donga exists in the northern-most wetland at 27°10'40.48"S 31° 7'35.01"E. This should ideally be rehabilitated as part of the crossing design as above.	
Wetland focus location km243 – 244	Start: 27°10'16.06"S 31° 7'27.95"E Stop: 27° 9'50.12"S 31° 7'6.08"E	New 5m gravel road	The original alignment of the road along the border (at km243) crosses an oxbow lake wetland feature and other parts of the floodplain of the Mozana River which have been identified to be sensitive wetland features. Following the alignment along the international border would directly affect this area of floodplain wetland and would have a significant adverse impact on the oxbow lake wetland feature. As the oxbow lake feature cannot be avoided by routing to the east due to the location of the border line, a realignment is proposed to avoid the floodplain area and an associated highly sensitive seep wetland located to the north west (Figure 44). An alternative crossing of the Mozana River is proposed approximately 150m upstream of the point at which the border line crosses the river at an area of granite (bedrock) outcropping.	This alignment has been harmonized with recommendations to minimize impacts to the downstream river (river crossing 7).	Design recommendations will be considered and accommodated as far as possible during detailed planning. The Design team recommended that the crossing point of the Mozana River be located at an area of bedrock outcropping to allow a drift-type crossing structure to be used.

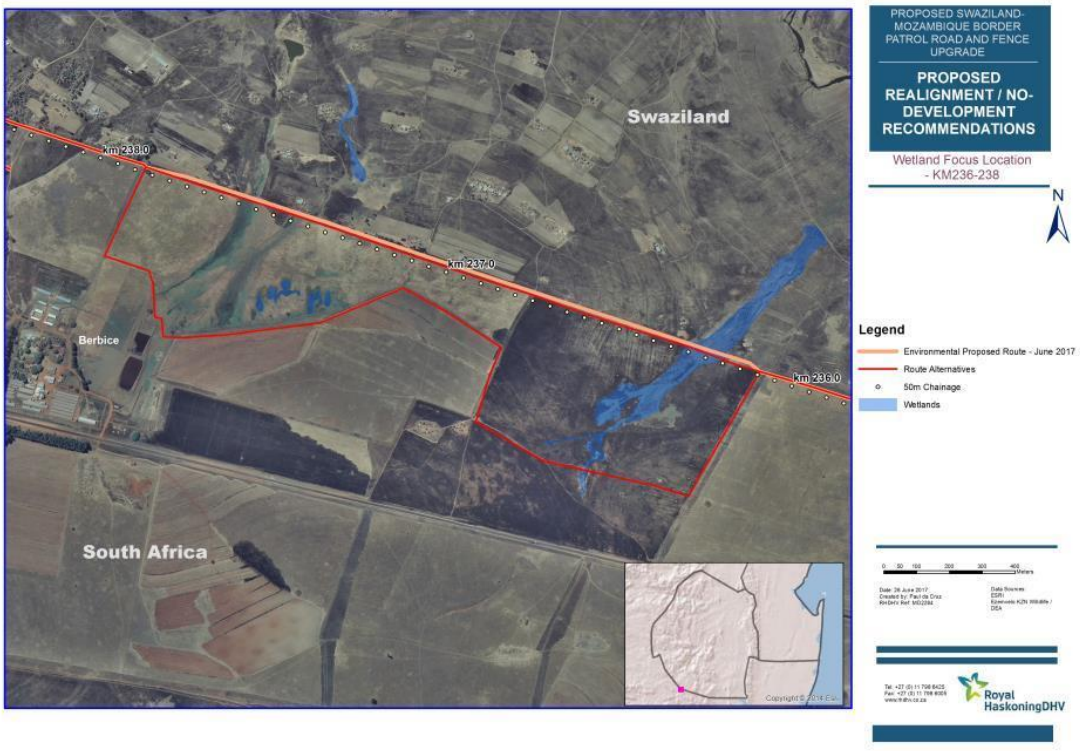


Figure 41: Map showing the proposed location and alignment of the road associated with wetland focus location (km236 – 238)

Figure 42: Map showing the proposed location and alignment of the road associated with wetland focus location (km239 – 241.5)

Figure 43: Map showing the proposed location and alignment of the road associated with wetland focus area (km241.7 – 243)

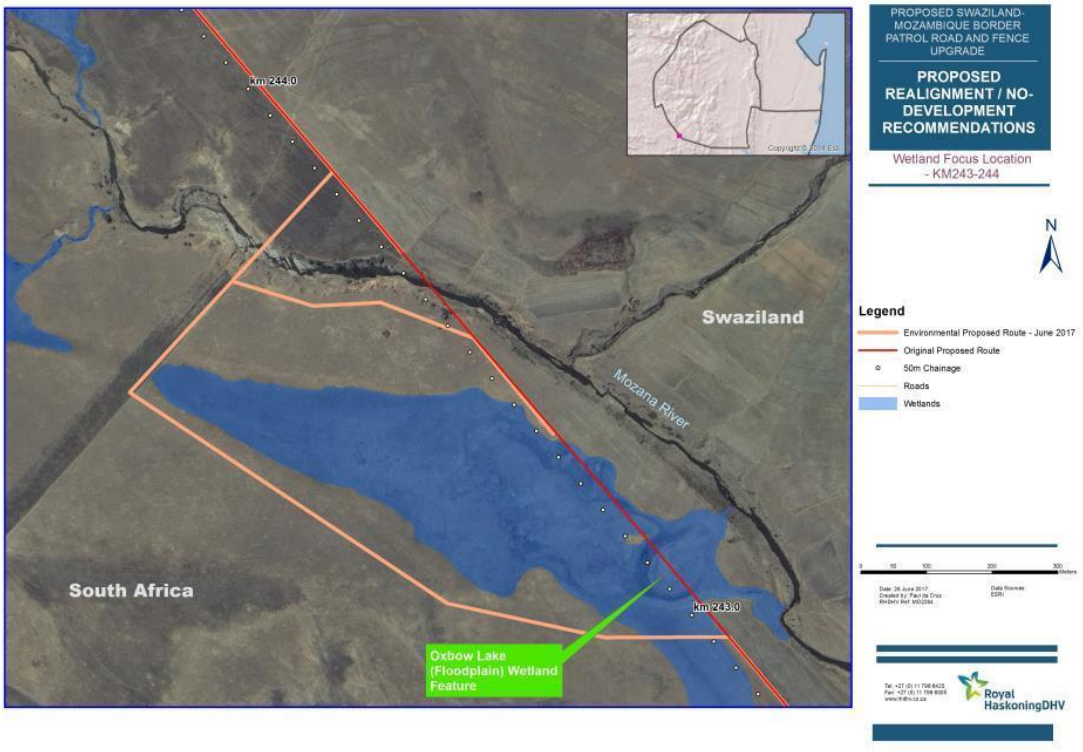


Figure 44: Map showing the proposed location and alignment of the road associated with wetland focus location (km243 – 244)

5.2.3 Terrestrial Habitats

The following section focusses on changes and realignments proposed in order to avoid impacts on sensitive terrestrial areas. In each instance, a description of proposed changes is provided together with a supporting rationale. The location and description of these focal areas is indicated in Figure 45, Figure 48 and Table 12.

Table 12: Realignment recommendations (terrestrial habitats)

	Focal Area 1	Focal Area 2
Chainage	km78.30 - 80.40	km385.3 - 387.2
Location Coordinates	Start: Lat: -26.86030944 Long: 32.1593073 End: Lat: -26.84865104 Long: 32.14215601	Start: Lat: -26.20301615 Long: 30.99210312 Stop: Lat: -26.18426794 Long: 30.99252111
Nature of Upgrade	Proposed new gravel road	New gravel road, Existing track to gravel road, and Partial track to gravel road
Design Consideration	The proposed alignment is not supported from a terrestrial perspective for the following reasons: ▪ The road could increase access into a communal conservation area (Usuthu Gorge CCA); ▪ The proposed development will result in considerable habitat destruction in a largely intact area. ▪ The proposed access road does not appear to critically important for access other than extending the distance along the banks of the Usuthu River that can be patrolled by vehicle. ▪ If a road is required, consider rather using the existing track that runs along what appears to be a firebreak south-east of the proposed alignment (Figure 45). This alignment would result in less disturbance but is rocky, making access difficult. Alternatively, maintain a footpath along the Usuthu River.	▪ Re-align the new gravel road such that it makes use of the existing road which links with the main road (Figure 46). This re-alignment is recommended for the following reasons: - It makes use of the existing road and therefore significantly decreases intact terrestrial habitat loss. - It makes use of existing river and stream crossing points thereby reducing degradation of affected watercourses. - It will reduce impacts to rivers and streams (see Section 5.2.1). ▪ The proposed realignment is shorter and therefore likely to be more cost effective to construct and maintain.
Feedback from design team	Refer to section 5.4.3.	The Engineering team recognised that terrain makes road construction difficult in this area. The realignment was accepted by the Engineering team.

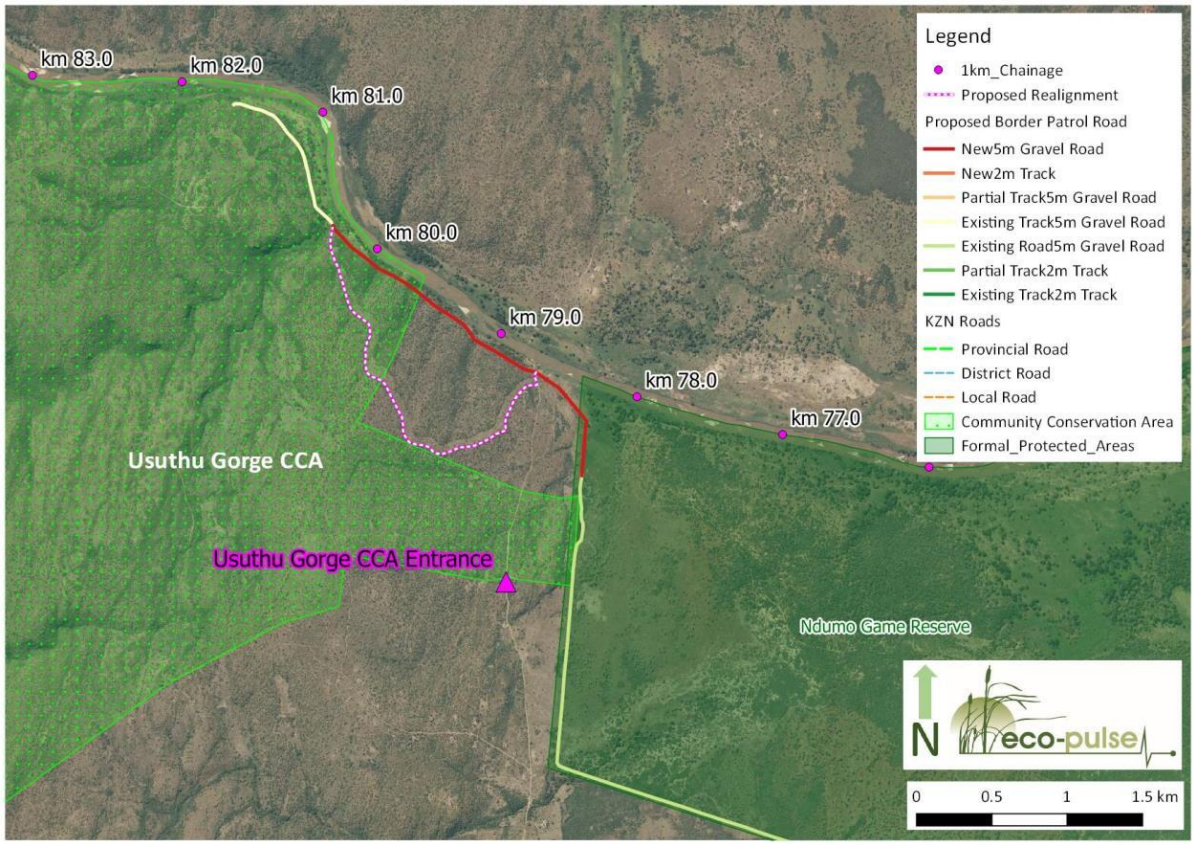


Figure 45: Focal area 1, map showing the proposed gravel road section between km78.30 - 81.70 that must be downgraded to a track[4]

[4] *Prior to receiving the Usuthu Gorge CCA updated shapefile from EKZNW.*

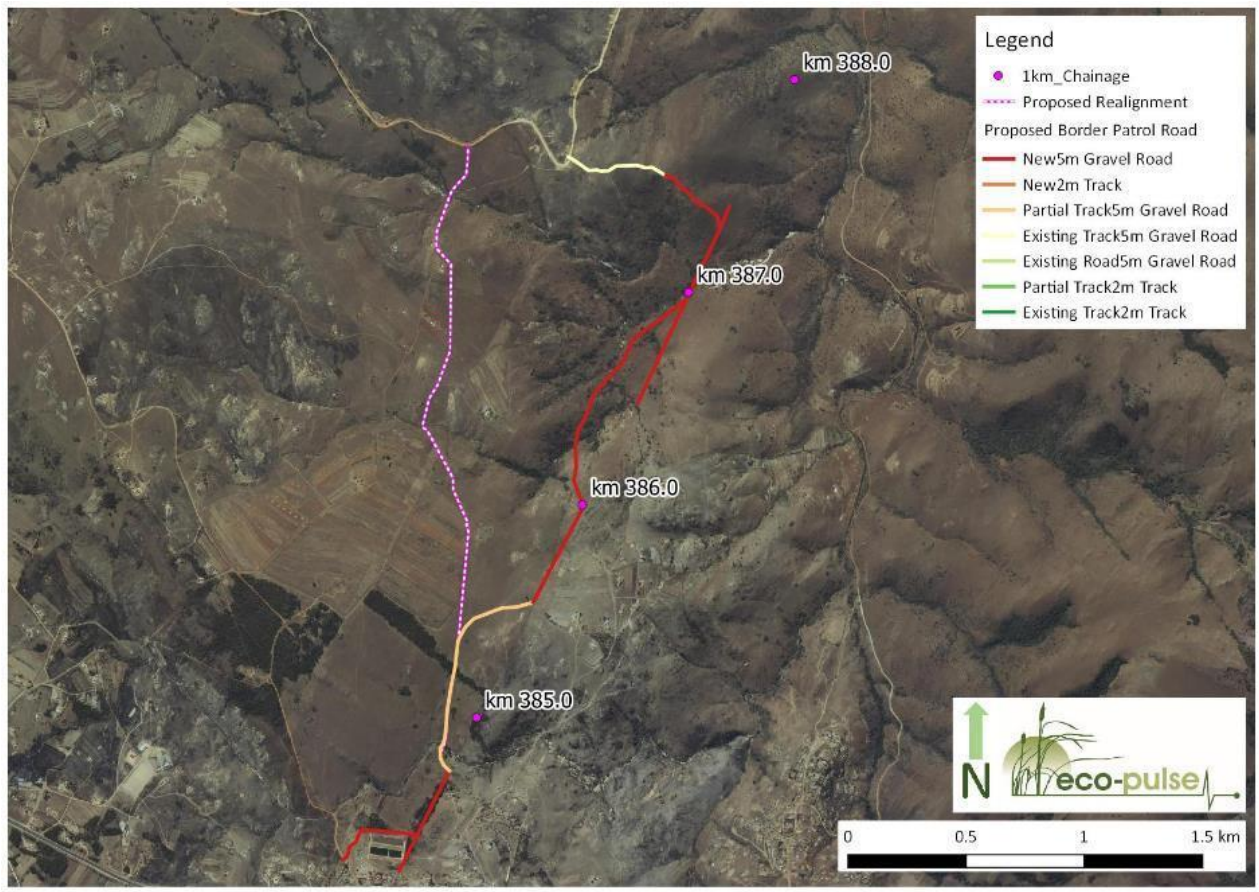


Figure 46: Focal area 2, map showing the proposed realignment between km385.3 - 387.2

5.3 Route Optimisation

The route optimisation included the following steps:

i) Identification of road alternatives based on road alignment criteria and other factors;
ii) Life cycle cost analysis of the various alternatives based on construction cost, maintenance costs, operational cost and comparison of the net present value (NPV) of the alternatives;
iii) High level risk analysis of each alternative;
iv) Screening in terms of safety and security;
v) Screening in terms of topography and geometrics and physical constraints;
vi) Travel time implications;
vii) Screening in terms environmental constraints as identified in the desktop ESI and recommendations for realignments and avoidance of sensitive areas; and
viii) Recommended route optimized alternative based on the above.

5.3.1 Road Alignment Criteria

A set of criteria (Table 13) was created to inform the preliminary fence and route alignment identification. This includes the following:

- ***Primary objective criteria:***
  - To have the fence established on the position of the existing fence or on the international boundary and the border patrol road aligned along the fence; and

- To have easy access to the border patrol road from public road infrastructure and where required, private access roads with secure rights in favour of the state, but restricted for use by the general public.

Table 13: Road alignment criteria

Road Alignment Criteria	
Border Patrol Road Criteria	
Design vehicles	Suitable up to 10 ton weight and Land Cruiser type and alternative modes such as motorcycle, horse and foot patrol
Challenging features such as wetlands, drainage features or steep gradients are encountered (but the balance of the general terrain before and after such sections remain suitable)	Engineering solutions such as culvert / elevated crossings or minor realignments and/or combinations of road types are proposed. This may, for example include short realignment of vehicle road around obstacle, in combination with foot patrol path along the border
General terrain, along longer sections of the border, include gradients in excess of 1:5 (or 20%)	Alternative patrol modes are proposed
Significant barriers such as significant steep terrain, cliffs or river valleys	In such areas access road criteria is used to ensure adequate continuity in patrol infrastructure
Gravel track	5m wide with 0.5m shoulders = total of 5.5m wide
Gradient / slope	▪ Gravel road (5.5m, for design vehicle) 0 – 12% ▪ Concrete road (3m wide concrete surface with 1m wide gravel shoulder on each side, total of 5m wide, for design vehicle) 12 – 16.67% (1:6) ▪ Could use up to 20% (1:5) if very short length (about 40m) with a short flat area (safety and rolling is a concern if slope too steep) ▪ Gravel track (1.5 – 2.0m) wide, quad) with gradient of 20 – 25% ▪ Slope for pedestrian walkways depends on terrain and to be finalised in detail design (or on site).
Design speed	50km/hr
Border servitude	Typically 30.48m (100ft) from international boundary
Detection zone (cleared of all vegetation)	10m wide adjacent to the international fence where possible
Contour/ Detour Roads	
Contour/ Detour roads	▪ 5.5m min width, 8m max) with typical 13.49m road reserve ▪ Detour / contour roads are used where the border patrol route along the international border is not accessible by the design vehicle and a detour around the obstacle (e.g. river or mountain) could be used as a short alternative to give fast access to the border ▪ The design criteria is similar to border patrol roads
Access Roads	
Access roads	▪ Suitable accessibility to fulfil the needs of the end user departments in terms of patrol duties, response needs to incidents and long term maintenance requirements ▪ Cost effective solutions, both from a capital expenditure and long term maintenance point of view ▪ Suitable deployment distances and accessibility in areas where foot patrols will be introduced. This includes access to positions on both sides of features that will not be connected by continuous patrol roads ▪ A typical spacing of about 30km between access roads is recommended based on:

Road Alignment Criteria	
	- Distance that can be travelled by foot is about 30km - Limit amount of accesses to the border as the access routes could be used as access for illegal activities and increase the risk for an ambush to the SANDF and DAFF staff ▪ Existing access roads on which to have a servitude registered. Road servitude to tie in with existing road reserve width ▪ For exclusive use for border patrol – see contour road details (5m min width, 8m max) with typical 13.49m road reserve ▪ Existing public roads which will also be used for public vehicles– 8m max width, 20m road reserve or as per existing road reserve

5.3.2 Life Cycle Cost Analysis

A life cycle cost analysis of the various alternatives was based on construction cost, maintenance costs, operational cost and comparison of the net present value (NPV) of the alternatives.

5.3.3 High Level Risk Assessment

A high level risk analysis screening was done for each alternative based on discussions with the various stakeholders, including SANDF, DAFF, DPW and the Environmental team. The typical risks included:

- Spreading of foot and mouth disease (DAFF);
- Illegal pedestrian border crossings (SANDF);
- Illegal vehicle border crossings (SANDF); and
- Other (e.g. environmental risk and sensitivities)

5.3.4 Travel Time

The impact of travel time on the various alternatives was also investigated. In order to calculate the travel time, the following assumptions were made with regards to travel speed on the various alternatives:

- Paved public road signposted as 120km/hr – average speed is assumed to be 100km/hr;
- Gravel public road signposted as 80km/hr – average speed is assumed to be 70km/hr; and
- All border patrol roads – average speed is assumed to be 50km/hr.

5.3.5 Environmental Constraints

Refer to Sections 5.1 and 5.2 above.

5.3.6 Stakeholder Requirements

- ***SANDF***
  The SANDF requested that the design vehicle be a 10 ton truck to meet their requirements. However, the actual patrol vehicles used are typically a 4x4 vehicle. Their response time is critical, but did not disclose this information. It is assumed that the SANDF will set up temporary base camps in high risk areas.

- ***DAFF***
  DAFF (Vet Labour) staff use bicycles and foot to patrol the fence and do minor repairs to the fence on a daily basis. The DAFF Veterinary Technician Supervisor to the DAFF Vet Labour also does spot checks on fence condition, delivers material and administratively manage the Vet Labour unit. The DAFF Veterinary Technician Supervisors use 4x4 vehicles (bakkies) for their duties and requires access routes to the fence to carry out their duties. The current proposed access routes are sufficient and no new access routes is required by DAFF.

DAFF has various temporary vet camps set up along the border (typically at about 10-20km spacing consisting of little prefabricated houses within the 30.48m servitude). Their response time is not as critical (response time by vet teams depends on disease outbreaks / status on the border) as for SANDF.

5.3.7 Traffic Volumes

The peak hour traffic volumes along a section of the border are less than 5 vehicles per hour. This small volume of traffic does not warrant a traffic impact study at any of the intersections. However, once the preliminary design phase commence, the geometric and safety aspects of linking the proposed border patrol roads to existing access routes should be investigated in detail. In addition, the design team will have to coordinate to align with the various masterplans for the border posts.

5.4 Route Alignment Border Control Infrastructure Alternatives Proposed by Partners

5.4.1 Ndumo Game Reserve

- ***Eastern and southern boundary of the Ndumo Game Reserve up to the Phongolo River***
  The initial proposal of an elephant fence has been changed to a veterinary fence on the eastern and southern boundary of the Ndumo Game Reserve. The DAFF approve of this change in the fencing specification.
- ***Southern boundary of the Ndumo Game Reserve***
  No new infrastructure will be developed, except for the upgrading of the existing boundary fence. An agreement will be formalised between EKZNW, DAFF and SANDF for the internal perimeter roads to be used to patrol the reserve boundary. A footpath will still be required on the outer side of the fence as the DAFF will need to inspect the fences whilst the SANDF would patrol using the internal roads within the reserve.

5.4.2 Fencing and Patrol Infrastructure from Ndumo to Abercorn Drift, along the Usuthu River

Concerns were raised by EKZNW around the proposed establishment of a fence along the Usuthu River, from the western boundary of Ndumo to Abercorn Drift. This is based on the fact that the proposed fence will cut off access to the river as a drinking source for animals in the reserve. The fencing out of perennial water from this community reserve will significantly impact on the wildlife densities and hence the tourism / biodiversity economy potential of the community conservation area (CCA).

There is also concern around the potential impact of a patrol road along this section of the river on the riparian zone.
The following were agreed to / resolved:

- As an alternative to fencing this section of the Usuthu River, barriers (similar to those proposed along other sections of the Mozambique / KZN border) will be used to block any potential access to vehicles (in areas where the topography is conducive to illegal vehicle movement). A design solution will need to be developed to deal with the rocky conditions to ensure that these barriers can be securely anchored so as to achieve the desired security over the long-term. The barriers must not impede wildlife access to the river.
- The fencing emphasis will shift from the Usuthu River to the maintenance of the Usuthu Gorge CCA fence, with all future fence patrol infrastructure to be internal to the CCA (forming part of the future proclaimed conservation area's infrastructure).
- Where the international border is defined by the middle of a river, border beacons / markers will as a minimum still be needed on the South African bank of the river.

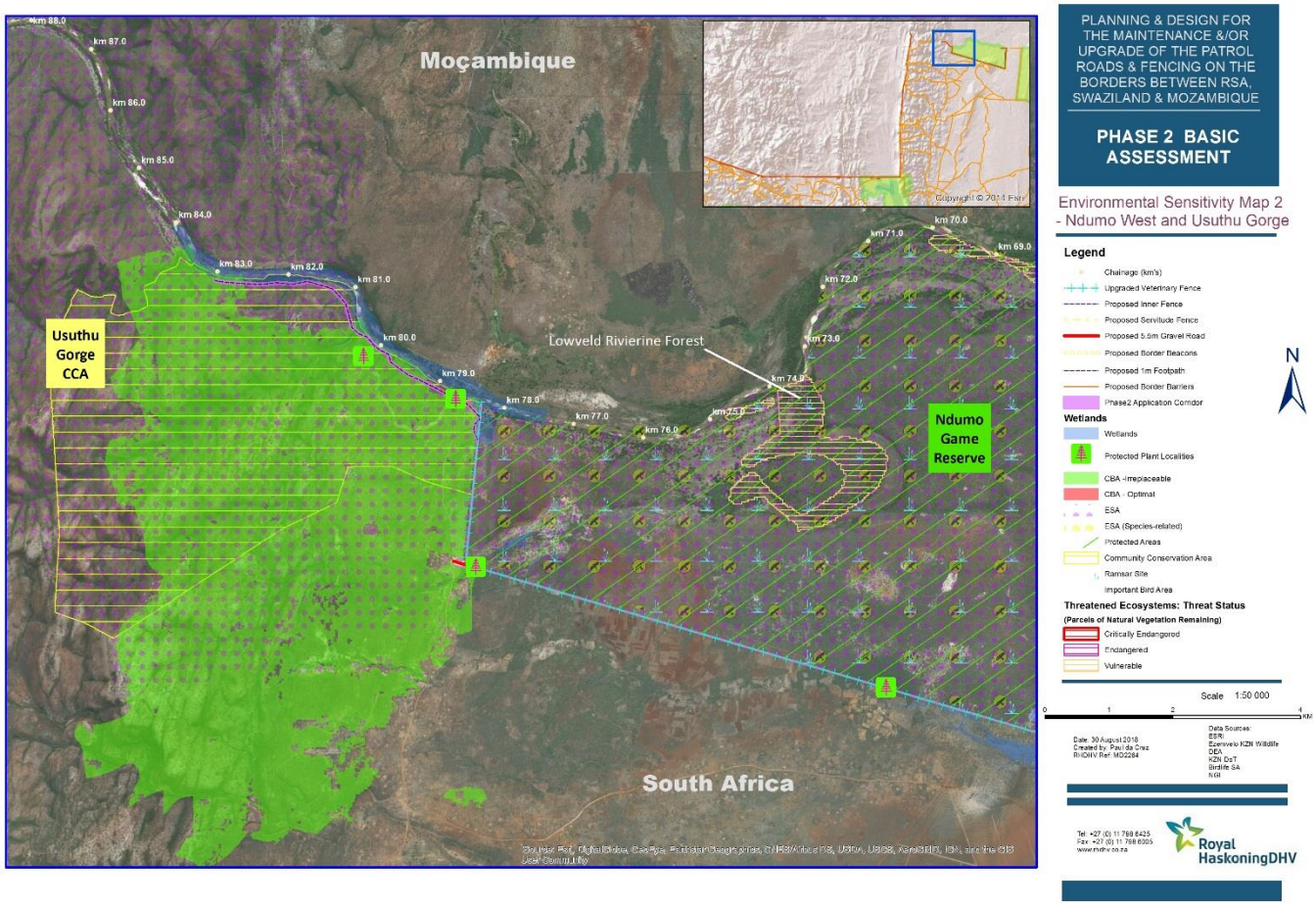


Figure 47: Proposed fencing and patrol structure from Ndumo to Abercorn Drift

5.4.3 Access to the Usuthu Gorge CCA

The proposed access road to Nkonjane, situated immediately west of the Ndumo Reserve, is along an existing public road (D1841) that is in an extremely poor condition. The responsibility for upgrading / maintaining of this road rests with the KZN Provincial Roads Authority (i.e. KZN Department of Transport).

Concerns have been raised that the upgrading of this section of road may increase the risk of trafficking along this route. The following were agreed to / resolved:

- An alternative access alignment to Nkonjane will be along the internal perimeter roads along the western boundary fence of the Ndumo Game Reserve.
- As a further alternative, EKZNW proposed that construction of a camp at Nkonjane could be considered (at the intersection of the CCA and the north-west boundary of Ndumo). EKZNW also indicated that responsibility for patrolling this section of the border within the CCA can be considered for EKZNW (or such other management authority to appointed for the CCA) to manage. This will effectively remove the need for SANDF and DAFF to access this section of the Usuthu Gorge CCA.

5.4.4 Western Boundary of the Pongola Nature Reserve

On the western boundary of the Pongola Nature Reserve, there is an access road going north that is inside the reserve as this is state-owned land. The public road P720 up to the existing gate will be fenced and access controlled.

5.4.5 Songimvelo Nature Reserve

As there has been a recent incident where elephants from the nature reserve went into Swaziland, a veterinary fence is needed on the South African side of the border specifically the pan handle section of the nature reserve (km 420 – km 447). It is recommended that there is an elephant fence from the Josefsdal Border Post (Bulembu) km 390 to km 418. These recommendations have been incorporated into the preliminary design.

5.5 Motivation for the Preferred Border Control Infrastructure Alignment

As highlighted by the preceding sections, the route that was refined after the route optimisation stage has been a culmination of various factors and has undergone an iterative process with the engineering team, key stakeholders and the environmental team. The current route for the border patrol infrastructure may also need to be revised based on comments received during the public participation process.

In the context of alternatives it is very important to note that the border control infrastructure is required to be placed immediately alongside the international boundary or existing fence or from the 1:20 year flood line or a river, as the primary aim of the infrastructure is to secure the border (in the case of fencing) and to allow the patrolling of the border (in the case of the border patrol road and associated infrastructure including the footpath that replaces the road along certain sections of the alignment and detour roads).

It is thus technically not feasible to locate this infrastructure away from the border, as the purpose of securing the border and in particular the patrolling of the border which requires visibility of the border will not be achieved. In certain sections of the route, the nature of the terrain (where terrain is very steep) has necessitated the alignment of the border road away from the border for short sections.

In addition, there is existing border patrol infrastructure along the border (i.e. tracks, forestry roads gravel roads and public roads), and there is no value in considering an (new) alternative alignment away from the border – environmentally this would result in the transformation of “greenfield” areas which is much less preferable than widening the existing impacted footprint.

5.6 No-Go Alternative

Should the development not proceed, the existing infrastructure will remain. The activities related to border control and border patrol will still be able to be undertaken by the relevant law enforcement agencies, as is currently the case due to the existence of the existing track and fence along the majority of the length of the alignment. However, the benefits in terms of improved law enforcement, improved ability to secure the international border and in terms of the ability of government agencies will continue to be compromised by infrastructure that in a state of disrepair in certain parts of the route, or which hinders the ability of the illegal movement to be prevented due to poor access and patrol infrastructure which makes it difficult to patrol and respond to incidents.

The upgrading of the border fence will also enable South Africa to retain its FMD-free zone status as recognised by the World Organisation for Animal Health (Office International des Epizooties).

Whilst there are unavoidable environmental impacts i.e. vegetation removal, impact of fencing on fauna, impact on watercourses and Protected Area expansion plans, the environmental benefits of the project cannot be underestimated. The project will provide a number of indirect biodiversity benefits (e.g. reduction of poaching, improved drainage and appropriately designed watercourse infrastructure, promote conservation initiatives i.e. CCAs as well as social benefits in the form of employment opportunities.

6 DESCRIPTION OF THE BASELINE ENVIRONMENT

6.1 Ecoregions

The proposed route corridor traverses six (6) ecoregions[5], including the Lowveld, North Eastern Highlands, Northern Escarpment Mountains, Highveld, Lebombo Uplands and Natal Coastal Plain. The climatic data is summarised in Table 14 and presented in Figure 48.

Table 14: Ecoregions classified in the study area

	Lowveld	North Eastern Highlands	Northern Escarpment Mountains	Highveld	Lebombo Uplands	Natal Coastal Plain
Mean Annual Precipitation (mm)	200 to 1000	400 to 1000	500 to 1000	400 to 1000	400 to 1000	500 to 600 (limited), 600 to 1000
Rainfall seasonality	Early to late summer	Early to mid-summer	Early to mid-summer	Early to late summer	Early to mid-summer	Mid to late summer
Mean annual temp (°C)	16 to >22	16 to 22	10 to 22	12 to 20	18 to >22	20 to >22
Mean daily max temp (°C) February	24 to 32	24 to 32	16 to 30	20 to 32	26 to 32	26 to 32
Mean daily max temp (°C) July	18 to >24	18 to>22	12 to 24	14 to 22	20 to >24	20 to >24
Mean daily min temp (°C) February	14 to >20	14 to 20	8 to 20	10 to 18	18 to >20	>20
Mean daily min temp (°C) July	4 to >10	2 to 10	0 to 8	minus 2 to 4	6 to >10	8 to >10

[5] *Ecoregions are essentially regions within which there is a relative similarity in the mosaic of ecosystems and ecosystem components such as physiography, climate, rainfall, geology and potential natural vegetation.*

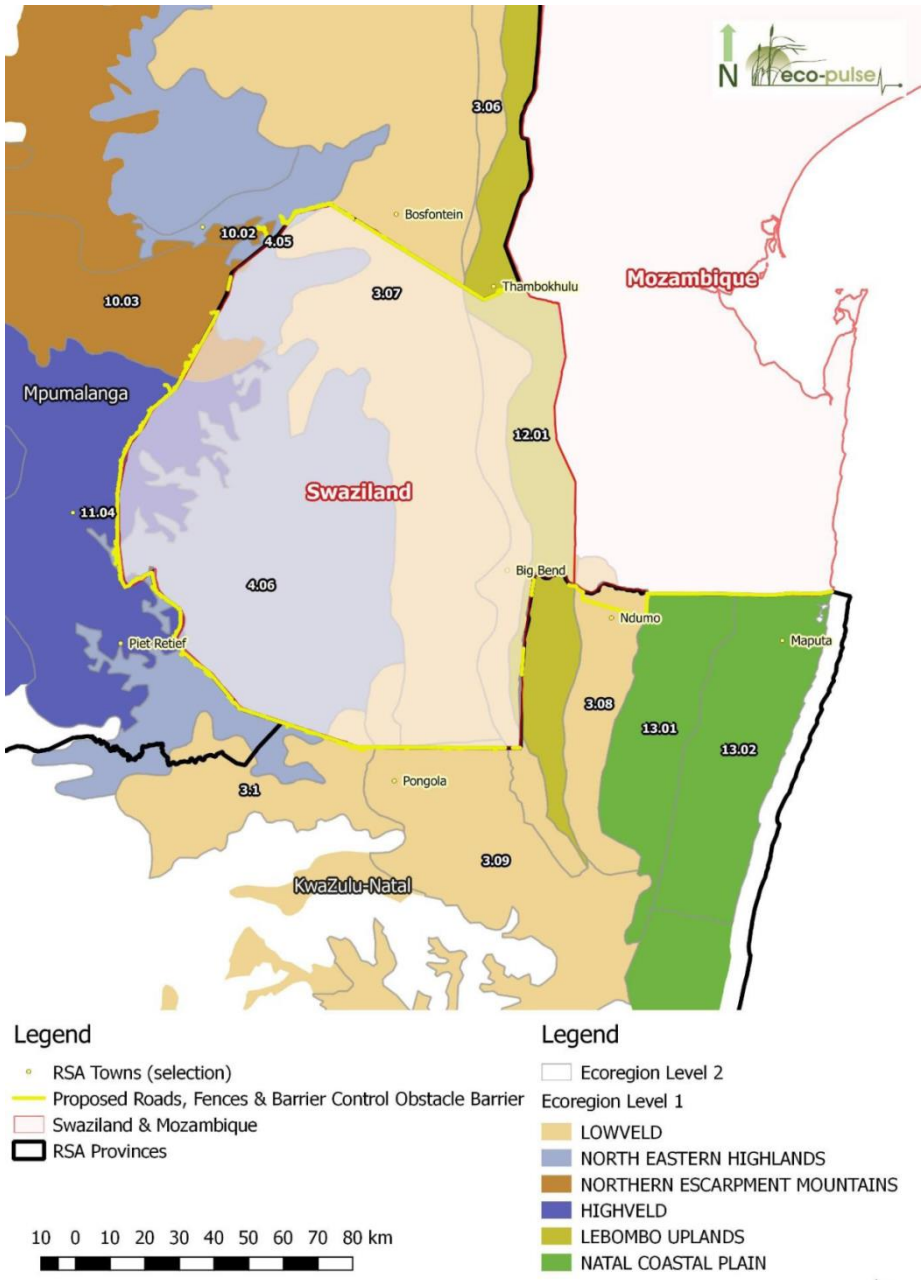


Figure 48: Map indicating the location of ecoregions relevant to the study area

6.2 Quaternary Catchments

The location and extent of quaternary catchments traversed by the proposed project are presented in Figure 49.

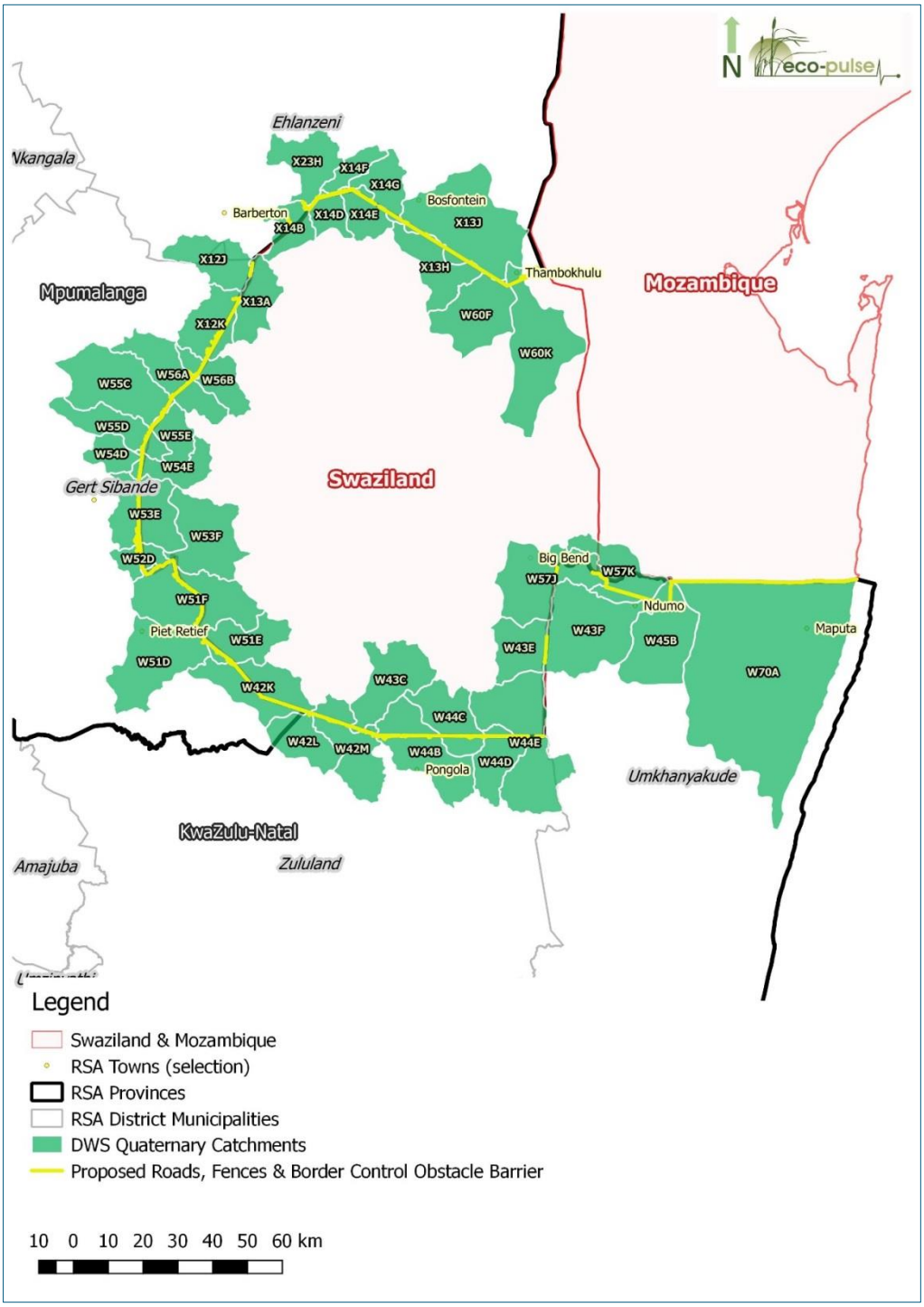


Figure 49: The location and extent of quaternary catchments traversed by the proposed project

6.3 Topography

The topography along the border varies greatly, from extremely flat terrain that is subject to seasonal wetland waterbodies in the eastern extent (km 1 to km 82), to very dramatic steep terrain in some parts further west along the north-western and western extent of the KZN border (km 82 to km 154), near Pongola (km 194 to km 221) and the mountains before the Komati River (km 384 to km 406). The topography along the border is schematically presented in Figure 50 and summarised in Table 15 below.

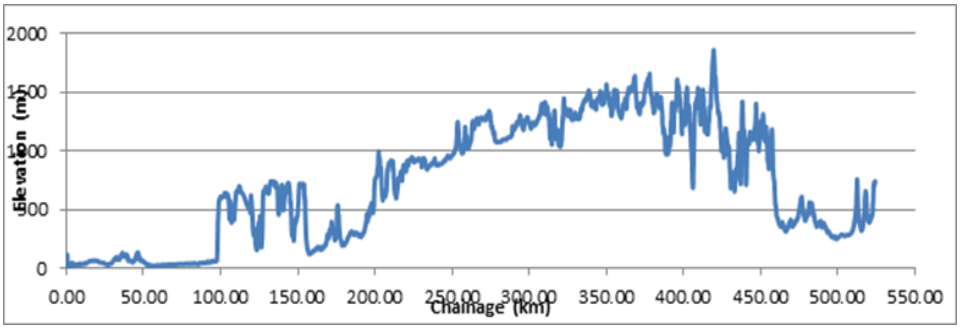


Figure 50: Elevation along border

Table 15: Overview of topography along the border

Section (km)	Topography
1 – 82 (Abercorn Drift)	Flat
82 (Abercorn Drift) to 154.5 (Pongolopoort Dam)	Mountainous
154.5 (Pongolopoort Dam) - 169	Flat
169 - 178	Mountainous
178 – 194	Flat
194 - 221	Mountainous
221 - 240	Flat
240 - 252 (Mahamba Border)	Flat with various river crossings
252 - 260	Mountainous
260 - 312	Flat
308 – 338.5 (Nerston) - 352	Rolling
352 - 357	Mountainous
357 - 384 (Oshoek)	Rolling with rocky outcrops
384.2 (Oshoek) – 406 (Komati River) - 460	Mountainous
460 - 465	Flat
465	Dam
465 - 511	Flat
511 - 512	Mountainous
512 - 524.5 (Zulu Crossing)	Flat

6.4 Geology and Soils

The South Africa and Mozambique / Swaziland Border from Kosi Bay in the east to Mbuzini in the west encompasses a full range of rock types (sedimentary, igneous and metamorphic) which represent geological time from relatively recent, some 65 million years ago, through to some of the oldest and best known greenstone belts in the world making up the Barberton Supergroup, some 3.65 billion years old. These variably aged rock formations are in turn overlain by variable thicknesses of unconsolidated quaternary sediment ranging from aeolian (wind-blown) dune sands along the eastern KZN coastal plain, alluvial sand

/ silt / clay associated with major rivers and their tributaries, flood plains, pans, vleis and wetlands as well as colluvial and residual material derived from the mechanical and chemical weathering of the parent rock.

The various rock formations serve to define the route geomorphology which, together with the degree of weathering in the parent rock and thickness of the unconsolidated soils thereupon, presents a number of geotechnical factors to be considered in the proposed border road development.

A breakdown of the anticipated geology along the border alignment is summarised in Tables 1A (Kosi Bay to Oshoek) and Table 1B (Oshoek to Mbuzini) of the Geotechnical Report appended to this report as ***Appendix C1***.

The progression of the prevailing geology and soils from east to west along the border alignment has been simplified and briefly described in Table 16.

Table 16: Geology and soils summary of the border alignment

Section	Description
Kosi Bay to Ndumo Area (km 0 – km 78)	▪ Unconsolidated quaternary sediments comprising recent aeolian dune sand and Berea Formation clayey sand, these materials blanketing the underlying Cretaceous sedimentary bedrock. ▪ Relatively low-lying area is also characterised by sandy / silty and clayey sediment associated with flooding rivers or estuary / wetland / marsh areas. ▪ Highly compressible, collapsible and erodible soils in conjunction with a perennially shallow ground water table are likely to predominate. ▪ Along the eastern foothills of the Lebombo Mountain range, Cretaceous sedimentary bedrock, ranging from siltstone to sandstone and conglomerate, occurs at relatively shallow depths but is blanketed by unconsolidated scree deposits (boulder / cobble / gravel accumulations) transported down the mountainside by gravity.
Lebombo Mountain Range (km 78 – km 154.85)	▪ Steep mountainous terrain and deeply incised valleys underlain by rhyolite and rhyodacite of the Jozini Formation. ▪ Sheets of intrusive dolerite and quartz-feldspar porphyry are fairly abundant. ▪ High-silica rhyolites / rhyodacites are very resistant to weathering.
Pongolapoort Dam / Golela Border Post (km 154.85 – km 172)	▪ Basalt of the Letaba Formation. ▪ The silica-deficient basalt is prone to weather chemically to produce montmorillonite clays and thus bedrock is usually capped by variable thicknesses of these highly active clay soils. ▪ Highly compressible and seasonally very soft alluvial clay soils will be encountered in the drainage lines.
Low-lying Pongola Region (km 172 – km 194)	▪ Karoo Supergroup bedrock is encountered as sedimentary shale, sandstone and siltstone of the Ecca Group, in particular the Vryheid and Pietermaritzburg Formations which have been regionally intruded by Karoo dolerite. ▪ In the relatively low-lying, commercially farmed region surrounding the town of Pongola the weathered bedrock is blanketed by thick alluvial soils and floodplain sediment associated with the Pongola River. ▪ The clay soils derived from chemical weathering of the Ecca Group are generally active clays, whilst the alluvial floodplain materials may be compressible and collapsible.

Section	Description
Pongola Mountainous Region (km 194 – km 221.5)	▪ Medium to coarse grained granite (biotite granite) of the Ushashwana Complex along with large regional outcrops of dolerite bedrock. ▪ The granite is capped locally by much younger tillite bedrock of the Dwyka Group and in turn some shale of the Ecca Group. ▪ Chemical weathering of the granite may give rise to various combinations of collapsible, dispersive, highly erodible or potentially active soils. Some of the steeper gradients are characterised by hard rock outcrops.
Belgrade to Mahamba (km 221.5 – km 254)	▪ Dwyka tillite intruded locally by Karoo dolerite underlies the area. ▪ The tillite generally comprises fine grained, massive bedrock which was deposited under glacial conditions and is thus essentially unsorted, the fine grained matrix often hosting very large boulder-size drop stones. ▪ Underlying the tillite bedrock is shale and quartzite with subordinate banded iron stone and diabase materials of the Pongola Supergroup (Mozaan Group). ▪ The Sulphur Springs area to the immediate south of Mahamba is characterised by alluvial sediment, likely comprising sand and clay typically associated with wetland areas along with perched shallow groundwater conditions. ▪ Mahamba generally represents a transition in the Pongola Supergroup between the Mozaan Group (south) and the Nsuze Group (north).
Mahamba to Amsterdam Region (km 254 – km 328)	▪ Comprises a suite of felsic, ultramafic and mafic volcanic rocks of the Ushashwana Complex and Amsterdam Formation which were intruded as dyke-like bodies. ▪ The prevailing bedrock types include basaltic and andesitic lavas, felsic rhyolite, granite gneiss as well as granite and gabbro. ▪ Erodible, collapsible and dispersive soils, where steep natural spurs are traversed, hard rock sometimes crops out at the surface.
Amsterdam Region to Oshoek (km 328 – km 384.8)	▪ Mpuluzi Batholith comprising primarily granite (potassic granite). ▪ Extensive occurrence of hard rock along this section of the route, including both hard boulder outcrop and massive, “whale-back” outcrops or sheet rock.
North of Oshoek Region (km 384.8 – km 388.2)	▪ Tonalitic gneiss associated with the archean Batholith intrusion as well as the Steynsdorp Pluton comprising a biotite and trondhjemite gneiss bedrock.
Barberton Mountain Range (km 388.2 – km 460.15)	▪ Barberton sequence comprising three main groups, namely the Onverwacht, Moodies and Fig Tree Groups. ▪ The Onverwacht Group comprises mainly volcanic rocks including mafic lavas, tuffs, felsic lavas, pillow basalts and agglomerates and komatiite lavas. ▪ The overlying Fig Tree Group consists of undifferentiated tuffs, lavas, conglomerate siltstones, shale, chert and banded ironstone. ▪ The Moodies Group comprises sandstone, shale, conglomerate, quartzite, jasperlite, cherts and banded ironstone.
Jeppes Reef to Mananga Border Post (km 460.15 – km499.45)	▪ Granitic rocks (potassic gneiss and migmatite) of the Nelspruit Granite Suite with localised occurrences of diabase. ▪ Soils capping these rock formations may locally be dispersive, erodible, or potentially active to varying degrees.

Section	Description
Mananga Border Post to Masibekela wetland (km 499.45 – km 510.2)	▪ Ecca Group shale, sandstone and siltstone. ▪ Continuing eastward, outcrops of Clarens Formation sandstone occur in high-lying areas whilst low-lying areas are characterised by the alluvial and floodplain sediments (sand / silt / clay) associated with the Masibekela wetland area. ▪ Various combinations of compressible, erodible and active soils in combination with locally shallow groundwater can be expected along this section of the route.
Masibekela to Mbuzini (km 510.2 – km 524)	▪ Karoo Supergroup sedimentary rocks are capped by basalt of the Letaba Formation and in turn by Jozini Formation rhyolite. ▪ Hard rock exposure is present on the elevated ridges whilst variably active or erodible transported soils are to be expected on the ridge flanks and valley bottoms.

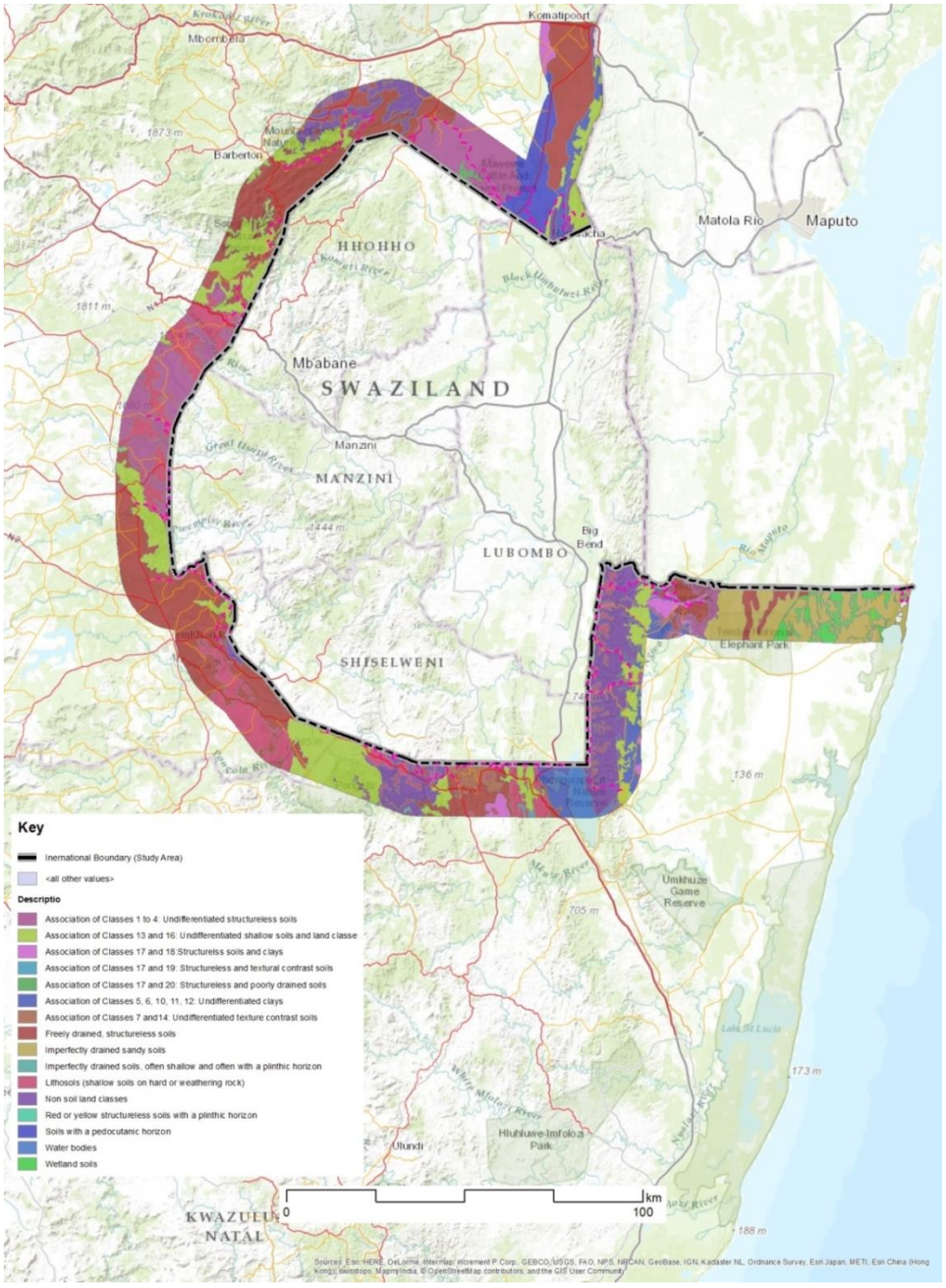


Figure 51: Soils (inferred geology) in the study area

6.5 Land Use

6.5.1 Existing Use within the Immediate Patrol Road Corridor

The following categories are evident:

- Conservation areas (managed by the Ezemvelo KZN Wildlife and Mpumalanga Tourism and Parks Agency)
  - Existing vehicle path / track

- Natural veld
- Private game farms / Reserves
  - Existing vehicle path / track
  - Natural veld
  - Rural / Communal land
  - Grazing / Natural veld
  - Existing road / vehicle path / track
  - Arable (dry-land cropping)
  - Arable (irrigation)
- Commercial farm / forestry
  - Grazing / Natural veld
  - Existing road / vehicle path / track
  - Arable (dry-land cropping)
  - Arable (irrigation)
  - Forestry (pine / blue gum)

6.5.2 Land Use in the Broader Border Area

In terms of the broader area (Figure 52), land uses are categorised in terms of the following:

- Protected areas (conservation)
- Natural veld (communal / private)
- Intensive agriculture (crop production)
- Forestry
- Settlements

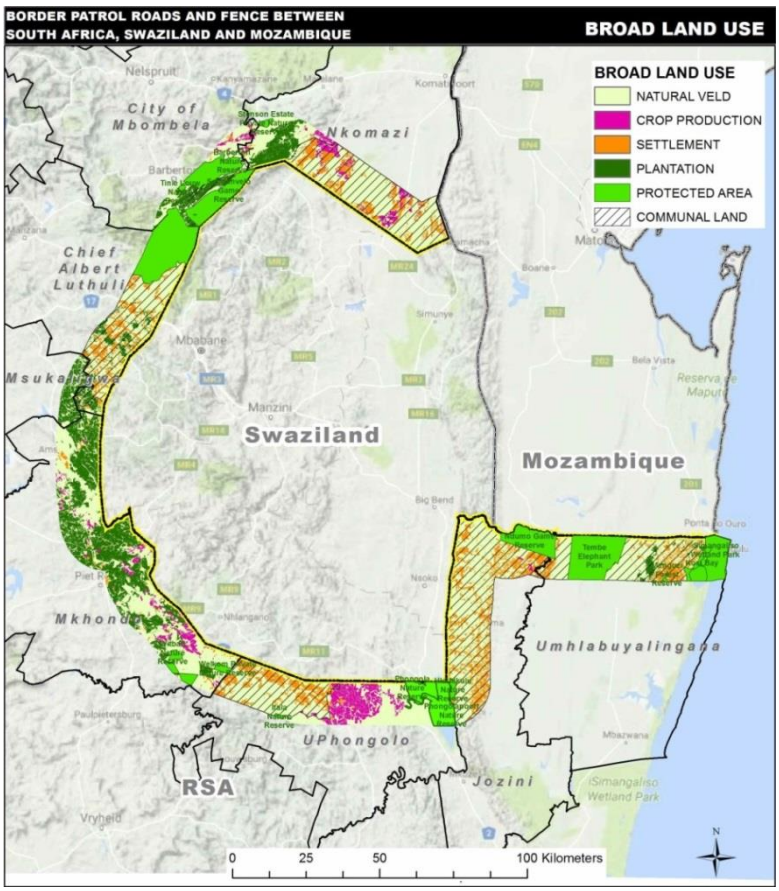


Figure 52: Land use in the broader border area

The reason for differentiating between communal and private land relates to the implications that it holds for the Local Municipalities' ability to control and enforce effective land use management measures. In terms of the implications that land use (and future development and management of land use) may potentially hold for security along the border, the following needs to be considered:

- ***Protected / Conservation areas***
  - Access control to such areas assists to limit the chances of access to the border by criminal elements.
  - Internal patrol / ranger activity assists in providing a security presence in the area.
  - Accountability exists in the fact that a specific constituted authority holds responsibility for the management of the area under their control.
- ***Natural veld and crop production – private***
  - Reserved right of access to private land enables owners of the land to limit access and potential undesirable / risky elements to such areas. This further enables security patrols to immediately respond to the primary activity (trespassing on access restricted land).
  - Accountability exists in the fact that a specific person or legal entity (company, CC or trustees) can be held responsible for activities taking place with their consent or knowledge.
  - The limited amount of human activity (due to restricted access rights) makes it easier to monitor potential illegal activity.
- ***Natural veld and crop production - communal***
  - The limitations on ability to reserve the right of access to land-right holders (members of the community) results in such areas practically function as open access areas, resulting in higher levels of human activity in such areas. This makes it difficult to distinguish between normal activity and activity aimed with criminal intent (particularly in areas close to the border).
  - Due to differences in the interpretation of decision-making powers (between that of the local municipality and traditional leadership structures), land use management and enforcement (generally) does not get implemented in the manner that the new SPLUMA requires.
  - Due to the complex mix of customary practice, traditional administrative practices and protocols and legislated provisions, it is difficult to determine who should be held accountable for / or illegal development.
  - The limited amount of human activity (due to restricted access rights) makes it easier to monitor potential illegal activity.
- ***Intensive Agriculture (crop production)***
  - Intensive cultivation results in areas that are generally free of public access ways, with producers exercising a measure of control over the areas under cultivation.
  - Due to risk of loss of crops from animals grazing in these areas, cultivated fields are generally fenced, with access *via* specific positions where gates are provided. This results in a reasonable well controlled area with obvious benefits for additional security monitoring.
- ***Forestry***
  - Due to the limited risk of loss of trees to theft or browsing animals, forestry areas are generally not fenced or access not restricted by gates.
  - The cover provided by established plantations and the limited need for continuous maintenance (and resulting absence of management and staff), contributes to forestry areas being high risk areas for illegal activities linked to border security challenges.
  - Forestry areas generally have good internal road networks, which opens up numerous options for access to the border.
- ***Settlements***
  - Formal structured settlements generally result in better monitoring of movement and access to areas beyond demarcated settlement boundaries. Growth and expansion of such settlements will likely also be better managed by the responsible local municipality in the areas.

- Sprawling rural settlements, predominantly in communal land areas, are generally associated with informally established access networks.
- Such sprawling “informal” settlement generally also continues to grow without any formal planning input or control.
- There is a real risk of negative impact on security in areas where such settlements are situated in close proximity to the border, due to higher traffic volumes and demand for access to social and business infrastructure that is likely to develop is such areas, from across the border.

6.6 Conservation Context

Understanding the conservation context and importance of the study area and surrounds is important to inform decision-making regarding the management of the resources in the area. In this regard, national, provincial and regional conservation planning information available was interrogated to obtain an overview of the study site in terms of conservation. Conservation concerns and features of particular importance to the study area are presented below.

6.6.1 National and Provincial Conservation / Threat Status

A total of 26 National and Provincial terrestrial vegetation types were identified within the 50m corridor area to be traversed by the proposed development, with the threat status of the identified vegetation falling into one of the following categories: Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Least Threatened (LT).

Based on the area of vegetation communities within the 50m corridor in each province, the following should be noted (Figure 54):

- The results show that 8% of KZN vegetation types are CR, 22% are EN, 14% are VU and 56% are LT. The CR vegetation type is Delagoa Lowveld located just north of the town of Pongola within the Zululand District Municipality, KZN.
- None of the vegetation types within Mpumalanga were identified as CR, however a large portion of the area (70%) was identified as VU. Endangered vegetation types constitute 3% of the area and LT vegetation types constitute 27%.

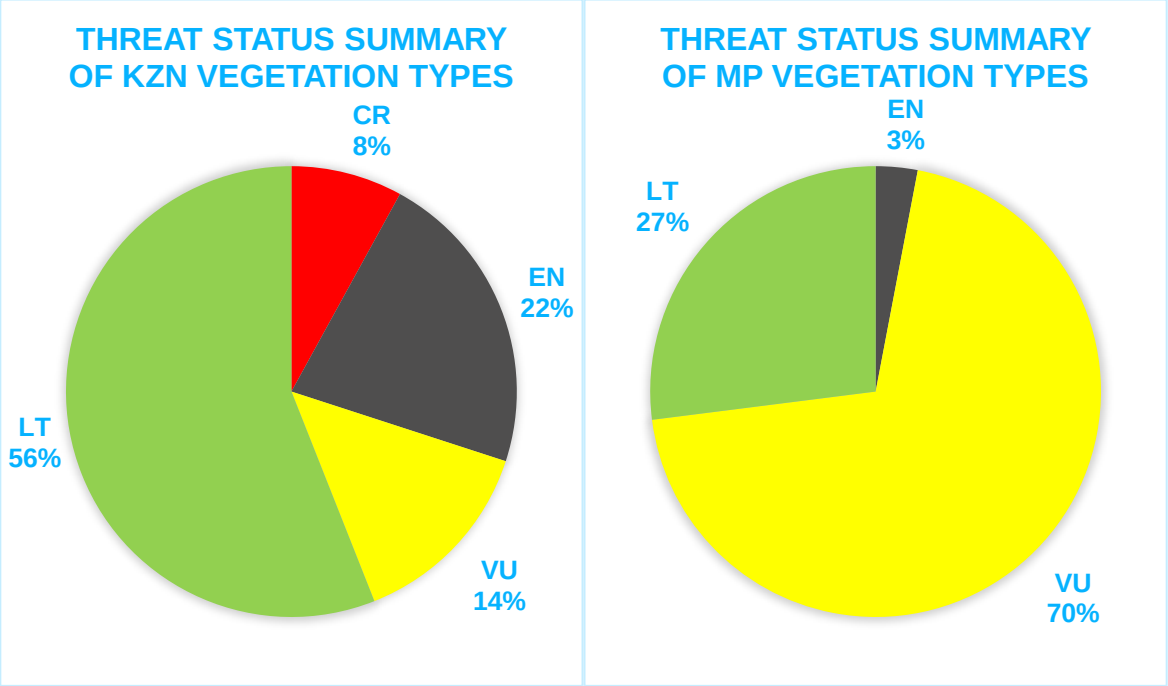


Figure 53: Threat statuses of vegetation types found within the study area and within KZN and MP

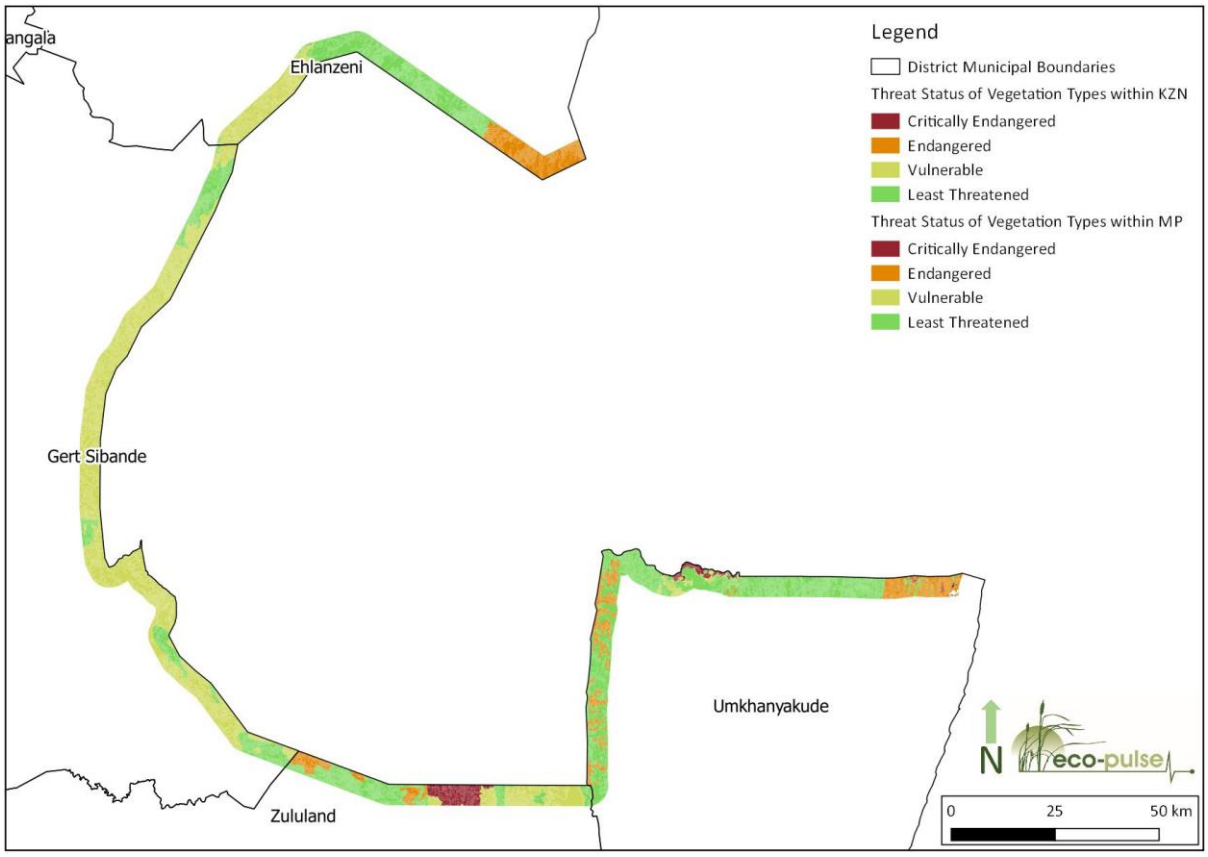


Figure 54: Distribution of vegetation types identified within the proposed corridor presented in terms of their threat statuses

Table 17: General description and threat statuses of vegetation types identified within the study area

Vegetation Type[6][7]	National Threat Status	KZN Threat Status[8]	Location within the study area (km)	Description
Tembe Sand Bushveld (SVI 17)	LT	LT	32 – 56	Characterised by open to closed woodland with canopy dominated by leguminous woody species and *Terminalia sericea*, with species-rich shrub layer and grassy undergrowth. It is moderately protected in the Tembe Elephant Park
Western Maputaland Sand Bushveld (SVI 19)	LT	LT	58 – 64	Comprises of mixed, but mainly simple-leaved, short (5–10 m) bushlands, woodlands and wooded grasslands
Western Maputaland Clay Bushveld (SVI 20)	VU	VU	64 – 78, 159 – 168	Comprises a mixed but mainly compound-leaved short woodlands and wooded grasslands. It occurs on the crests, upper and mid-slopes of gently undulating terrain and is considered fully protected in KZN
Licuati Sand Forest: Western Sand Forest (FOz 8)	LT	LT	56 – 60	Characterised by dense thickets short to tall forests with a canopy reaching 15m, with well-developed shrub layer and very poorly developed ground layer. Fully protected in KZN
Makatini Clay Thicket (SVI 21)	LT	LT	65 – 66 & 75.5 – 78	The Makatini Clay Bushveld comprises a mixed, but mainly simple-leaved short bushland and thicket with emergent trees up to 10m and generally dense dominant shrub layer measuring 1m tall. It has a national protection status of moderate. Fully protected in KZN
Southern Lebombo Bushveld (SVI 16)	LT	LT	78.7 – 81.6, 127.6 – 128.8 & 509.4 – 522.3	Characterised by open bushveld with dominant *Acacia* and *Combretum* species. Moderately protected in KZN
Lebombo Summit Sourveld (SVI 17)	VU	EN	99 – 104.2, 128.8 – 130.4 & 512	Open, tall, sour, wiry grasslands, often dotted with low bushes and solitary savanna trees. Poorly protected in KZN
Zululand Lowveld (SVI 23)	VU	VU	168.2 – 172 & 494.6 – 509.4	The Zululand Lowveld is characterised by a complex of various bushveld units ranging from dense thickets of *Dichrostachys cinerea* and *Acacia* species, through park-like savanna with flat-topped *A. tortilis* to tree-dominated woodland with broad-leaved open bushveld with *S. birrea* subsp. *caffra*. Moderately protected in KZN
Northern Zululand Sourveld (SVI 22)	VU	LT	172 – 177.2 & 199.5 – 218.2	The dominant structural vegetation type is wooded grassland, in places pure sour grasslands and rarely also dense bushveld thickets. Poorly protected in KZN
Delagoa Lowveld (SVI 4)	VU	CR	177.2 – 194	The Delagoa Lowveld is characterised by dense tree to tall shrub layer dominated by *A. welwitschii*, often forming thickets. Not protected in KZN
KaNgwane Montane Grassland (Gm 16)	VU	EN	218.2 – 393.5	The vegetation structure of this unit is comprised of a short closed grassland layer with

[6] *Mucina, L. & Rutherford, M. 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. Pretoria: South African National Biodiversity Institute.*

[7] *Scott-Shaw, R. & Escott, B. 2011. KwaZulu-Natal Provincial Pre-transformation Vegetation Type. Pietermaritzburg: Ezemvelo KZN Wildlife.*

[8] *Jewitt, D. 2014. KZN Vegetation Types: Targets, Statistics and Conservation Status (December 2014). Unpublished report, Biodiversity Research and Assessment, Ezemvelo KZN Wildlife.*

Vegetation Type[67]	National Threat Status	KZN Threat Status[8]	Location within the study area (km)	Description
				many forbs and a few scattered shrubs on the rocky outcrops
Ithala Quartzite Sourveld (Gs 2)	LT	LT	252 – 270	Vegetation structure varies according to altitude and rockiness, but the basal density of the grass sward is relatively low. This unit occurs in the zone between Grassland and Savanna where the dominant grassland gives way to woodland as elevation decreases. The grasslands are species-rich covering a variety of altitudes but sharing a common species unique to the dystrophic quartzite geology
Swaziland Sour Bushveld (SVI 14)	VU	N/A	405 – 407	Comprises open to closed, medium to tall tree layer with closed well-developed grass layer
Barberton Montane Grassland (Gm 17)	VU	N/A	405 – 408, 434.0 – 457.5	Characterised by short rocky grasslands which transition into woodlands along the lower slopes
Northern Mistbelt Forest (FOz 4)	LT	N/A	445 & 450	Tall, evergreen afrotemperate mistbelt forest occurring primarily in east-facing forest refugia such as sub-ridge scarps and fragmented patches
Scarp Forest (FOz 5)	LT	N/A	457 – 458	Tall, species-rich and structurally diverse, multi-layered forests, with well-developed canopy and understorey tree layer, but a poorly developed herb layer. Typically occurs on scarps
Kaalrug Mountain Bushveld (SVI 12)	LT	N/A	458.8 – 460.8	The Kaalrug Mountain Bushveld is characterised by dense, short mountain savanna or thickets, with a denser grassy layer at higher altitudes
Granite Lowveld (SVI 3)	VU	EN	460.8 – 494.6	Comprises a complex of tall shrubland with few trees to moderately dense low woodland and dense thickets to open savanna in the bottomlands

6.6.2 Protected Areas and Protected Area Expansion Strategy (PAES)

A number of formally Protected Areas are located in the study area; and within a 5km buffer area, and are important in the context of the potential environmental impacts of the proposed project (Figure 55). These include:

- Ndumo Game Reserve;
- Pongola Nature Reserve;
- Songimvelo Nature Reserve; and
- Mountainlands Nature Reserve.

The Protected Area network in South Africa is deemed to be currently inadequate for sustaining biodiversity and ecological processes. In response to this concern, protected area expansion strategies (PAES) have been developed at both national and provincial level and include opportunities for expansion into large, intact and unfragmented areas of high importance for biodiversity representation and ecological persistence.

The focus areas for the expansion of existing Protected Areas in the study area are presented in Figure 55.

6.6.3 Community Conservation Areas

The Usuthu Gorge Community Conservation Area (CCA), a wildlife conservation area run and owned by the Mathenjwa community, is situated in the north-west corner of Maputaland on the foothills of the Lebombo

Mountains. In the east, the Ndumo Game Reserve forms the boundary and the western boundary is a large wilderness area leading to the beautiful series of cliffs forming the Swaziland Border.

The Mawewe Cattle and Game Reserve Project is situated in the Nkomazi area, south of Malelane in Mpumalanga. The 9170ha reserve would not be used exclusively for conservation purposes, but also serve as grazing land for local cattle herds and as a source of firewood, building materials, food and traditional medicine for the community.

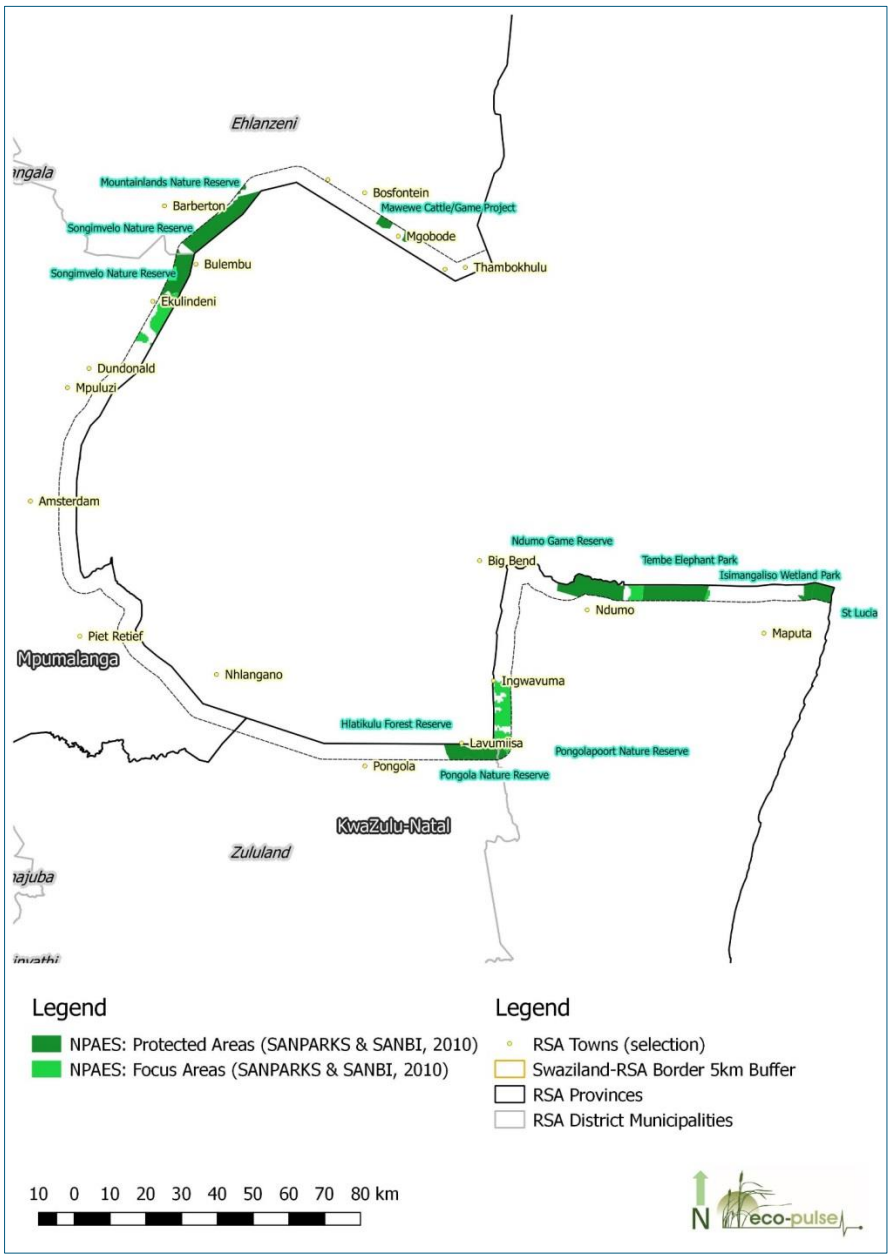


Figure 55: Map showing national Protected Areas and focus areas for the expansion of existing Protected Areas

6.6.4 Centres of Endemism

A centre of endemism is an area that is home to a wide variety of species that are not found anywhere else. Two centres of endemism would be affected by the proposed project i.e. the Maputaland-Pondoland-Albany Hotspot and Barberton Centre of Endemism.

The Maputaland-Pondoland-Albany Hotspot is the amalgamation of three centres of endemism (Maputaland, Pondoland and Albany), and is the remarkable meeting point of six of South Africa's eight biomes. The region has unusually high levels of endemism at all levels, as well as an endemic vegetation type called "subtropical thicket." Subtropical thicket is a condensed forest of thorny trees, shrubs and vines and is an unusual ecosystem driven by elephants, black rhino and buffalo that crash open paths and disperse seeds through their digestive tracts.

The Barberton Centre of Endemism is dominated by surface outcrops of ancient volcanic (ultramafic) and sedimentary rocks which have associated with them many unusual and unique species. Outcrops of serpentine (so-called 'greenstone') occur throughout the Barberton Centre, giving rise to soils with high magnesium:calcium ratios and high concentrations of heavy metals such as nickel and chromium that are potentially toxic to many plants. This has resulted in a distinctive flora including many edaphic (soil) specialists, most of which occur in grassland areas, with a few woody serpentine-endemic plants occurring in lower-lying, savanna areas.

6.6.5 Ramsar Sites

The Ndumo Game Reserve (Site no. 887) is designated as a Ramsar site as it was recognised as forming the largest floodplain system in South Africa, consisting of five wetland types, from fresh to brackish, permanent to ephemeral lakes, marshes and pools, as well as riparian and gallery forest. The reserve is well known for its abundant bird life and diversity of species, internationally important numbers of several species are supported, including many that are rare or vulnerable.

6.6.6 Transfrontier Conservation Areas

The governments of South Africa, Mozambique and Swaziland signed a protocol on the establishment of the Lubombo Transfrontier Conservation and Resource Area, covering a total area of 10 029km² on 22 June 2000.

Four specific areas targeted in the original protocol were listed – refer to Figure 56 and Table 18.

Table 18: Lubombo Transfrontier Conservation and Resource Area

Lubombo Transfrontier Conservation and Resource Area	Description[9]
Ponta do Ouro-Kosi Bay TFCA (Mozambique / RSA)	This marine and coastal TFCA links the Ponta do Ouro-Inhaca coastline of Mozambique with South Africa's iSimangaliso Wetland Park, a World Heritage Site. The TFCA has a rich diversity of marine life and is an important leatherback and loggerhead turtle nesting ground
Lubombo Conservancy – Goba - Usuthu-Tembe-Futi TFCA (Swaziland / RSA / Mozambique)	In March 2014, the Lubombo Commission decided to merge the Lubombo Conservancy – Goba and Usuthu-Tembe-Futi TFCAs to link the Lebombo Mountain Ecosystem with the coastal plains. The new boundary reflects an initial consolidation phase and will focus on three transboundary core areas:

[9] *http://www.peaceparks.co.za*

Lubombo Transfrontier Conservation and Resource Area	Description[9]
	▪ Maputo Special Reserve -Tembe Elephant Park-Bekhula-Tsanini Community Conservation Area ▪ Catuane-Ndumu Game Reserve - Usuthu Gorge Community Conservation Area – Mambane Community Conservation Area ▪ Goba-Lubombo Conservancies
Nsubane-Pongola TFCA (RSA / Swaziland)	The South African component of the TFCA includes community, public and private land surrounding the Pongola Nature Reserve, which forms the core conservation component. In Swaziland, the area consists of private land, government-owned land and community areas, all of which are relatively undeveloped with regard to tourism infrastructure
Songimvelo-Malolotja TFCA (RSA / Swaziland)	The TFCA links the Songimvelo Game Reserve in South Africa with the adjacent Malolotja Nature Reserve in Swaziland. The central feature of the TFCA is the Drakensberg Escarpment, which is the dominant physiographic feature of south-eastern Africa, and its associated highlands and mountains known locally as the Barberton Mountains

Figure 56: Transfrontier conservation areas[10]

6.6.7 Barberton-Makhonjwa Mountainlands World Heritage Site

The Makhonjwa Mountains, known as the Barberton Greenstone Belt in Mpumalanga, has been declared as South Africa's 10th World Heritage Site on 02 July 2018.

The site comprises 40% of the Barberton Greenstone Belt, one of the world's oldest geological structures. The Barberton Makhonjwa Mountains represents the best-preserved succession of volcanic and sedimentary rock dating back 3.6 to 3.25 billion years, when the first continents were starting to form on the primitive Earth. It features meteor-impact fallback breccias resulting from the impact of meteorites formed just after the Great Bombardment (4.6 to 3.8 billion years ago), which are particularly well preserved.

[10] *http://www.peaceparks.co.za*

6.7 KwaZulu-Natal Systematic Conservation Assessment

The Systematic Conservation Assessments (SCAs) is a strategic conservation plan developed in 2016 by the Provincial Conservation Authority, Ezemvelo KZN Wildlife (EKZNW), to ensure that representative samples of biodiversity are conserved. It is used as a land use decision support tool in KZN and replaced the 2010 Terrestrial Systematic Conservation Plan (MINSET). The SCAs are derived from merging the Provincial Terrestrial Systematic Conservation Plan (TSCP) with other conservation datasets. In terms of terrestrial conservation three conservation categories were developed including

1. Critical Biodiversity Area (CBA): Irreplaceable;
2. CBA: Optimal; and
3. Ecological Support Area (ESA).

These conservation categories are described in Table 19 below.

Table 19: Description and derivation of conservation planning categories

Conservation Category	Description
Critical Biodiversity Area: Irreplaceable	Areas considered critical for meeting biodiversity targets and thresholds, and which are required to ensure the persistence of viable populations of species and the functionality of ecosystems
Critical Biodiversity Area: Optimal	Areas that represent an optimised solution to meet the required biodiversity conservation targets while avoiding high cost areas as much as possible
Ecological Support Area (ESAs)	ESA are functional but not necessarily entirely natural terrestrial or aquatic areas that are required to ensure the persistence and maintenance of biodiversity patterns and ecological processes within the CBAs

6.8 Mpumalanga Biodiversity Sector Plan

The conservation planning authority for Mpumalanga, the Mpumalanga Parks and Tourism Agency (MTPA) has developed a Biodiversity Conservation Plan for the Province which was used to inform the development of the Mpumalanga Biodiversity Sector or MBSP. Similar to the TSCP for KZN, the MBSP identifies spatial priority areas that meet both national and provincial conservation targets in the most efficient way possible, while trying to avoid conflict with other land-uses and actively tries to build-in landscape resilience in response to a changing climate.

The conservation categories are described in Table 20 below.

Table 20: Description and derivation of conservation planning categories

Conservation Category	Description
Critical Biodiversity Areas (Irreplaceable and Optimal)	Areas that are required to meet biodiversity targets for species, ecosystems or ecological processes
Ecological Support Areas (ESAs)	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of Protected Areas or CBAs and for delivering ecosystem services
Other Natural Areas	Areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character

	and perform a range of biodiversity and ecological infrastructural functions
Heavily or Moderately Modified Areas	Areas that have been heavily modified by human activity so that they are by-and-large no longer natural, and do not contribute to biodiversity targets

Maps indicating the conservation status of the study area are provided in *Figures 8 and 9 of the Desktop Aquatic and Terrestrial Ecological Sensitivity Assessment (**Appendix B2**).*

6.9 National Freshwater Ecosystem Priority Area (NFEPA) Assessment

6.9.1 NFEPA Wetland and Wetland Clusters

According to the NFEPA project the most prominent wetlands are those located on the coastal plain of KZN along the border of South Africa and Mozambique. Figure 57, below shows the locating and extent of Wetland FEPA's and NFEPA Wetland Clusters within the study area.

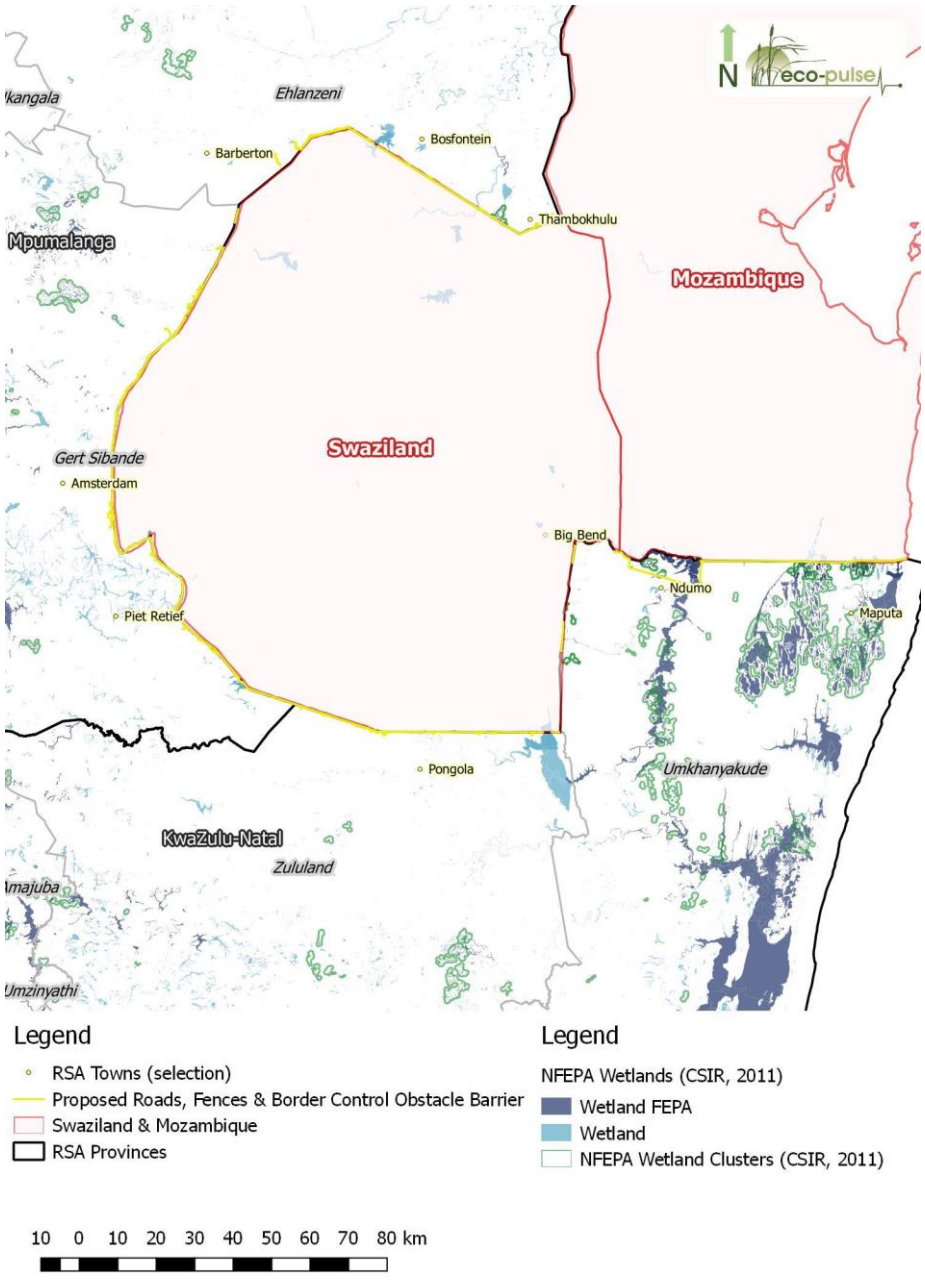


Figure 57: Map showing the location and extent of NFEPA Wetlands and NFEPA Wetland Clusters

6.9.2 NFEPA Wetland Vegetation Groups

The various wetland vegetation groups present across the study area according to the NFEPA wetland vegetation groups is summarised in Table 21 . A map showing the distribution of the various NFEPA Wetland Vegetation Groups according to threat status is provided below in Figure 58. Note that this spatial coverage does not depict individual wetlands, but rather broad areas where vegetation groups and appropriate threat status would apply to any mapped wetlands.

Table 21: Summary of the different Wetland vegetation groups for the project area, indicating ecosystem threat status and protection status for different wetland vegetation groups

NPEFA Threat Status	NPEFA Wetland Vegetation Group	Protection Status
Critically Endangered	Lowveld Group 2	Well protected
	Lowveld Group 3	Not protected
	Lowveld Group 8	Not protected
Endangered	Lowveld Group 10	Well protected
	Mesic Highveld Grassland Group 5	Not protected
Vulnerable	Lowveld Group 11	Well protected
	Lowveld Group 9	Moderately protected
Least Threatened	Indian Ocean Coastal Belt Group 1	Well protected
	Mesic Highveld Grassland Group 6	Not protected
	Sub-Escarpment Grassland Group 2	Not protected
	Swamp Forest	Well protected

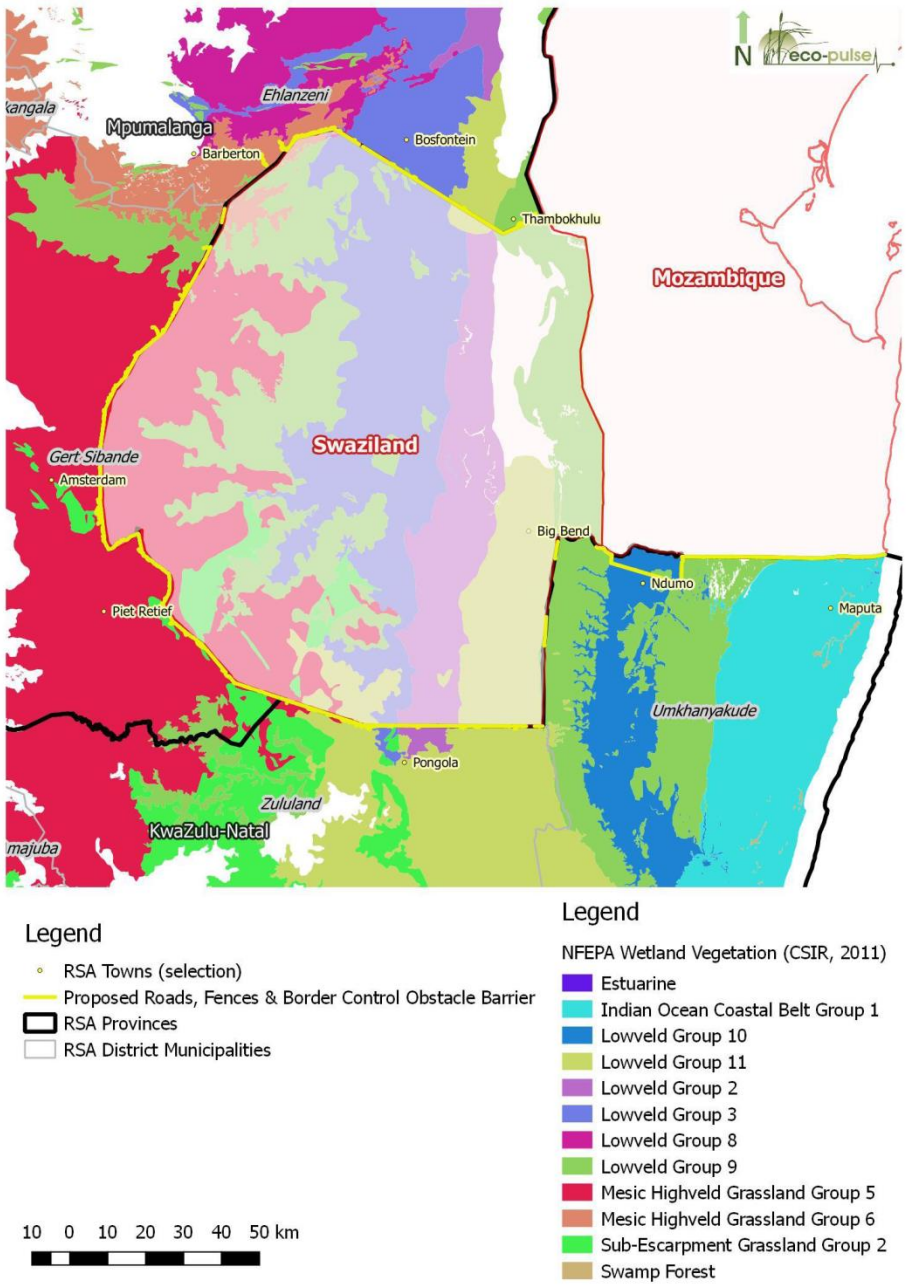


Figure 58: Map showing the threat status for NFEPA Wetland Vegetation Groups within the study area

6.9.3 NFEPA Rivers and Associated Sub-catchments

The NFEPA status of each NFEPA River occurring within NFEPA sub-quaternary catchment planning units in the study area is summarised in Table 22 . The spatial location of NFEPA Rivers and their associated catchment status is provided in Figure 59. The Hlelo, Komati and Mhlangampepa Rivers are classified as FEPAs. The Phongolo, Mhkondvo, Blesbokspruit, Ndlozane, Mpuluzi and Lusushwana Rivers are all classified as Fish Support Areas and remaining rivers and their associated catchments are Upstream Management Areas, with a few unclassified rivers.

Table 22: Summary of the FEPA Rivers identified for the project area

Quaternary Catchment	River Name	NFEPA Classification
W52D	Hlelo	FEPA
X12K	Komati	FEPA
X12K	Mhlangampepa	FEPA
W45B	Phongolo	Fish support area
W51E	Mhkondvo	Fish support area
W51F	Blesbokspruit	Fish support area
W51F	Ndlozane	Fish support area
W55E	Mpuluzi	Fish support area
W56A	Lusushwana	Fish support area
W53E	Mlambo	Upstream management area
W54E	uSuthu	Upstream management area
W55D	Metula	Upstream management area
W42K	Mozana	Upstream management area
W42K	Nyamane	Upstream management area
W42M	Mtokotshwala	Upstream management area
W42M	Spekboom	Upstream management area
W43F	Ngwavuma	Upstream management area
W44B	Manzawakho	Upstream management area
W44C	Sitilo	Upstream management area
W60K	Tsambokhulu	Not classified
X13H	Komati	Not classified
X13J	Mzinti	Not classified

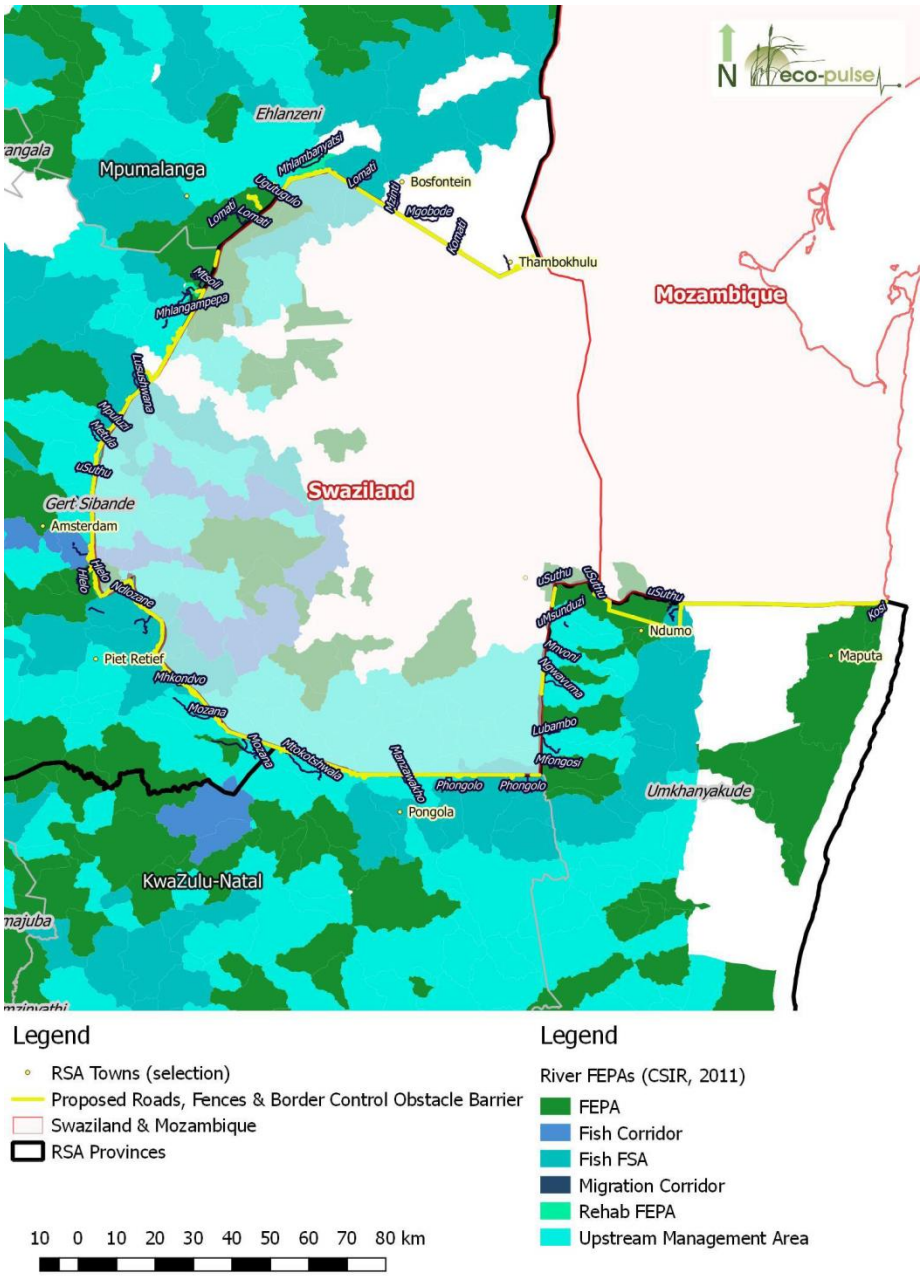


Figure 59: Map showing the location and extent of the various sub-types of River FEPA catchments in relation to the study area

6.10 KwaZulu-Natal Freshwater Systematic Conservation Plan

The aquatic conservation plan for KwaZulu-Natal was analysed to inform the assessment of provincial level aquatic conservation priorities and sensitivities. The location and classification of river sub-catchment according to the conservation priorities of the KZN Aquatic Conservation Plan is shown in Figure 61 below.

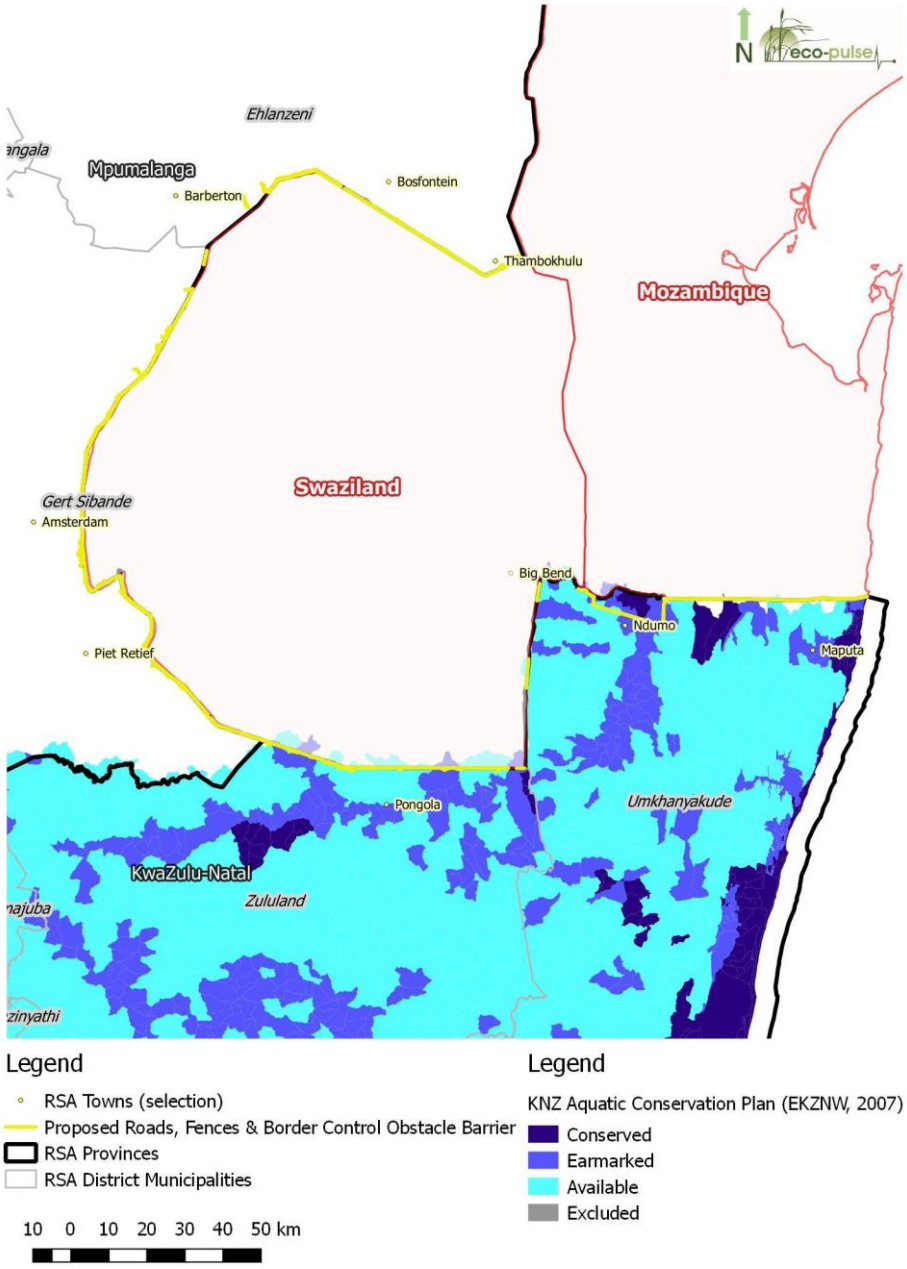


Figure 60: Map showing the classification of river sub-catchments with conservation priorities according to the KZN Aquatic Conservation Plan

6.11 Mpumalanga Freshwater Systematic Conservation Plan

While the Mpumalanga Freshwater Assessment does identify unit scale features of conservation importance, this coverage was based on the NFEPA wetland dataset. To avoid the duplication of results and ensure comparability with the KZN Freshwater Conservation Plan, only catchment level planning status is presented for freshwater ecosystems at a provincial level using the important catchment dataset for Mpumalanga. Figure 61 below shows the outputs of the Mpumalanga catchment level aquatic conservation planning dataset.

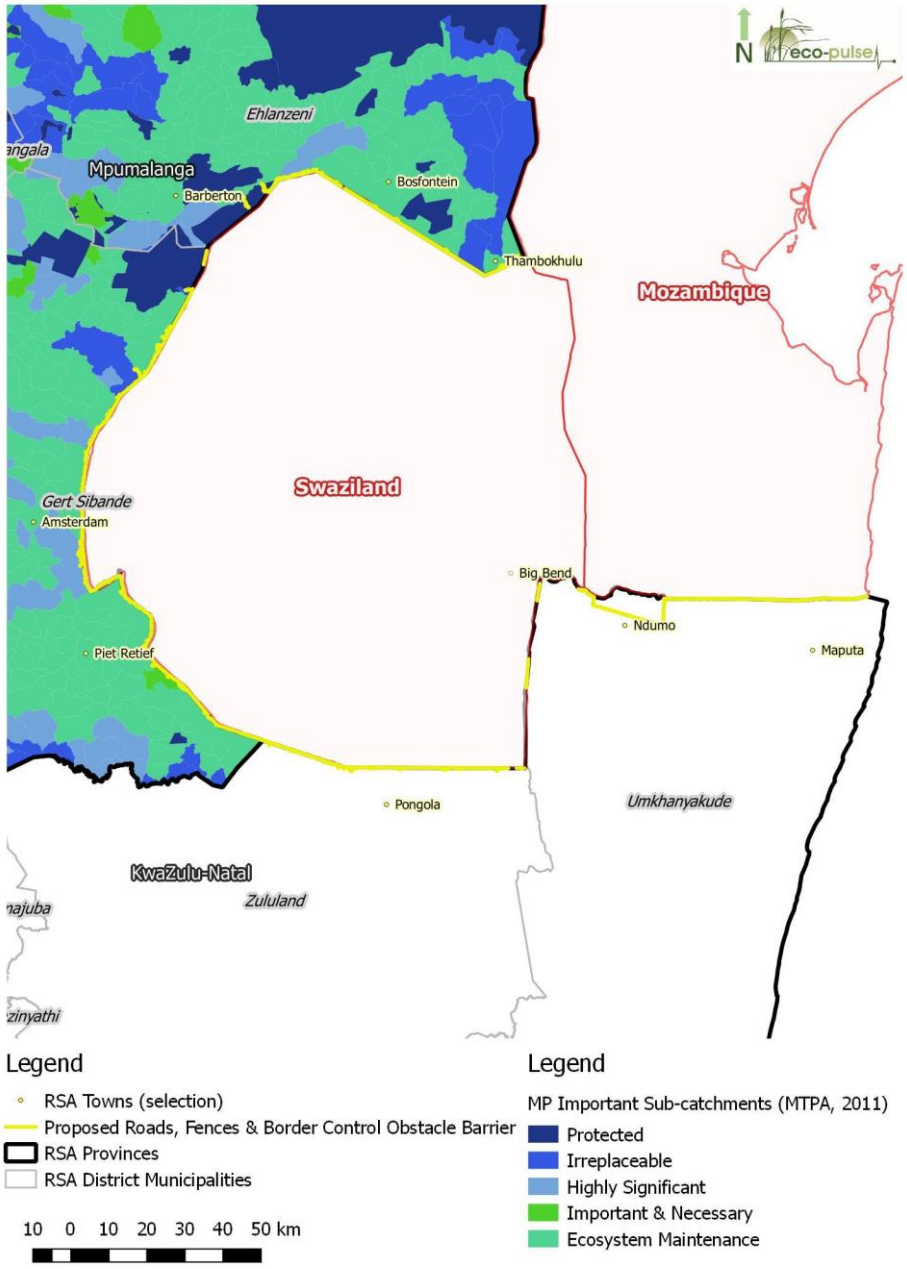


Figure 61: Map showing the classification of river sub-catchment according to the Mpumalanga Aquatic Biodiversity Sub-catchments

6.12 Heritage

6.12.1 Pre-colonial Archaeology

Archaeological sites occur throughout the project area along the border with Swaziland and Mozambique. These include five Early Stone Age, eight Middle Stone Age, five Later Stone Age, two Later Iron Age, one Rock Art, and four Later Iron Age / Historical period sites. The highest heritage rating for all these sites in applies to the globally significant Border Cave site.

The desktop study indicated that many areas within the project area have never been systematically surveyed for any heritage sites. These include the far western and northern sections of the study area that borders onto Mpumalanga. However, given the extraordinary rich heritage of the Mpumalanga Province[11&12] and the fact that significant Rock Art[13] and Later Iron Age sites are known to occur within 15km or so from the proposed border road project[14] it is expected that these categories of sites may also be found in the near environs of the footprint.

6.12.2 Historical Period: Archaeology and Built Environment

The various border posts along the road have been operating as entrances to and from Swaziland and Mozambique for many decades. It is highly likely that some of the earlier buildings and structures associated with these border posts are older than 60 years and they will therefore have heritage value. In addition, the historical towns of Barberton and Pilgrims Rest are situated relatively close to western and northern border of Swaziland[15].

6.12.3 Graves

Large sections of the proposed border road project pass through communal or tribal areas. It is expected that some of the existing homesteads of these areas do contain associated grave sites.

6.12.4 Cultural Landscapes and Sense of Place

The cultural landscape is an aspect of heritage not defined in the National Heritage Resources Act but nevertheless listed as part of the National Estate. No evidence for any known cultural landscapes exists along the proposed border road project.

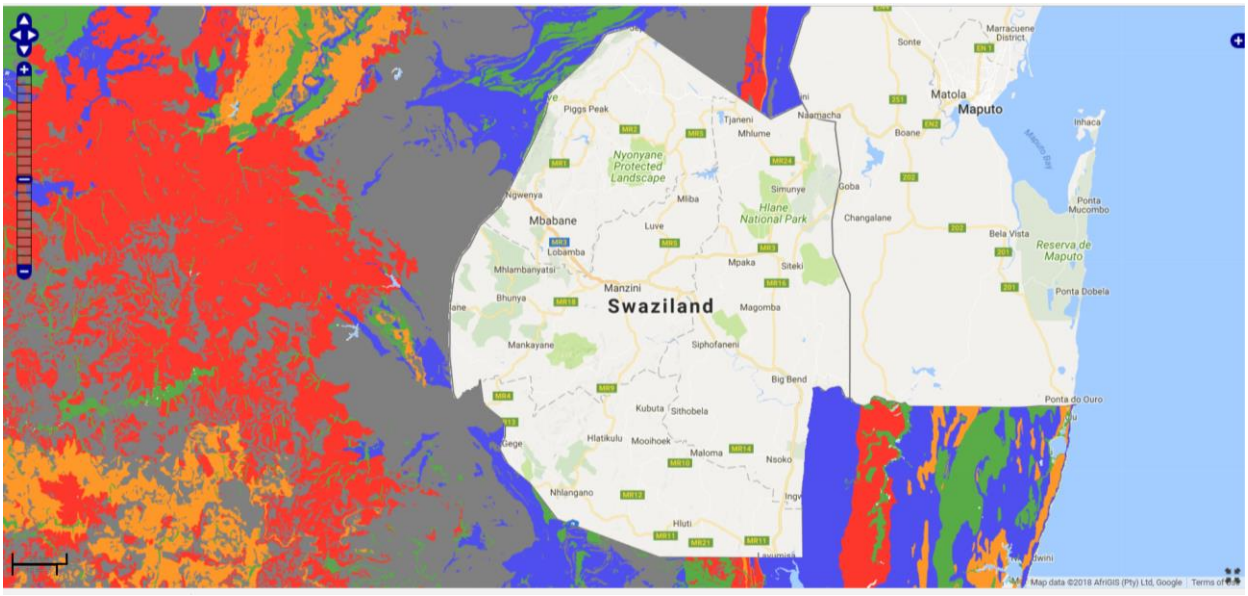
6.12.5 Living Heritage

The living heritage of the project area has not been researched and is not represented in any database. Some of the prominent mountains and other natural features in the greater project area may have 'living heritage' values.

6.13 Palaeontology

A palaeo-sensitivity map covering the project area is presented in Figure 62. From a palaeontological perspective, the greatest section of the project area is underlain by formations of low and moderate fossil sensitivity (indicated by grey, blue and green colouring in Figure 62). However, formations of high and very high sensitivity (indicated by orange and red colouring in Figure 62) occur in the environs of the Ndumo Game Reserve and near Golela on the South African-Mozambique Border. Formations of high and very high sensitivity also occur near Tshaneni on the northern border of Swaziland with Mpumalanga.

[11] *Delius, P. 2007. Introduction. In Delius, P (ed) Mpumalanga reclaiming the past, defining the future. Department of Culture and Tourism, Mpumalanga.*
[12] *Kros, C. 2007. The Heritage of Mpumalanga. In Delius (ed) Mpumalanga reclaiming the past, defining the future. Department of Culture and Tourism, Mpumalanga.*
[13] *Smith, B. & Zubieta, L. 2007. The rock art of Mpumalanga. In Delius (ed). Mpumalanga reclaiming the past, defining the future. Department of Culture and Tourism, Mpumalanga.*
[14] *Huffman, T. N. 2007. Handbook to the Iron Age: The Archaeology of Pre-colonial Farming Societies in Southern Africa. University of KwaZulu-Natal Press. Pietermaritzburg.*
[15] *Van Wyk-Rowe, C. 1997. The Prehistorical and Early Historical Inheritance of the Mpumalanga Escarpment. Research by the National Cultural History Museum Vol (6): 59-77.*



Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

Figure 62: Paleo-sensitivity map and description of sensitivity ratings

6.14 Social Environment

6.14.1 Population Concentrations

According to the 2011 Census data, there are approximately 461 144 people living within 15km of the border that is being covered by this project (on the South African side). Statistics are not available for the Mozambique and Swaziland areas across the border.

From the spatial presentation (Figure 63) it is clear that population concentrations in close proximity to the border mostly occur in semi-rural and rural settlement areas that can be described as State Land, Ingonyama Trust Land or Communal Land areas.

The highest concentration of population exists in the Nkomazi Municipal area, Mpumalanga (northern section of the study area), where settlements reflect a formal structured layout. The second highest concentration of population appears to be within the Chief Albert Luthuli Municipal area where both structured and sprawling unstructured (and seemingly uncontrolled) settlement appears to occur.

Thirdly, population groupings exist within the uPhongolo and Jozini Municipal areas of KZN.

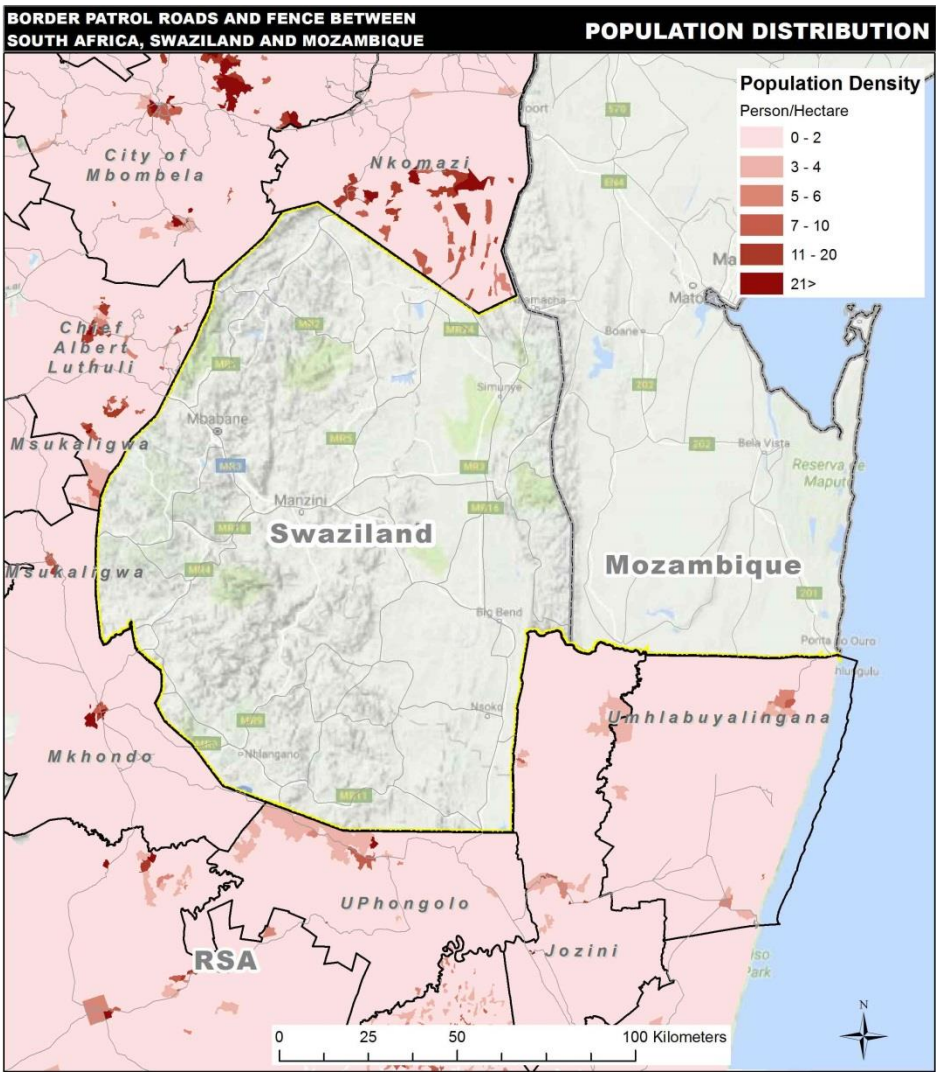


Figure 63: Population distribution in the study area

6.14.2 Social and Economic Infrastructure

It is therefore expected that social infrastructure such as schools, clinics and day hospitals and retail infrastructure will also be situated within the areas of higher population concentrations.

Based on the spatial presentation of social infrastructure, there are 34 schools within 2km of the border and 2 hospitals, 13 clinics and 18 schools within 5km of the border (Figure 64).

It is in particular where population concentrations and settlement areas exist, especially if in close proximity to where similar concentrations on the opposite side of the border, there is evidence of Swaziland residents accessing social and business services on the South African side on a regular and some instances, daily basis. It is important that these areas be discussed with the relevant Departments' (DIRCO and DHA), to seek guidance on the manner in which they plan to address or regulate such activity and what the fencing, patrol / monitoring or other infrastructure requirements will be, in accommodating their needs.

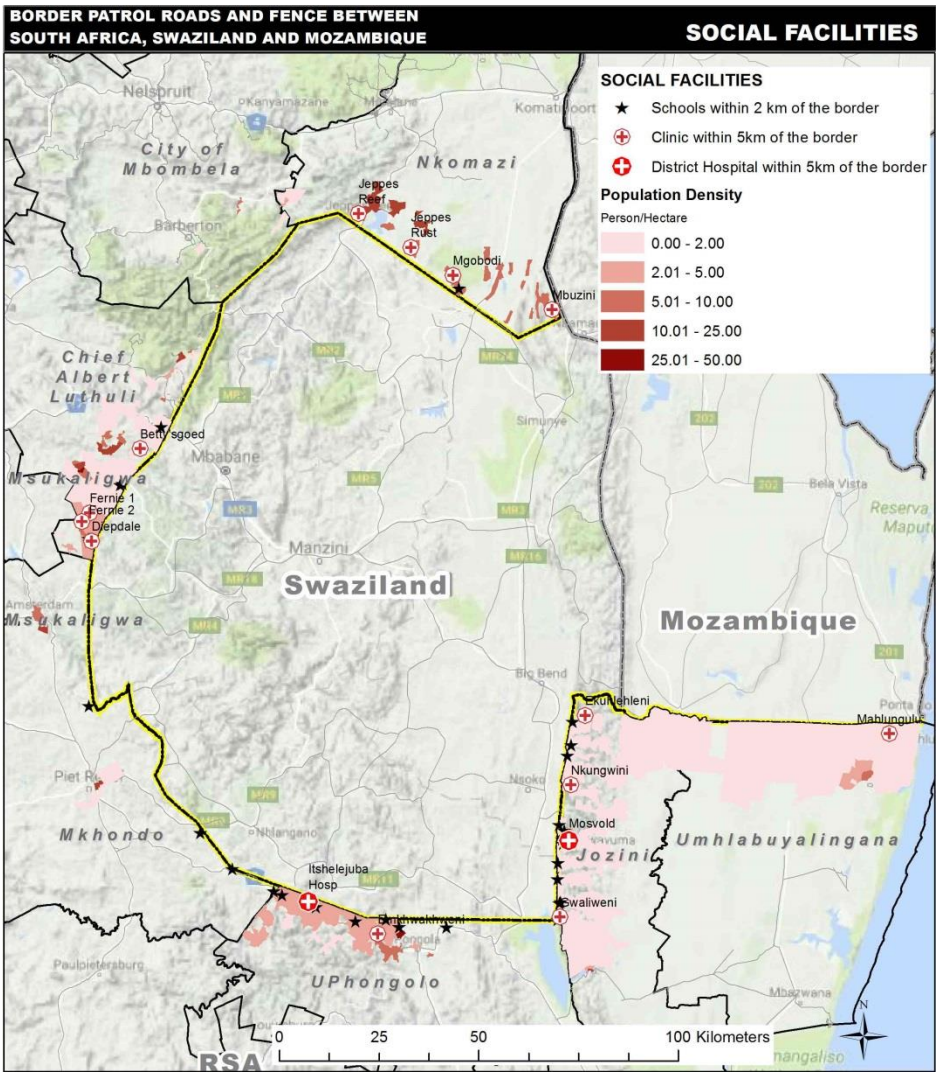


Figure 64: Social facilities in the study area

6.15 Cross-border Informal Movement of people in the Study Area

Another key social issue in the wider study area that relates directly to the proposed development is the 'porosity' of the international border – i.e. the level of informal (i.e. not subject to immigration controls) that occurs along much of the international border.

At a number of other locations along the fence line, movement of people across the border occurs, either through points in the fence that are under disrepair or through culverts. Much of this movement appears to be for visiting family and friends, accessing social services (educational and health care) and business services. Such movement can therefore not automatically perceived as being "illegal" or "criminal" and the necessary systems need to be put in place to enable such movement to continue in a controlled manner. The reality however is that there is also movement of people (as part of illegal immigration) and goods (as part of smuggling networks) which needs to be prevented.

In response to the potential social impact of such informal movement of people between the two countries being threatened by the securing of the border, the Applicant has stated that the intention of the project to upgrade fencing and patrol infrastructure along the border and not to disrupt current cross-border activities

by neighbouring local rural communities that needs to be accommodated and regulated by relevant Departments. The necessary provision of V-gates, gates and control infrastructure will be accommodated in the detailed design and construction phase.

In this context, it is important to note that the responsibility for the control of the movement of people across South Africa's border remains the responsibility of the Department of Home Affairs. Although this Department is not the end user of the proposed patrol and security infrastructure upgrades, the Applicant (DPW) is in on-going consultation with the Department as part of the DPW's Integrated Border Management approach.

It is expected to be the less formalised movement of people away from these control points that is most likely to be affected by the proposed project, as it would be very difficult to accommodate such movement while preventing the illegal smuggling of contraband which is one of the key objectives of the development of improved security infrastructure.

7 PUBLIC PARTICIPATION PROCESS

Public participation is a process that is designed to enable all Interested and Affected Parties (I&APs) to voice their opinion and / or concerns which enables the practitioner to evaluate all aspects of the proposed development, with the objective of improving the project by maximising its benefits while minimising its adverse effects.

I&APs include all interested stakeholders, technical specialists, and the various relevant organs of state who work together to produce better decisions.

The primary aims of the public participation process are:

- to inform I&APs and key stakeholders of the proposed application and environmental studies;
- to initiate meaningful and timeous participation of I&APs;
- to identify issues and concerns of key stakeholders and I&APs with regards to the application for the development (i.e. focus on important issues);
- to promote transparency and an understanding of the project and its potential environmental (social and biophysical) impacts (both positive and negative);
- to provide information used for decision-making;
- to provide a structure for liaison and communication with I&APs and key stakeholders;
- to ensure inclusivity (the needs, interests and values of I&APs must be considered in the decision-making process);
- to focus on issues relevant to the project, and issues considered important by I&APs and key stakeholders; and
- to provide responses to I&AP queries.

The public participation process must adhere to the requirements of Regulations 41 and 42 (GNR 326) promulgated under the NEMA (as amended).

The public participation process for proposed project will be undertaken according to the steps outlined in Figure 65 below.

Figure 65: Steps in the public participation process

In order to achieve a higher level of engagement, a number of key activities have taken place and will continue to take place. These included the following:

- The identification of stakeholders is a key deliverable at the outset, and it is noted that there are different categories of stakeholders that must be engaged, from the different levels and categories of government, to relevant structures in the non-governmental organisation (NGO) sector, to the communities of wards of residential dwellings which surround the study area;
- The development of a living and dynamic database that captures details of stakeholders from all sectors;
- The fielding of queries from I&APs and others, and providing appropriate information;
- The convening of specific stakeholder groupings / forums as the need arises;
- The preparation of reports based on information gathered throughout the BA *via* the PPP and feeding that into the relevant decision-makers;
- The PPP includes distribution of pamphlets or Background Information Documents (BIDs) and other information packs; and
- Where appropriate site visits may be organised, as well as targeted coverage by the media.

The proposed project PPP has entailed / will entail the following activities:

7.1 Consultation with Stakeholders

Consultation with relevant key stakeholders were, and will continue, to be undertaken through meetings, telephone calls and written correspondence in order to actively engage these stakeholders from the outset and to provide background information about the project during the BA process.

7.1.1 Commenting Authorities

The KZN Economic Development, Tourism and Environmental Affairs (EDTEA) will be a Commenting Authority for the portion of the route that traverses the KZN Province. The Mpumalanga Department of Agriculture Rural Development, Land and Environmental Affairs (MDARDLEA) will be the Commenting Authority for the portion of the route that traverses the Mpumalanga Province.

Formal comments will be requested from the Commenting Authorities when the Consultation BAR (cBAR) is ready for review and comment.

7.1.2 Provincial Conservation Authorities

Workshops have taken place with MTPA and EKZNW on 11 May 2018 and 28 May 2018 respectively. The purpose of the meeting was to introduce the MTPA and EKZNW to the proposed project in an attempt to determine specific requirements with regards to route determination, road and fencing around Protected Areas, TFCA and CCA implications.

A follow-up workshop was held with EKZNW, DAFF, SANDF and DPW on 12 July 2018 resolved a few issues emanating from the workshop held on 28 May 2018.

Minutes of the meeting are included in ***Appendix A***.

7.2 Site Notification

The EIA Regulations 2014 (as amended in 2017) require that a site notice be fixed at a place conspicuous to the public at the boundary or on the fence of the site where the activity to which the application relates and at points of access or high through traffic. The purpose of this is to draw people's attention to the project and make them aware that they are able to play a role in the project.

I&APs were identified primarily from responses received from the notices that were placed, notifying the public of the project and the invitation for the public to register as stakeholders and inform them of the PP Process.

Royal HaskoningDHV erected a number of notices at various noticeable locations along the proposed location (refer to ***Appendix I1***).

7.3 Identification of Interested and Affected Parties

E-mails and letters were sent to key stakeholders and other known I&APs, informing them of the application for the project, the availability of the draft cBAR for review and indicating how they could become involved in the project.

The contact details of all identified I&APs are updated on the project database, which is included in ***Appendix I2***.

This database will be updated on an on-going basis throughout the BA process.

7.4 Briefing Paper

A Background Information Document (BID) for the proposed project was compiled in English, *isiZulu* and *Siswati* (refer to ***Appendix I3***) and distributed to key stakeholders.

The aim of this document is to provide a brief outline of the application and the nature of the development. It is also aimed at providing preliminary details regarding the BA process, and explains how I&APs could become involved in the project.

The briefing paper was distributed to all identified I&APs and stakeholders, together with a registration / comment sheet inviting I&APs to submit details of any issues, concerns or inputs they might have with regards to the project.

7.5 Focus Group Meetings

A series of Focus Group Meetings will be held during the review and commenting period of the cBAR. Details of the FGMs and minutes will be included in the final cBAR.

7.6 Advertising

In compliance with the EIA Regulations 2014 (as amended in 2017), notification of the commencement of the BA process for the project as well as the review and commenting period was advertised in three newspapers i.e. Isolezwe, Mpumalanga News and Highvelder *(**Appendix I4**)*. I&APs were requested to register their interest in the project and become involved in the BA process. The primary aim of these advertisements was to ensure that the widest group of I&APs possible was informed and invited to provide input and questions and comments on the project.

7.7 Issues Trail

Issues and concerns raised in the public participation process during the BA process have been and will continue to be compiled into an Issues Trail.

The Issues Trail is attached as ***Appendix I5***, in which all comments received and responses provided to date have been categorised and captured.

7.8 Public Review of the draft Consultation BAR

The draft Consultation BAR (cBAR) is being made available for authority and public review for a total of 30 days from 17 September to 17 October 2018.

The Executive Summary (English, *isiZulu* and *Siswati*) will be made available at the following public locations within the study area as well as the Royal HaskoningDHV website, which are all readily accessible to I&APs:

- Manguzi Public Library – No 4b Manguzi Main Road – P522 (opposite Manguzi Cash and Carry)
- Jozini Public Library – No 1 Circle Street, Jozini Bottom Town, Jozini
- Manyiseni Public Library - Next to Mathenjwa Tribal Authority, Manyiseni
- Pongolo Public Library - 61 Martin Street, Pongolo
- Ncotshane Public Library - Yende Street, Next to Ncotshane Clinic, Ncotshane Township
- Piet Retief Public Library, 10 Retief Street, Piet Retief
- Chief Albert Luthuli Public Library, Voortrekker Street; Carolina
- Khululwazi Public Library, Empuluzi
- Msukaligwa Public Library, Cnr Church & Taute Street, Ermelo
- Armsterdam Public Library, 10 R65, Amsterdam
- Badplaas Public Library, Goodman Street, Badplaas, eManzana
- Elukwatini Public Library, 28 Church Street, Carolina
- Komatipoort Public Library, Erf Street, Komatipoort
- KaMhlushwa Public Library, A KaMhlushwa
- Kwamaqhekeza Public Library, B Kwamaqhekeza
- Langeloop Public Library, Langeloop Community Hall
- Emjindini Public Library, 477 Shongwe Street, Kwamhola, Barberton
- Nelspruit Public Library, 45 Samora Machel Road, Nelspruit
- Royal HaskoningDHV Website: www.rhdhv.co.za/pages/services/environmental.php

7.9 Final Consultation BAR

The final stage in the BA process entails the capturing of responses and comments from I&APs on the cBAR in order to refine the cBAR, and ensure that all issues of significance are addressed.

The final cBAR will be the product of all comments and studies, before being submitted to Department of Environmental Affairs (DEA) for review and decision-making.

7.10 PPP Summary

A summary of the PPP is provided in Table 23 below, with the documents provided in ***Appendix E***.

Table 23: Summary of Public participation process

Activity	Description
Identifying stakeholders	Stakeholders were identified and a database of all I&APs were compiled
Publishing newspaper adverts	Isolezwe, Highvelder and Mpumalanga News
Distribution of a BID	BIDs were distributed electronically and by hand to I&APs
Erection of site notices	A number of A2 site notices were erected along the proposed alignment
Preparation of an on-going Issues Trail	Comments, issues of concern and suggestions received from stakeholders thus far have been captured in an Issues Trail

Activity	Description
Release of Draft Report	The draft Consultation Basic Assessment Report (cBAR) was advertised and made available for a period of 30 days for public review and comment The cBAR is available for review until 17 October 2018
Focus Group Meetings	A series of FGMs will be held during the 30 day review and commenting period
Release of final Report	The final cBAR is the product of all comments and studies and will be submitted to DEA for review and decision-making

8 SPECIALIST ASSESSMENTS

8.1 Geotechnical Assessment

This study was undertaken by Drennan Maud (Pty) Ltd (***Appendix C1***).

The geotechnical factors most likely to have a material effect on the proposed project are considered to be:

- Global stability of the natural slopes traversed by the route.
- The occurrence of various problem soils i.e. heaving clays, collapsible, erodible and compressible soils, dispersive soils.
- Poorly drained areas characterised by marshy ground and / or groundwater seepage.
- Occurrence of hard rock outcrop at surface along the route.
- Sourcing of suitable materials for general fill and for use in the proposed road surface layers.

8.1.1 Slope Stability

Although no evidence of slope instability was noted during the site visits or desktop review, it is not possible to rule out localised instability at this stage, particularly within the mountainous regions and the toe-slopes thereof. In addition to the natural slope stability, consideration must be given to the effect that any significant earthworks may have on this stability. Cut-to-fill earthworks on steep slopes should be avoided as far as possible.

8.1.2 Problem Soils

- ***Active soils***
  Active soils are those that may be prone to volume changes (heave when wet and shrink when dry) with a fluctuation in the materials in-situ moisture content. Clay soils are generally active in nature although potential expansiveness is not wholly dependent on the relative amount of clay particles but rather the type of clay mineral (i.e. swelling clay such as montmorillinite and smectite). Nonetheless clayey material likely to be encountered in flat lying wetland / marshy areas as well as relatively thick deposits of colluvial and residual material derived from parent rock such as the Letaba basalt and mafic volcanic bedrock, Ecca shale and Dwyka tillite in general are considered to be potentially expansive in nature.

- ***Collapsible soils***
  Loose, sandy soil, such as the Quaternary dune sand material from Kosi Bay to the Lebombo Mountains as well as alluvial sand within rivers and tributaries, are in general considered collapsible in the sense that the material will be prone to settlement under an applied load with a critical increase in the materials moisture content.

- ***Erodible / dispersive soils***
  Due to the sandy nature of the Quaternary dune sand and inherent low cohesive forces between individual particles the material is considered highly susceptible to erosion via wind and flowing water forces, especially once cover vegetation has been removed. The same applies for sandy alluvial or colluvial material derived from sandstone / granite-based parent rock material. Dispersive soils are those clay-bearing soils that will in the presence of water undergo deflocculation, resulting in the very rapid formation of dendritic dongas and erosion scars across sloping areas as seen across side-slopes of the mountainous area directly west of the town of Pongola. Once initiated, the formation and expansion of these dongas is difficult to mitigate.

- ***Compressible soils***
  Normally consolidated clays and silts are generally compressible to varying degrees and tend to be associated with low / flat lying marsh / wetland areas and river crossings. Once loaded the soils will be subject to considerable consolidation settlement over the mid to long-term which may result in undulating road embankments and structural strain on bridges due to differential settlement thereunder.

- ***Groundwater seepage***
  Across elevated sloping areas ground water seepage is likely to be restricted to the seasonal perched variety i.e. localised seepage over short periods of the year. Such conditions could generally be dealt with symptomatically if and where encountered.

  However, permanent shallow ground water is likely to be encountered across low lying / level marsh / wetland areas or in the vicinity of drainage lines and major rivers / tributaries. Such shallow groundwater may present difficulties with the placement and compaction of fill embankments or stability of cuts and fills on sloping areas, necessitating either some form of drainage or alternatively, building the new development up to a “dry” level.

- ***Excavatability***
  Excavation within all unconsolidated soil material and completely weathered bedrock is likely to classify as ‘soft’ excavation after SANS 1200D standards. However, where large boulders are encountered within the soil material, as is likely in material derived from tillite or dolerite or hillwash / talus material and alluvial boulder horizons, the excavation thereof may be locally more onerous depending on the concentration and size of the boulders.

  Across undulating topography where cutting is required for the construction of the border road or where deviations away from the border are required, the excavatability of the weathered bedrock will range from ‘soft’, ‘intermediate’ to ‘hard’, depending on the degree of bedrock weathering. Nevertheless, in mountainous regions such as the Barberton range and the section of the route spanning Amsterdam to Oshoek, exposed hard rock is ubiquitous and such exposed bedrock should be expected to classify as “hard excavation” (i.e. blasting) from the outset.

- ***Material suitability***
  Based on information provided the type of material required for the construction of the border road and associated infrastructure includes the following:
  - Fill: G7 – G8 type gravel material (after TRH 14 – 1985).
  - Surfacing: Gravel wearing course material.
  - Gabion Rock: Crushed stone.
  - Concrete aggregate: Crushed stone.

  In terms of the above, G7 / G8 and wearing course material is likely to be attainable from weathered bedrock along most of the border route and in some cases even the overburden soils derived therefrom. However, the problems associated with sourcing large volumes of this material will generally be the overburden thickness and bedrock hardness at depth, both of which limit the volumes of potential borrow pits.

  Gabion stone and concrete aggregate, which has certain size and durability requirements, will be more difficult to source on a regular basis within potential existing or potential new borrow pit areas and as such it will likely be necessary to import these materials from the nearest commercial sources along the border route.

8.2 Freshwater Habitat Assessment

This study was undertaken by Eco-Pulse Environmental Consulting Services (***Appendix C3***).

8.2.1 Prioritisation (Flagging) of Watercourses for Field Verification

Due to the sheer number of watercourses potentially impacted by the border control infrastructure development, it was not practically or financially feasible for all of these watercourses to be assessed at a high level of detail. Practical constraints hindered the ability of the project team to access some areas due to either land use / ownership, dense vegetation or topographical limitations.

Key areas along the proposed corridor were therefore prioritised by for field verification and the collection of baseline information based on (i) the 'sensitivity' of the receiving environment (informed by the Desktop Ecological Sensitivity) and (ii) the 'threat' posed by the various road and fence activities. Accessibility was then a practical constraint limiting the actual implementation of the flagging process on the ground.

During a meeting with the Department of Water and Sanitation (DWS), the level of assessment applied to a uniquely large project of this nature was agreed upon. A proposal was put forward to screen watercourses for assessment based on the nature of the development type proposed and the sensitivity of the receiving environment. The proposed outcome was a 'flagging' exercise which would ultimately determine the level of field verification and detailed habitat assessments undertaken - Table 24.

Table 24: Summary of various flag statuses and the associated level of assessment required

Flag Status	Flag Status Description	Level of Field Assessment	Baseline Assessment Level
Green Flag	Given the status of the receiving environment and the nature or proximity of the proposed activity, the potential impacts on the receiving system are negligible	None	Desktop mapping and classification only. No PES and EIS assessment
Orange Flag	Given the status of the receiving environment and/or the nature or proximity of the proposed activity, the potential impacts on the receiving system are likely to be limited. Impacts within these areas are likely to be successfully mitigated through the application of generic mitigation measures	Desktop with some field verification where accessibility allows.	PES and EIS assessment to be undertaken
Red Flag	Given the status of the receiving environment and/or the nature or proximity of the proposed activity, the potential impacts are likely to be significant and generic mitigation measures may not be sufficient. Such areas require further specialist investigation to determine the extent of features that will be impacted, to collect more detailed information on PES / EIS and to identify potential site-specific options for mitigation	Desktop assessment and mapping refined through onsite delineation and assessment where possible	PES and EIS assessment to be undertaken

8.2.2 Wetland Flagging Results

The vast majority of wetlands were assigned a green flagged status (Figure 88 below), thus meaning that these wetlands would either be unaffected or subject to a very low degree of impact by the proposed border control infrastructure. The primary reason for the very high proportion of wetlands being assigned a green flagged status is that all wetlands within a 500m radius of the proposed infrastructure alignments were delineated, and accordingly the vast majority of wetland units will thus not be physically affected by the proposed border control infrastructure upgrades.

Certain wetlands located along the proposed infrastructure alignments were also green flagged. This was either because the wetland was determined to have a very low sensitivity rating due to a likely degraded state as evident during the desktop-based sensitivity rating assessment, and / or the nature of the upgrading / development of border control infrastructure was determined to be associated with a very low degree of risk of impact. In these cases the development / upgrading of border control infrastructure (especially related to the border patrol road) was determined to be low risk and the wetland unit was assigned a green flag status.

A large number of wetlands that occur along the south-western and western border of Swaziland in the Mpumalanga Highveld – also fell into this green flag category. This is attributed to the presence of an existing, maintained and currently operational forestry road along this portion of the route. Whilst a number of higher sensitivity wetlands are crossed by these, there is little upgrading proposed except for road resurfacing (and importantly no expansion of the road footprint in wetlands). As such, most of these wetlands also received a green flag status.

Other examples of high sensitivity wetlands receiving a green flag status also exist along the alignment and include the wetlands associated with the Phongolo River floodplain within the Ndumo Game Reserve (Ramsar Site), where the only proposed infrastructure along the border proposed was border beacons – an infrastructure development posing a very low risk to aquatic resources.

Just over 15% of all wetlands (of those wetlands occurring within a 500m radius) were orange flagged. These wetlands were typically higher sensitivity wetlands where the existing infrastructure was proposed to be upgraded (with the footprint of the existing infrastructure being increased, for example), or lower sensitivity wetlands (either based on HGM type or due to the more greatly degraded state of the wetland) in which no road infrastructure exists, and new roads are proposed.

A small proportion of wetlands were assigned the highest priority level and accordingly red flagged. In most cases a prerequisite for red-flagging was a scenario where no road infrastructure currently exists along the international border. Certain wetland HGM types were assigned a greater degree of sensitivity than other types, in particular floodplains and unchannelled valley bottom wetlands. In certain instances the sensitivity of the HGM type of the affected wetland was the determinant between whether the wetland was orange flagged or red flagged. As an example of this, the northern border of Swaziland in the Mpumalanga Lowveld along which no existing road infrastructure exists for most of the length of the international border, most seep (seepline) wetlands were orange flagged, while valley bottom wetlands were rather assigned a higher flag status.

In accordance with the flagging methodology all red flagged wetlands were assessed in the field, except where access to the wetland was not possible. It should also be noted that a number of red flagged wetlands along the northern Swaziland Border were not assessed in the field as the initial desktop assessment indicated an existing road along the border, but following field verification (ground-truthing) it was determined that no existing border patrol road infrastructure exists, thus retrospectively elevating certain wetlands along this section of the border to a higher class of prioritisation.

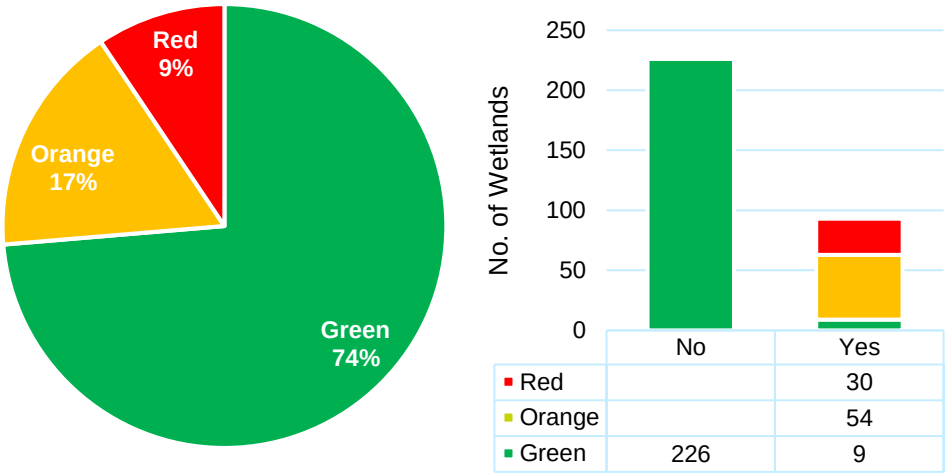


Figure 66: Pie chart showing the relative proportion of red, orange and green flags and bar graph illustrating the number of each flag and the degree to which each was assessed in detail[16]

8.2.3 River Flagging Results

The desktop flagging of rivers, using the development threat posed and the ecological sensitivity of each watercourses indicated that the vast majority (234 in total) of rivers and streams to be impacted (crossed) obtained a green flag status followed by orange flag rivers (26 in total) and red flag rivers (5 in total). Figure 67 shows the number of each river flag and the proportion of each river flag status.

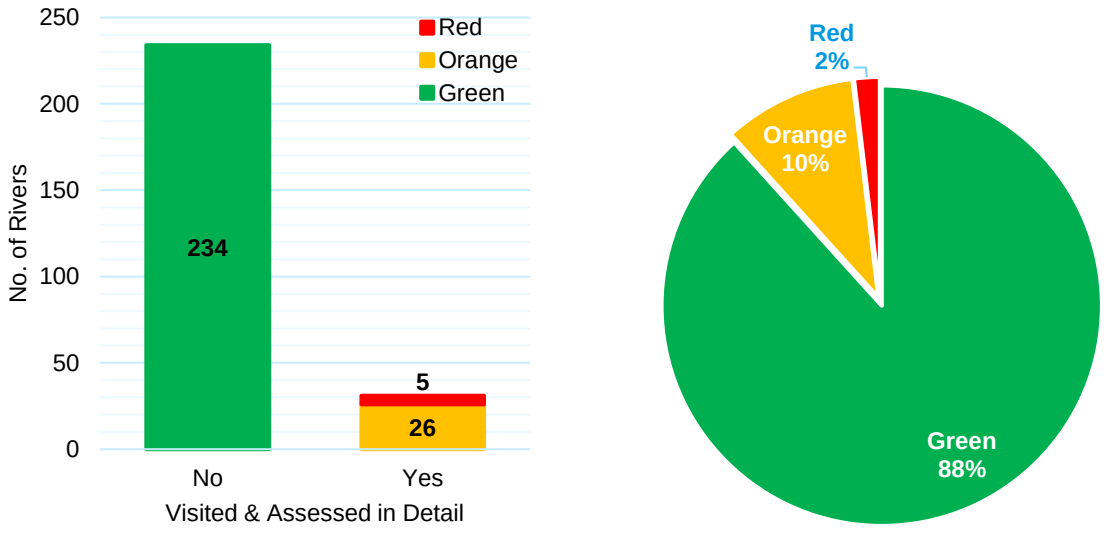


Figure 67: Bar graph and pie chart illustrating the number of each flag, the degree to which each was assessed and the relative proportion of red, orange and green flags[17]

[16] *'Yes' = assessed in detail and 'No' = desktop delineation and classification only.*
[17] *'No '= desktop delineation and classification only and 'Yes' = site visit and detailed assessment).*

Figure 68 below shows that small ephemeral streams were not particularly sensitive to the planned development types and obtained a green flag status across the board (202 in total). Twenty six (26) seasonal rivers also obtained green flag status due to the low sensitivity of these systems and the nature of the planned development (i.e. fence development or roads upgrades). These green flag rivers were not visited during field investigations or assessment in detailed. Seventeen seasonal (17) streams were however visited, delineated and assessed in detailed as they obtained orange (16 in total) and red (1 river) flags statues.

Majority (14 in total) of the perennial rivers mapped and rated obtained red and orange flag status and were field-verified, delineated and assessment in detail. Six (6) perennial rivers did however obtain a green flag status and were not assessed in detail. These perennial rivers were either not crossed by the planned infrastructure (i.e. occurring within 50m) or are crossed by existing fences that are to be upgraded, which were believed to be low risk activities to riverine habitats. Figure 68 shows the results of the flagging exercise per river class and the degree to which these were field verified and assessment in detail. Table 14 that follows presents the six (6) perennial rivers that were not field verified and assessed in detail and the rationale for their green flag status.

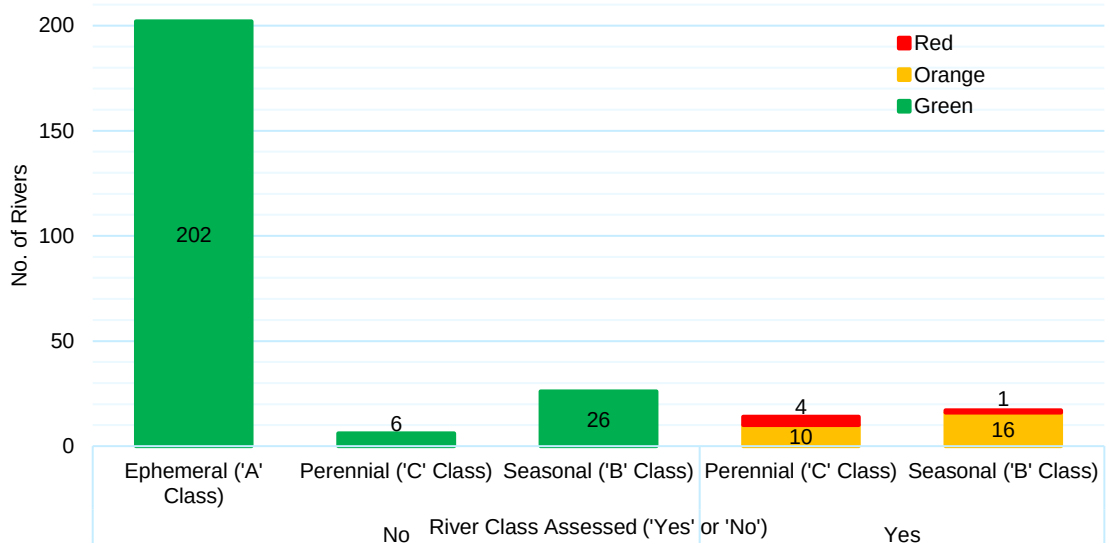


Figure 68: Bar graph illustrating the number of each river flag per river type and the degree to which each was assessed in detail[18]

Table 25: Summary of perennial rivers that were rated as 'green flags' for field investigations and detailed assessments

River ID	River Name	Planned Development and Rationale for Green Flag Status
W42K-R01	Nyamane River	Existing fence to veterinary fence. Existing fence to be upgraded with little to no additional impacts to the river expected
W56A-R05	Lusushwana River	
W42K-R03	Mozana River	

[18] *'No' = desktop delineation and classification only and 'Yes' = site visit and detailed assessment).*

River ID	River Name	Planned Development and Rationale for Green Flag Status
W53E-R07_50M	Ngwempisi River	Existing track to 5m gravel road to be development created near the river but no crossing planned (river within 50m of planned road)
X12K-R35	Komati River	Existing fence to veterinary fence. Existing fence to be upgraded near the river but no crossing planned (river within 50m of planned fence upgrade)
X13H-R01_50M	Komati River	Existing fence to be upgraded and a new 5m gravel to be constructed but no crossing of the river planned (river within 50m of planned road and fence)

8.2.4 Wetland Typology and Classification

Seeps are the most commonly occurring wetland type in the study area (along with valley bottoms), comprising just under 40% of the wetlands delineated in the study area (Figure 69). The prominence of this wetland HGM type within the study area is direct reflection of the nature of the topography of most of the terrain along the Swaziland Border which makes up the majority of the length of the alignment. Apart from the Maputaland Coastal Plain extending eastwards from the Ndumo Game Reserve and much of the Lowveld portion of the South Africa -Swaziland Border which are characterised by flat or very gently undulating topography, most of the remainder of the study area is characterised by sloping terrain of varying steepness.

While many valley bottom wetlands do occur in this type of terrain, many wetlands encountered are narrow drainage features in sloping terrain. Within the Lowveld portion of the route (northern Swaziland Border), many wetlands are Lowveld ‘seepline’ wetlands, occurring along the footslopes and midslopes and being characterised by seasonally activated shallow groundwater that leads to the development of hydric soils. The nature of the underlying geology along much of the western Swaziland Border supports the development of seep wetlands; a large section is underlain by basement granite which outcrops commonly in the form of exfoliation domes and inselbergs. Seepage of shallow groundwater to the surface is often associated with the presence of these granite outcroppings in this part of the route, often forming narrow seepage wetlands that are connected to the surrounding drainage systems.

Due to the nature of the topography of much of the route as detailed above, valley bottom systems are typically narrow drainage features, often naturally channelled with very limited channel overtopping and predominant water inputs from the surrounding slopes. Where the terrain is flatter, these valley bottoms are typically unchannelled. This is particularly the case in the flatter terrain of the Maputaland Coastal Plain and the Witkoppies-Berbice area (located south-east of Mkhondo along the south-western Swaziland Border) which are characterised by a higher portion of unchannelled valley bottom wetlands. Unchannelled valley bottom wetlands are typically highly important in a wetland functionality context (provision of ecosystem services) and in an ecological importance context and all of the sensitive swamp forest wetlands located in the Maputaland section fall into this HGM class.

Most of the remainder of wetlands are pan-depression wetlands. Like unchannelled valley bottom wetlands these typically occur in parts of the study area where the terrain is flatter; flatter terrain settings can be characterised by a low drainage network density and such settings often facilitate the presence of pans / depressions which are endorheic (inwardly draining), typically with no surface linkage to the surrounding drainage system.

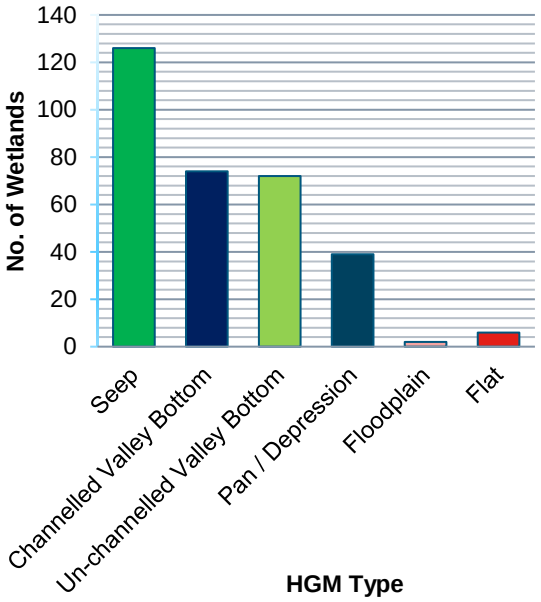


Figure 69: Number of different wetland types identified, mapped and classified to HGM level within 500m of the proposed development activities

At a quaternary catchment level it is evident that quaternary catchments W70A, W53E and W51F (Figure 70) have the highest numbers of wetlands, all with over 30 wetland units. W70A is a very large quaternary catchment, encompassing the entire Maputaland Coastal plain from the Indian Ocean to the Phongolo River at Ndumo (a distance along the international border of approximately 53km), hence the high number of wetlands. However parts of this catchment have a very low density of wetlands, as evidence by the very low overall drainage density within the wider catchment, in particular the western part of the quaternary catchment comprising of the Tembe Elephant Park and the corridor west of the park to Ndumo.

The catchment with the next highest number of wetlands is W53E. This catchment is much smaller than W70A but with a similar number of wetlands. The high proportion of wetlands relates to a very high drainage density in this particular part of the study area. The catchment comprises of a reach of the Ngwempisi River before flowing into Swaziland, as well one of its tributaries, the Mlambo River. The high drainage density relates to the nature of the topography which is very incised and hilly. A high proportion of drainage lines (typically expressed as valley head seep wetlands and narrow channelled valley bottom wetlands) drains the numerous valleys that occur along the border, with the border running parallel to the east-west aligned drainage network. It is important to note that most of the wetlands in this quaternary catchment were green flagged, due to the presence of existing forestry roads along the border being able to be used as the patrol road with little to no anticipated increase in footprint of the roads.

Quaternary catchment W51F (located to the north of the Bothashoop Border Post) comprising a reach of the Bleskbokspruit similarly contains a high number of wetlands, and the catchment W53E is characterised by hilly and incised topography with a high density of wetlands, comprised of a relatively equal split between seeps and narrow (unchannelled and channelled) valley bottom wetlands. Similarly to W53E, most of these wetlands are green flagged due to the presence of existing forestry roads along the border.

The other significant quaternary catchment containing a high density of wetlands is catchment W42K, located to the south of the Mananga Border Post. Unlike the catchments W53E and W51F, the topography within this catchment that comprises of the upper reaches of the Mozana River flattens significantly from the

hilly, incised ground to the north and the Mozana River drains a very wide, gently sloping valley. The flatter topography is conducive to the formation of a valley bottom wetlands characterised by depositional processes and a number of such valley bottom wetlands occur along the border line in this catchment. Along small parts of the reach of the Mozana River floodplain wetlands are formed (floodplain depressions in the form of oxbow lakes), one of the few parts of the study area where floodplain wetland features occur. It is important to note that a high proportion of the wetlands in lower part of the catchment were red flagged due to their high sensitivity and absence of a patrol road along this part of the border, and a number these wetlands were assigned high PES and EIS scores. The potential impact of the border patrol infrastructure on the wetlands in this catchment is thus significant.

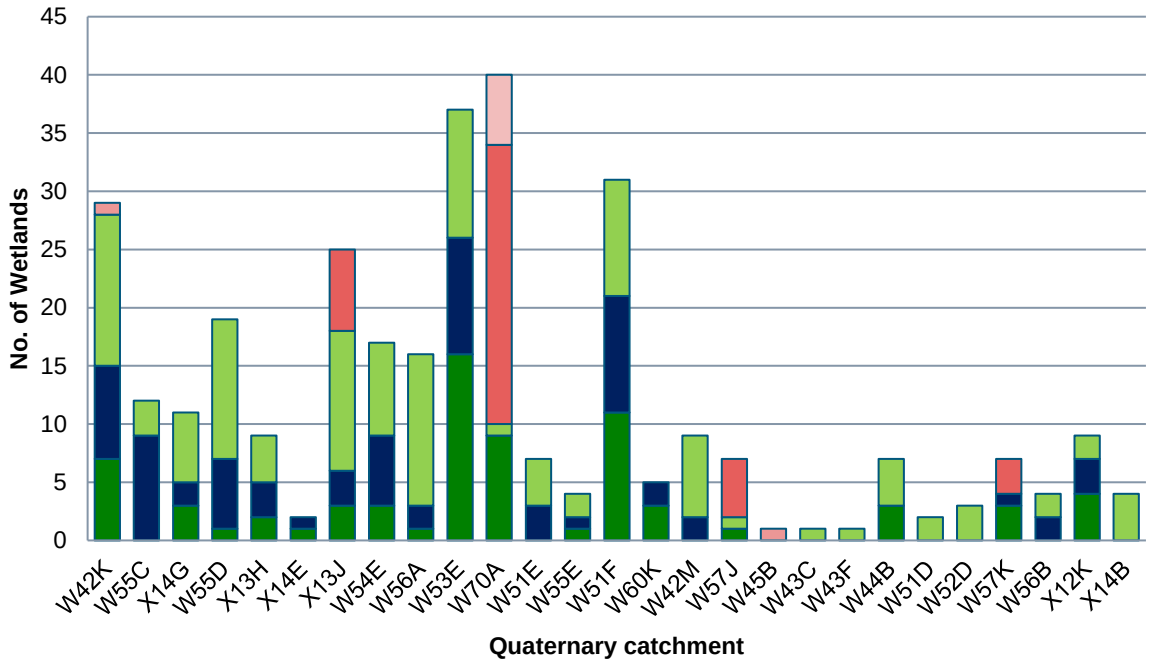


Figure 70: Number of different wetland types within 500m of the proposed development activities across the different quaternary catchments traversed

8.2.5 Wetland Vegetation Characteristics

The relative number of wetlands representing each of the respective vegetation communities per quaternary catchment assessed is presented in Figure 71. A brief description of dominant wetland vegetation communities encountered during field investigations is provided in *Section 2 of the Aquatic Ecological Impact Assessment* (***Appendix C3***).

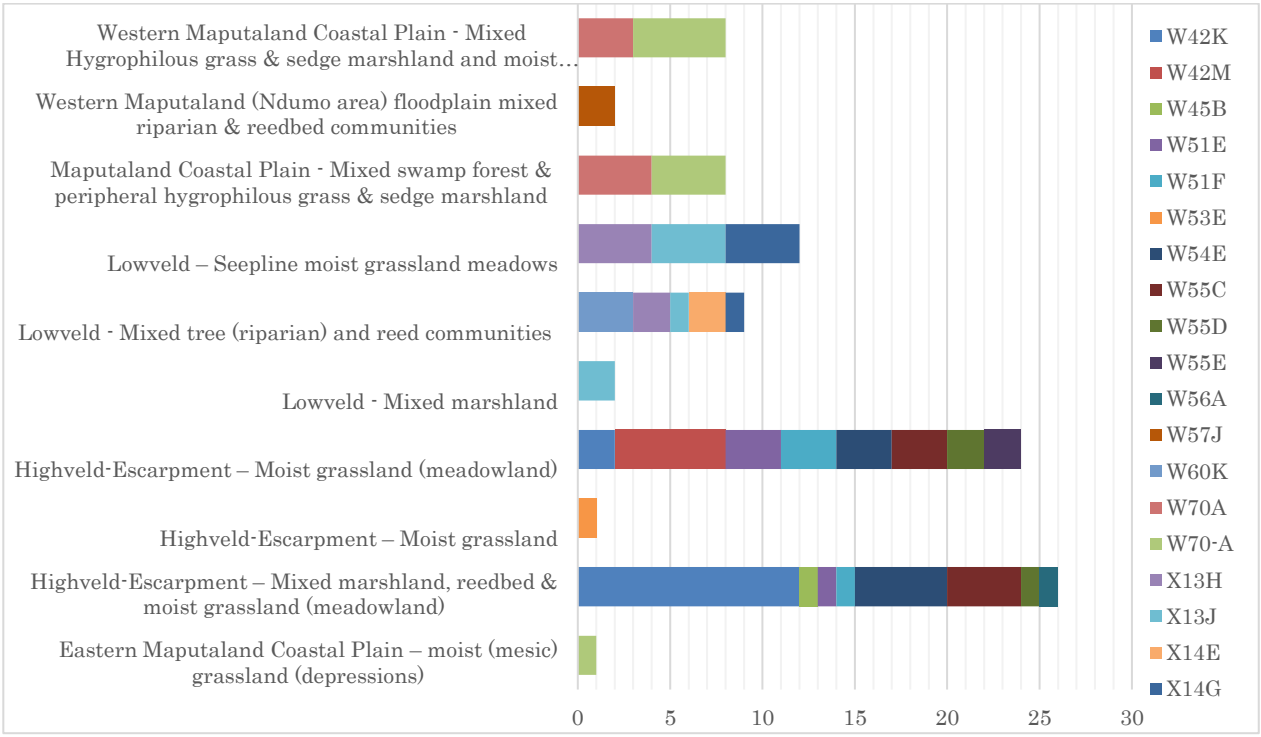


Figure 71: Respective vegetation communities per quaternary catchment assessed

8.2.6 Wetland Soil and Land-type Characteristics

The Maputaland Coastal Plain (located between the Indian Ocean and the Ndumo Game Reserve – and comprising the W70A quaternary catchment) is underlain by substrate of marine origin. Cretaceous to Miocene Era marine sands have been redistributed (over the period of the recent geological past) to create a number of dune cordons. The soils are accordingly highly sandy in nature.

The dominant land-types in this part of the study area are *Ha* and *Hb* land-type groupings. These are characterised by the predominance of grey regic sands (either dominant or with other soils); mostly deep, grey, apedal (structureless) soils with a sandy texture. They are mostly found on coastal plains, the soils having a low fertility status.

The various land-types present within the coastal plain are characterised by the predominance of the Fernwood Soil Form. The Fernwood Soil Form is a wetland soil form that is characterised by the presence of an E horizon as the underlying (subsoil) horizon, with the E horizon being indicative of the sub-surface (lateral) movement of water within the soil profile.

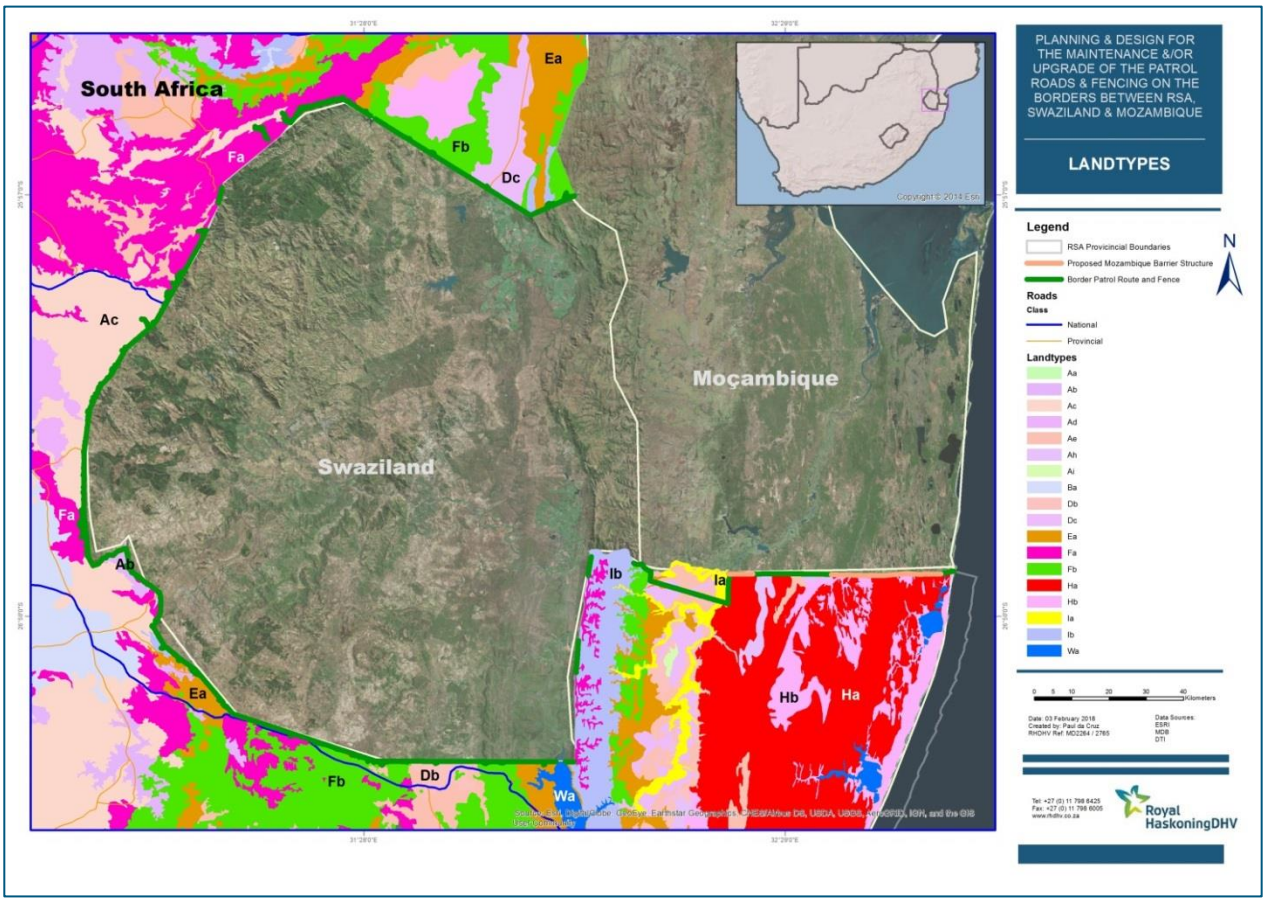


Figure 72: Land-type groupings in the study area

The Champagne Soil Form (a wetland soil form associated with permanently saturated wetland habitat and characterised by a very high degree of organic content) was found to occur in a number of the larger wetlands within the coastal plain in which field assessment was conducted and is the most typical soil form of the more saturated parts of these coastal plain wetlands.

The Phongolo River floodplain is characterised by the *Ia* land-type groupings, characterised by undifferentiated deep soil deposits. The soils within this land-type are typically deep pedologically youthful soils, which occur mostly along river courses, valley bottoms and in lower lying areas. Soils are usually weakly structured, with a great variety of colour (often mottled) and often, several layers have been deposited (usually by water) with different soil textures . The Phongolo River floodplain is characterised by extensive alluvial deposits and is thus a classical example of such a land-type. Extensive wetland soil forms occur within the *Ia30* land-type that occurs within the Phongolo floodplain, in particular the Dundee wetland Soil Form that is typified by hydromorphic soils of alluvial origin.

West of the Ndumo Game Reserve the terrain becomes much more rocky and elevated to form the foothills of the Lubombo Mountain Range. In this area and southwards along the Swaziland Border (which runs along the crest of the Lubombo Escarpment) wetlands and wetland soils become rare, as evidenced by the characteristics of the dominant land-type groupings – *Ib* and *Fa* land-type groupings. *Ib* land-type groupings are areas where 60-80% of the surface is occupied by exposed rock and stones / boulders and the slopes are usually steep. The rest of the area comprises mostly shallow soils, directly underlain by hard or weathered rock. *Fa* land-types are characterised by generally shallow soils consisting of a topsoil directly underlain by weathered rock (the Glenrosa Soil Form) or hard rock (the Mispah Form), sometimes with

surface rock and steep slopes . Due to slope steepness and the rockiness of the soil, hydromorphic soils are typically absent within this part of the study area and very few wetlands have been delineated west of Ndumo and along the south-eastern boundary of Swaziland to the Pongolapoort Dam. Where it occurs surface water drainage takes the form of watercourses rather than wetlands.

There is similarly a general absence of wetlands along the Swaziland Border west of the Pongolapoort Dam and north-westwards from the town of Pongola. Surface water drainage similarly takes the form of watercourses in this area, especially within terrain that is becomes increasingly elevated and steep and sloped as one moves north-west of Pongola along the international order. The predominant land-type family in this area is *Fb*, which is very similar to the *Fa* land-types and accordingly are characterised by very shallow soils with a predominance of rock in the substrate. Wetland habitat is thus limited or absent along the southern and south-western part of the Swaziland Border up to the Witkoppies-Berbice area where the terrain and land-type change to become much flatter.

The Witkoppies-Berbice area (south of the Mahamba Border Post) is characterised by soils falling within the *Ea* land-type grouping. Soils within this land-type are dark brown / black or red coloured strongly to very strongly structured (topsoil and subsoil) of varying depths. These soils have high clay content, displaying a high water-holding capacity and mostly containing a high percentage of swelling clay minerals. Vertic and melanic soils commonly occur in this land-type.

The Witkoppies-Berbice area is underlain by the *Ea96* land-type and in accordance with the characteristics for this particular land-type a large part of the valley floor component of the landscape was noted to be occupied by marshes and streambeds, with surrounding soils being either Rensburg (vertic) or Willowbrook (melanic) wetland soil forms.

To the north-west of the Witkoppies area the terrain rises in elevation and becomes more rocky and incised with the re-emergence of the *Fa* and *Ib* land-type families (rock and rocky substrate dominated). Although the occurrence of wetlands does not decrease, wetlands in this area are typically narrow seep or channelled valley bottom features in steep terrain.

Further north towards the Assegai Point area, and extending northwards along the western Swaziland Border to the Oshoek Border Post soils and land-types become dominated by the *Ac* family of land-types (with *Ab* land-types present to a lesser degree) that are interspersed with *Fa* land-types in rockier areas (predominantly landscapes associated with the outcropping of granite bedrock). *Ab* and *Ac* land-types are characterised by the presence of red-yellow apedal, freely drained soils. These soils are normally associated with high rainfall areas, where soils are subjected to moderate (i.e. mesotrophic) to intense (i.e. dystrophic) leaching of nutrients from the soil profile. The terrain remains largely hilly and incised in this part of the study area.

The most commonly occurring individual land-types in this area are the *Ac37* and *Ac38* land-types. Along with streambeds (that comprise 30% of the area of the valley floor terrain unit) Kroonstad and Katspruit wetland soil forms comprise half of the area of valley bottoms in these two land-types. Wetland soil forms are very limited in the footslope and midslope terrain units within these land-types, thus indicating that channelled valley bottom wetlands are widespread and the most dominant wetland HGM form within this part of the study area.

North of the Oshoek Border Post *Fa* land-types become entirely dominant, stretching north to the northern tip of Swaziland west of Jeppes Reef. The terrain in this part of the study area is highly incised and mountainous and the dominance of rock in the substrate (forming either Glenrosa or Mispah Soil Forms),

which coupled with the significant steepness of the terrain typically precludes the formation of hydromorphic soils and few, if any wetlands have been delineated in this part of the study area.

East of the Jeppes Reef area the terrain drops in elevation and changes in character to become much flatter (gently undulating), as is typical of the Lowveld area of this part of Mpumalanga. The section of the border between the Jeppes Reef and the Mananga Border Posts is characterised by the presence of the *Fb65* land-type – as described above *Fb* soil patterns are very similar to *Fa* soil patterns but are typically encountered in lower-lying areas with lower rainfall. Within valley bottom terrain settings, nearly a half of the land area of this land-type is comprised of wetland soil forms, including the Fernwood, Kroonstad, Wasbank and Cartref Soil Forms which are all characterised by the presence of an E horizon that overlies another horizon with distinct signs of wetness.

The seepline wetlands within which in-field delineation was undertaken displayed these wetland soil forms, in particular the Cartref, Westleigh and Kroonstad Forms.

The area to the south east around the Mananga Border Post and the Komati River is characterised by the *Dc34* land-type. This area is underlain by igneous rocks – basalt of the Letaba Formation – and the nature of this igneous underlying rock has resulted in the development of highly structured prismacutanic, pedocutanic and (less commonly) vertic clay soils. The very flat terrain within this particular area and within the *Dc34* land-type is associated with a low degree of surface water drainage, and a number of endorheic pan / depression wetlands are encountered in this area. Where wetlands were assessed in the field in this area they were found to be underlain by the Rensburg (vertic) wetland soil form.

In the remainder of the border extent within the study area two series of higher lying ridges are encountered which characterised by *Ib* land-types (areas where 60-80% of the surface is occupied by exposed rock and stones / boulders and the slopes are usually steep) and thus no wetlands are present. The intervening lower lying areas are characterised by *Ea* and *Fb* land-types with a very low occurrence of wetlands.

8.2.7 Present Ecological State (PES) Assessment

Results show that close to 50% of wetlands in the study area remain in natural to near natural condition (A / B PES classes). Of the remainder, most are moderately modified (C PES category) with few wetlands falling into the largely to seriously modified classes (D / E PES classes) (Figure 73). When evaluated against the thresholds applied in the National Biodiversity Assessment[19], this would suggest that the threat status of most wetland types within the project focal area could fall within the Least Threatened class (area of wetland ecosystem type in good or moderate condition >60% of the total area for that ecosystem type). This is based on an assessment of wetland condition within the study area however, which is poorly representative of the region, as limited development has taken place in close proximity to the border.

[19] *Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas project. Report to the Water Research Commission. WRC Report No. K5/1801. July 2011.*

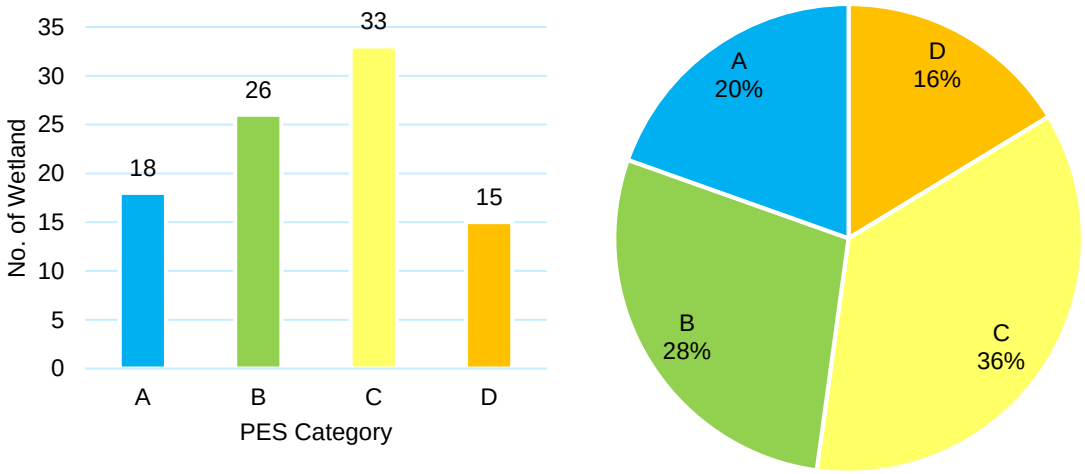
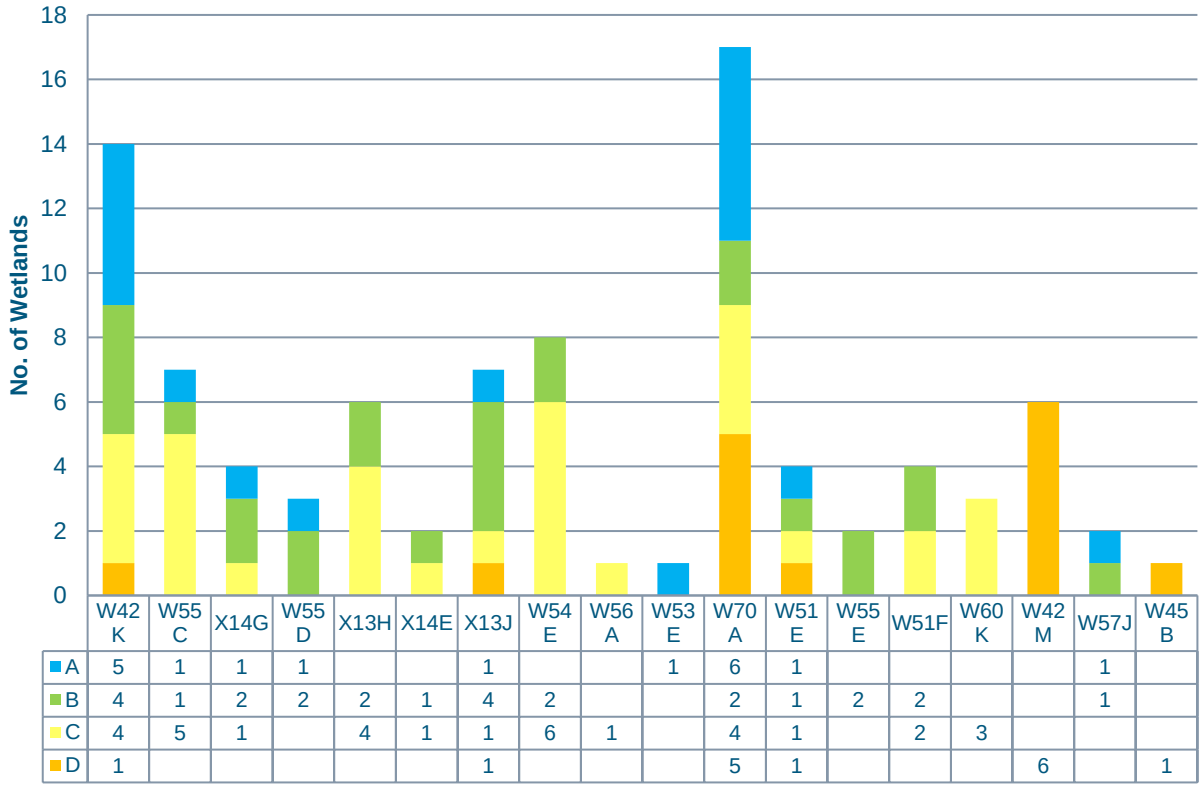


Figure 73: Condition of wetland systems across the entire project area (based on percentage and number of wetlands in each PES class respectively)

An analysis of the NFEPA WetVeg Group wetland ecosystem threat status provides a more regional perspective and indicates that a very large portion of WetVEG groups (i.e. wetland ecosystem types) in the study area have been identified to be threatened, with only the Maputaland Coastal Plain and certain of the Mesic Highveld Groups on the north-west Swaziland Border being listed as being not threatened (Least Concern). Most of the Lowveld WetVeg Groups (encompassing the Mpumalanga Lowveld portion of the study area and the western Maputaland (Ndumo) and Pongola areas in KZN) are listed as being Critically Endangered or Endangered. The Mesic Highveld WetVeg groups which occupy the western Swaziland Border are all largely listed as Endangered. The portion of wetland units that have been assessed through field assessment to be largely natural is thus significant in this context, but certain smaller scale spatial patterns of wetland state are evident, as discussed below.

A more detailed breakdown of the variation in wetland condition across the project focal area (at a quaternary catchment scale) is provided in Figure 74 below.



	W42K	W55C	X14G	W55D	X13H	X14E	X13J	W54E	W56A	W53E	W70A	W51E	W55E	W51F	W60K	W42M	W57J	W45B
A	5	1	1	1			1			1	6	1					1	
B	4	1	2	2	2	1	4	2			2	1	2	2			1	
C	4	5	1		4	1	1	6	1		4	1		2	3			
D	1						1				5	1				6		1

Figure 74: Graph showing the number of wetlands in each of the respective PES categories across all quaternary catchments

One of the key trends of this breakdown is the relatively high portion of highly transformed wetlands (assigned a highly modified PES score) in two of the quaternary catchments in the study area – W70A within the Maputaland Coastal Plain and W42M. As discussed above W70A is the largest catchment in the study area with the greatest number of wetlands. Figure 74 indicates that a third of all wetlands in this catchment for which PES scores were calculated were assessed to be highly modified (PES Class of D). This reflects a relatively high degree of land use-related wetland impact within large parts the Maputaland Coastal Plain. In most of the wetlands that were field surveyed in this part of the study area, historical subsistence cultivation (only one or two wetland units were noted be currently cultivated) had occurred which had resulted in much of the overall area of each wetland unit being physically disturbed – typically a hatched pattern of drains had been excavated within the wetland with the creation of associated cultivation mounds. This pattern of drains had thus significantly adversely altered the hydrological and vegetative state of these wetlands through the desiccation of much of the surface area of the wetland which in turn had allowed the colonisation of these parts of the wetlands by terrestrial (non-wetland) pioneer plants.

In certain of these wetlands that were assessed to be characterised by the presence of Swamp Forest under natural / reference conditions, almost complete alteration of natural vegetative structure and composition was noted to have occurred through the removal (felling) of all woody vegetation associated with Swamp Forest that had naturally occurred in the wetland. This vegetative transformative impact was compounded by the widespread drainage within these wetlands.

The other quaternary catchment characterised by high levels of wetland degradation was catchment W42M. This catchment occupies a hilly, incised part of the study area north-west of the town of Pongola. Due to the incised nature of the terrain most wetlands were identified to be narrow seep wetlands. All wetlands

assessed in this catchment were significantly eroded and channelised, with the majority of the reach of each wetland unit assessed either being eroded (gulley erosion leading to channelisation) and being significantly invaded by aliens with only certain reaches of the wetland units being more natural and less affected. Accordingly the hydrology, geomorphology and vegetation of these wetlands were assessed to be highly modified.

If quaternary catchments that are characterised by a high proportion of wetland units in a natural state are examined, the catchment W70A is one of these catchment, thus indicating that it has does not just have a high proportion of impacted wetlands, but a slightly higher proportion of wetland units in a natural state. Just under half of wetland units assessed in this catchment were assigned a natural / near natural state (PES = A / B).

Two other quaternary catchments (W42K and X13J) contained a majority of wetlands in natural / near natural state. W42K is significant as this catchment contains a high density of wetlands, many of which are of significant extent. The wetland units assigned a PES score of A or B were noted to be largely unaffected by land use-related and other impacts in a context of a low livestock 'footprint'(presence) within the wetlands and assisted by much of the units' catchments consisting of natural grassland, thus not allowing the catchment hydrology to be largely natural.

In the catchment X13J on the northern Swaziland Border in Mpumalanga land use-related pressures (in the form of livestock rearing) and subsistence cultivation were noted to have exerted a relatively low impact on many of the wetlands located along the international border line. The border line within this part of the study area is relatively remote, located away from large peri-urban settlements that are typical of human settlement patterns in this area, and large areas of land along the border are fenced off, thus not enabling livestock to permanently forage in these wetlands. In addition, no current or only historic subsistence cultivation has taken place within the catchments of the wetlands, with the natural vegetation cover having largely been retained. The relative prominence of wetlands in natural / near natural state is significant in the context of the very high threat level (Critically Endangered) assigned to the respective WetVeg group in much of this catchment.

The relative contribution of hydrology, geomorphology and vegetation PES scores that contribute to the overall PES of wetlands has been summarised below. A very strong trend that emerges from the analysis of the relative contributions of these three factors is the relative absence of geomorphological impacts in most of the wetlands assessed. The wetlands in the Maputaland Coastal Plain (quaternary catchment W70A) were noted to be characterised by very little, if any erosion, or large scale disturbance of wetland substrate. In spite of the alteration of wetland substrate by (historical) subsistence cultivation, wetlands which had formerly been altered by cultivation and drainage were noted to be well-vegetated with no visible signs of erosion. A combination of very flat topography and absence of channelised water flow in many of these coastal wetlands is a strong factor in maintaining the geomorphological stability of these wetlands.

This trend of limited erosion was also observed in other parts of the study area, including those areas which were characterised by more steeply sloping settings and wetland hydrological characteristics of largely channelled flows. As discussed above the quaternary catchment W42M displayed a relatively high degree of gulley erosion within the wetlands assessed and this catchment represents the part of the study area where wetlands were characterised by the lowest levels of geomorphological integrity.

Very little erosion was encountered within the wetlands of the Mpumalanga Lowveld in spite of poor land use practices and very high livestock densities in these former homeland areas. Such land use practices are often conducive to the development of erosion within wetlands and their catchments, but the wetlands

within much of the northern Swaziland Border area conversely displayed no erosion. The exclusion of livestock from large parts of the border area is partly responsible for this trend in this part of the study area.

Certain quaternary catchments displayed wetlands with high levels of hydrological impacts. In certain of these catchments – primarily on the western Swaziland Border (W42M, W56A, W55C) - infestation of wetland units by invasive alien vegetation (primarily Black Wattle – *Acacia mearnsii*) within the wetland and in the wetland unit's catchment was noted to have had significantly altered the hydrology of the wetland unit assessed. Subsistence cultivation within wetlands in certain parts of the study area – in particular the catchments W45B, X14E (on the northern Swaziland Border) and W70A (the Maputaland Coastal Plain) was also a significant factor in adversely altering wetland hydrology. Subsistence cultivation within wetlands alters wetland hydrology through the common practice of digging a network of drains and by creating mounds with the excavated substrate on which crops are cultivated. The widespread network of drains lowers the water table within much of the wetland, thus drying out the wetland and resulting in wetland vegetation composition alteration.

Plantation forestry was also responsible for elevating hydrology impact scores (i.e. adversely altering wetland hydrology), especially in quaternary catchments along the western Swaziland Border (e.g. W51F). Although plantations do not typically extend into wetlands, the high degree of water use by the trees (mature trees in particular) prevents water inflow to wetlands from the catchment, thus depriving the wetlands of water and altering their hydrology.

Vegetative impacts were the most commonly encountered of the three modules assessed in assigning wetland health scores across the study area with no quaternary catchment across the study area displaying wetlands with no or minimal vegetative impacts. Vegetative impacts mirrored hydrology impacts to a certain degree, as some of the hydrology impacts are directly related to in-wetland vegetation change / alteration, in particular alien invasive vegetation infestation (especially in catchments W42M,W56A, W55C), flooding of wetlands, and current / historical subsistence cultivation (as particular evident in W70A and X14E).

One of the most commonly encountered vegetative impacts (which is also a hydrological impact associated with the reduction in roughness of wetland vegetation, thus impairing the wetland's ability to impede or slow down water inflow) is the impact of intensive livestock grazing / trampling. The presence of cattle in wetlands often leads to the trampling of saturated soils which reduces vegetative cover through trampling that physically disturbs wetland vegetation, thus leaving soils vulnerable to desiccation and erosion. Such trampling impacts were encountered in many cases in direct proximity to the border fence line, as cattle tend to move along fence lines, thus concentrating the impact of trampling where saturated parts of wetlands are encountered. In certain places the development of headcuts at the border fence line were noted due to this cattle trampling factor as the primary cause of headcut initiation.

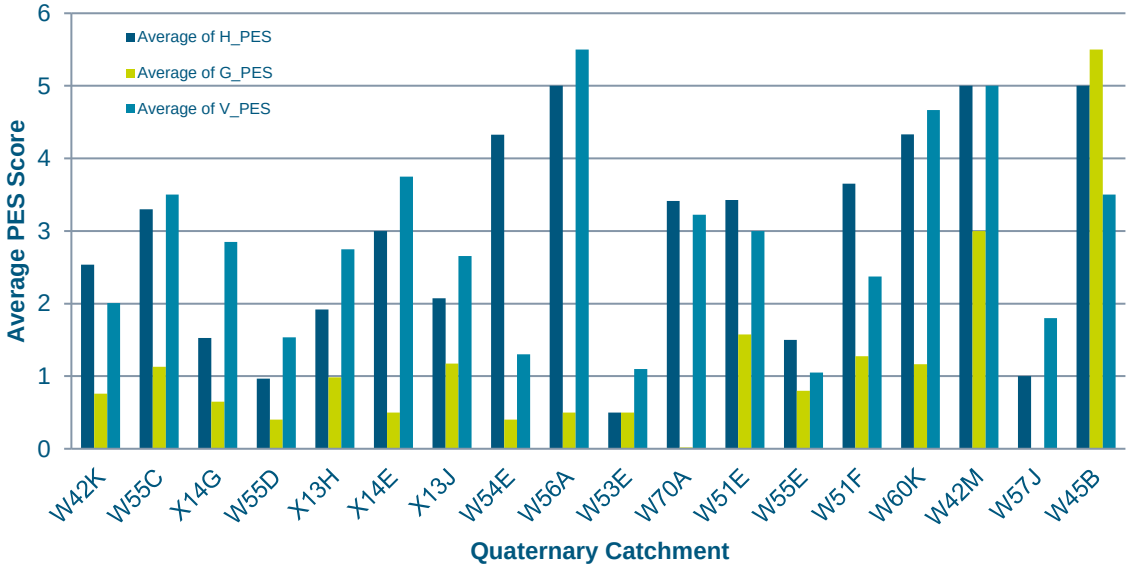


Figure 75: Graph showing the average hydrology (H_PES), geomorphology (G_PES) and vegetation (V_PES) PES scores for wetlands across all quaternary catchments

Annexure 4 of the Aquatic Ecological Impact Assessment (***Appendix C3***) provides a summary of the PES information for all wetlands delineated within a 500m radius of the proposed development types including which were assessed in detail.

8.2.8 Wetland Ecological Importance and Sensitivity (EIS)

A majority of the wetlands for which EIS scores were derived were assigned a low EIS score (Figure 76). At an overall level, this prominence of low-scored wetlands does not reflect a poor state (refer to section above), rather it reflects the relatively high number of wetlands traversed by the border patrol infrastructure that are small in size and located at the head of quaternary and smaller sub-quaternary catchments, thus not providing significant degree of ecological goods and services that are associated with larger wetlands with large areas of intact habitat and not typically being associated with unique or high levels of wetland-dependent biodiversity.

Although there are parts of the study area where the overall EIS scores were higher, much of the border area under consideration traverses mountainous / hilly terrain in which there is limited occurrence of wetlands of significant extent and thus significant areas of habitat (typically wide valley bottom and floodplain wetlands). Rather the larger drainage features across the study area (with the exception of the Maputaland Coastal Plain) tend to be riverine in character. Such larger valley bottom and floodplain wetland units are typically associated with a high degree of wetland habitat diversity and provide large areas of wetland habitat. These factors allow these types of wetlands to perform a high degree of hydrological and water quality-related functionality and typically provide habitat for large populations of wetland-dependent species.

Smaller wetlands, as typical in many parts of the study area offer limit habitat for wetland-dependent biota and are typically offer a low degree of heterogeneity in a wetland habitat context. As an example, many wetlands in the incised terrain along the western Swaziland Border are narrow seep or channelled valley bottom features characterised by moist (mesic) grassy vegetation with very little other wetland habitat types such as seasonally flooded marshland or open water depressions. It should be noted however that in spite of low individual EIS scores in large parts of the study area, the cumulative function of wetlands at a

catchment scale is important in the context of certain aspects of wetland functionality, especially in a hydro-functionality context such as streamflow provision.

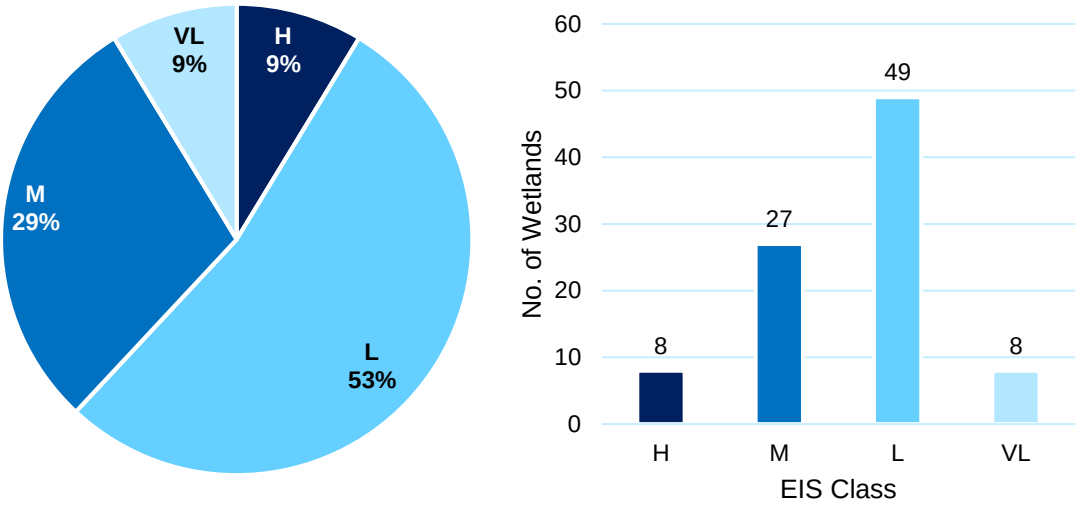
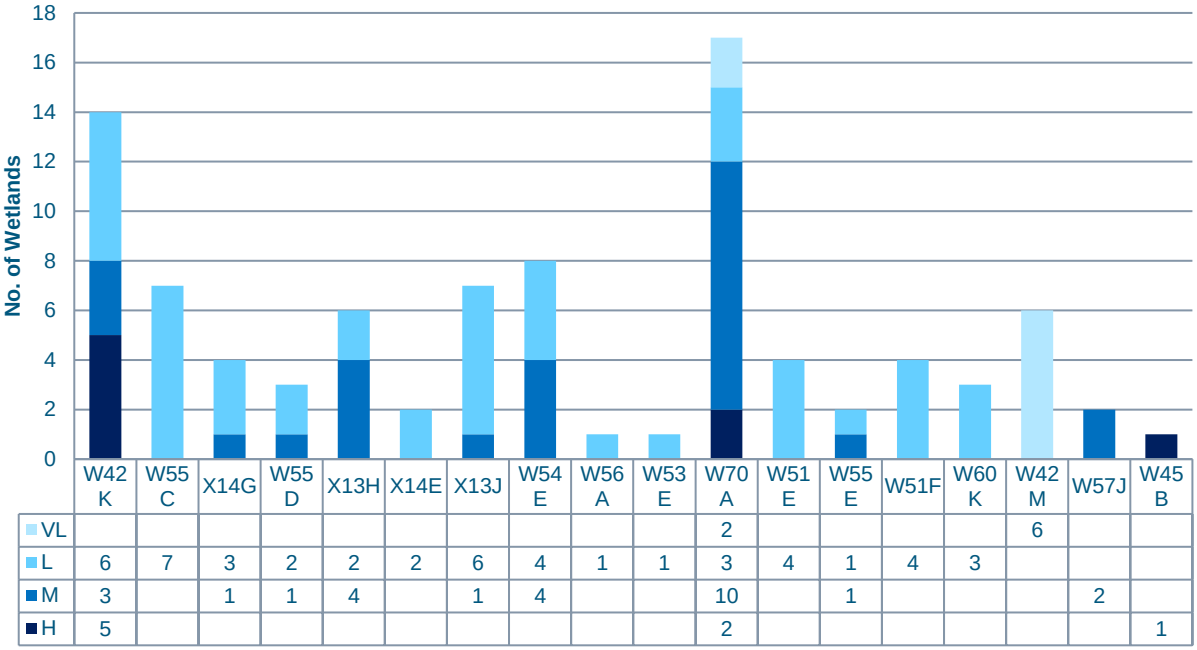


Figure 76: Pie chart and bar graph showing the relative proportion of EIS class at a project level and the number of wetlands in each respective EIS class

Nonetheless, almost 40% of wetlands have been assigned at least a moderate EIS score. From an ecological perspective, wetlands rated highly in this context were typically displayed intact wetland habitat and were characterised by high habitat diversity, supported plant species of conservation concern or contained certain unique attributes. Other wetlands ranked highly in terms of their social importance and provided a range of important direct benefits to local communities. The most important socio-economic benefits included water provision for domestic and livestock use, grazing for livestock and subsistence cultivation. In some instances, wetlands provided a suite of harvestable natural resources such as sedges used for craft production or housed medicinal plants used by local communities. The linkage of wetlands to important downstream resources, together with their type and condition were key factors affecting their hydrological importance.

An examination of the range of EIS scores at a quaternary catchment level reveals that certain parts of the study area were assigned a higher portion of moderate and high EIS scores than the average for the study area (Figure 77). In particular two catchments – W70A -comprising the Maputaland Coastal Plain and the catchment W42K near Mkhondo (Piet Retief area) – had the highest proportion of wetlands assigned a moderate or significantly, a high overall EIS score.



	W42K	W55C	X14G	W55D	X13H	X14E	X13J	W54E	W56A	W53E	W70A	W51E	W55E	W51F	W60K	W42M	W57J	W45B
VL											2					6		
L	6	7	3	2	2	2	6	4	1	1	3	4	1	4	3			
M	3		1	1	4		1	4			10		1				2	
H	5										2							1

Figure 77: The number of wetlands for each respective EIS class across all quaternary catchments assessed

As discussed above W70A is the largest catchment in the study area, encompassing a very large spatial extent and is unique in terms of a number of factors including climate, ecological assemblage, geology and topography and resultant nature of hydrology. The largely highly flat terrain and nature of the substrate (marine sediments that are highly sandy) have resulted in the development of very few larger riverine / fluvial drainage systems east of the Phongolo River floodplain. The coastal plain is rather characterised by the presence development of a number of wetlands of large lateral extent in the flat terrain setting that are hydrologically characterised by groundwater inputs rather than surface flows. These wetland types are thus characterised by factors which elevate ecological importance and sensitivity- in particular the large size of the wetlands and their distinct hydrological characteristics.

A number of wetland units in the W70A catchment were determined to naturally be swamp forest wetland, but were assessed to have been completely vegetatively transformed through the removal of all woody vegetation from within the wetland unit. It is worth noting that in spite of the low EIS score assigned to these individual wetland units, the EIS 'potential' of these wetlands should be considered to be high, as if the forest habitat were able to be restored to these wetlands through wetland rehabilitation efforts, the EIS score value of these wetland units would rise significantly.

The other part of the study area where a greater number of wetland units were assigned higher EIS scores than the study area average is the W42K catchment located on the south-western Swaziland Border in the Witkoppies-Berbice area to the south of the Mahamba Border Post near Mkhondo. Large parts of this catchment are characterised by much flatter topography than the hilly terrain to the north-west and west. This catchment comprises a reach of the Mozana River that drains the steeper terrain to the north and flows through this flatter terrain, allowing the development of a number of valley bottom wetlands of wider extent than in other parts of the study area. Certain of these wetlands were assessed to be characterised by high levels of wetland habitat diversity, along with the recorded presence of a number of threatened wetland-dependent faunal (avifaunal) species. As many of these wetland units were assessed to be in a natural /

near natural state they were assigned a high EIS score. This catchment, particularly the Witkoppies and Berbice area, must be considered as highly sensitive from a freshwater perspective.

A summary of the average importance values attributed to wetlands in each catchment is presented in Figure 78. One of the trends that are clearly visible across the study area is s that social importance was typically scored as less important than ecological or hydrological importance. With the exception of certain catchments in the study area the level of human usage / value of wetland units assessed were typically low. There are a number of reasons for this trend – much of the border traverses privately owned farmland or areas of commercial forestry in which there is limited use of wetlands by individual households for cultivation or water abstraction. In these areas the most important social / human related function was noted to be provision of water and grazing resources for livestock (primarily cattle). Wetlands are particularly important for cattle grazing in the drier winter months when plants in the wetlands tend to retain higher levels of protein as compared to the surrounding grasslands.

In parts of the route characterised by subsistence cultivation and communal land ownership (especially the former homeland areas of KwaZulu-Natal on the KZN-Mozambique Border and kaNgwane on the Mpumalanga-Swaziland Border) slightly different patterns of social / human utilisation of wetlands were evident. In these former homeland areas livestock is critical for maintaining livelihoods and has high socio-cultural value. A high presence of livestock in wetlands was noted in most of these parts of the study area and it is important to note that wetlands are critical for sustaining cattle herds in these areas.

In the Lowveld portion of the study area (on the northern Swaziland Border), the numerous seepline wetlands are particularly heavily utilised by cattle for grazing. The presence of cultivation of crops within wetlands in these parts of the study area was found to be relatively low, contrary to expectation, particularly in the Maputaland Coastal Plain. In most wetland units surveyed in the Maputaland area to the east of Tembe large parts of the wetland units had historically been modified through cultivation with the digging of drains and associated creation of mounds for cultivation of crops, however no active cultivation of crops was noted. The mounds and drains had in most cases been re-colonised by wetland vegetation or other pioneer species. Only in certain wetlands and floodplain of the Phongolo River (in which land invasions into the Ndumo Game Reserve have occurred with associated felling of indigenous vegetation to create subsistence cultivation plots) was active cultivation of subsistence crops noted.

The harvesting of natural resources by the local population was also noted in certain wetland units within these areas of communal tenure, especially in wetland units that were vegetatively characterised by swampy habitat / marshland where a number of the larger sedge / reed species are utilised for harvesting of their stems. Harvesting of trees for firewood and other purposes such as fencing was also noted in certain swamp forest wetlands within the Maputaland Coastal Plain, although in certain of the these wetland units the total removal of all woody vegetation had severely degraded these wetlands.

The ecological functionality and importance of wetlands was the highest scoring aspect of EIS recorded in the wetlands across the study area. This was more pronounced in certain parts of the study area than in others. In the parts of the study area characterised by extensive plantation forestry (primarily on the western boundary of Swaziland), wetlands typically form open corridors in which the wetland and a buffer area of certain width have not been afforested (transformed). In this particular forestry land-use context wetlands are critical refugia for biota and thus comprise very important ecological linkages in a context where much of the rest of the landscape has been transformed.

As mentioned above the high scoring wetland EIS scores in the catchments W70A and W42K are largely related to the presence of suitable habitat for, and the recorded presence of species of conservation concern

within these wetlands, thus reinforcing the ecological importance of wetlands in these parts of the study area.

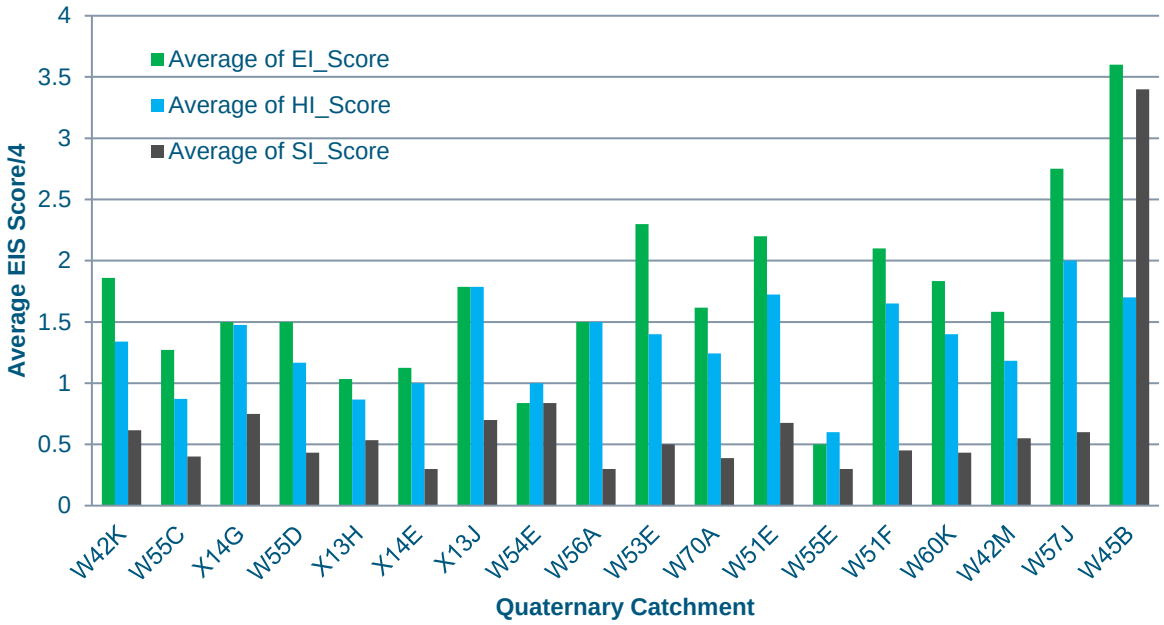


Figure 78: Average scores for the sub-components of wetland EIS assessed across the project area (EI=Ecological Importance, HI=Hydrological Importance, SI=Social Importance)

Annexure 4 of the Aquatic Ecological Impact Assessment (***Appendix C3***) provides a summary of the EIS information for all wetlands delineated within a 500m radius of the proposed development types including which were assessed in detail.

8.2.9 Delineation and Classification of Rivers

The classification results show that the majority of river ecosystems that stand to be affected are small ephemeral ('A' Class) streams which 76% (202 rivers) of the total 265 rivers and streams mapped. Seasonal ('B' Class) rivers make up 16% (43 rivers) with perennial rivers making up the remaining 8% (20 rivers) of rivers in the study area.

The relative proportion of river classes is largely due to nature of drainage networks in general, which characteristically comprise higher numbers of ephemeral streams then seasonal and perennial rivers. Furthermore, the planned alignments are in many instances located along or near catchment divides and as such transverse headwater streams more frequently then large low-lying valley floors in which perennial rivers occur. Figure 79 shows the number and relative proportion of river classes within the study area.

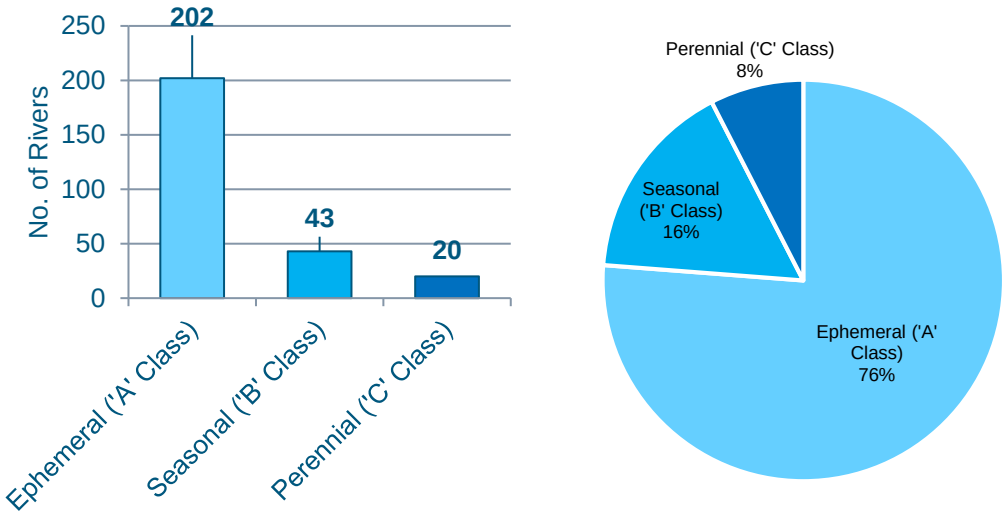
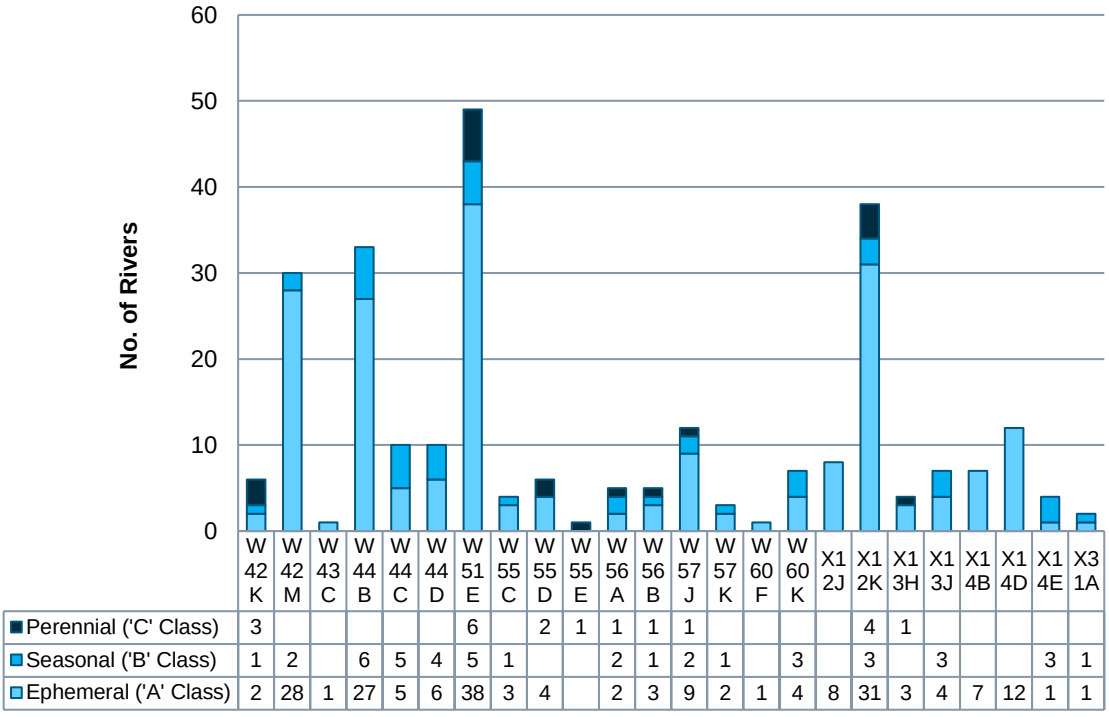


Figure 79: Bar graph and pie chart showing the relative proportion (pie chart) and number (bar graph) of different river types identified and mapped within 500m of the proposed development activities

Figure 80 provides an overview of the distribution of rivers classes per quaternary catchment traversed by the proposed border control infrastructure alignment. This highlights the high densities of rivers and streams distributed in quaternary catchments W42M, W42B, W51E and X12K in the western reaches of the project area where catchments are characterized by more steep and hilly terrain. These catchments are also characterized by a disproportionally higher numbers of small, ephemeral A Class streams than remaining catchments.

Refer to *Annexure 2 of the Aquatic Ecological Impact Assessment* (***Appendix C3***) for further details on the river classification per river units mapped.



	W 42 K	W 42 M	W 43 C	W 44 B	W 44 C	W 44 D	W 51 E	W 55 C	W 55 D	W 55 E	W 56 A	W 56 B	W 57 J	W 57 K	W 60 F	W 60 K	X1 2J	X1 2K	X1 3H	X1 3J	X1 4B	X1 4D	X1 4E	X3 1A
Perennial ('C' Class)	3						6		2	1	1	1	1					4	1					
Seasonal ('B' Class)	1	2		6	5	4	5	1			2	1	2	1		3		3		3			3	1
Ephemeral ('A' Class)	2	28	1	27	5	6	38	3	4		2	3	9	2	1	4	8	31	3	4	7	12	1	1

Figure 80: Graph showing the extent of different channel types within 500m of the route corridor across the different quaternary catchments

8.2.10 River Vegetation Characteristics

While vegetation structure and composition varied across the study area and between individual river reaches, instream and riparian vegetation were grouped into broad vegetation communities based on the structural and compositional similarities.

For instream vegetation, the most dominant communities were mixed hygrophilous grass communities (32% of total) and mixed hygrophilous grass, sedge, rush and reed communities (32% of total), followed by *Phragmites* sp. reed communities (14% of total) and Mixed hygrophilous grass and sedge communities (13%). The remaining 9% is of instream vegetation communities were made up of mixed hygrophilous grass and reed communities. Figure 81 shows the relative proportion of vegetation communities for river units visited and assessed in detail as part of the baseline assessment.

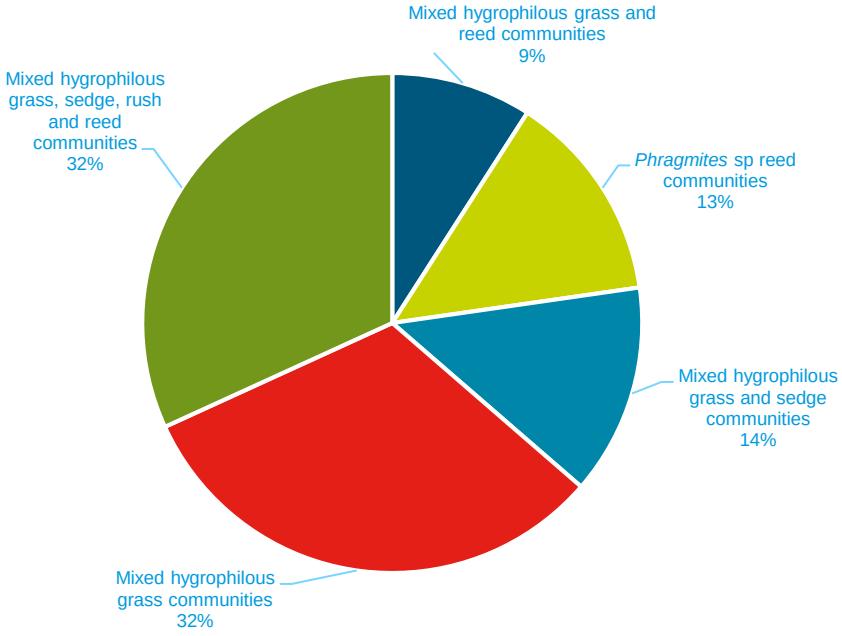


Figure 81: Proportion of various instream vegetation communities assessed at a project level

Riparian vegetation was more variable, linked largely with the terrestrial vegetation structural types in which the river occurred. The most prolific riparian vegetation community was that of mixed *Acacia sp.* and grass communities (36% of total) followed by mixed *Ficus* sp*., Acacia* sp*.* and grass communities which made up 13% of the total river units assessed units. Mix of various vegetation types made up the remainder of riparian communities. Figure 82 shows the relative proportion of vegetation communities for river units visited and assessed in detail as part of the baseline assessment.

The classification and description of aquatic resources in the project focal area are provided in *Table 21 of the Aquatic Ecological Impact Assessment (**Appendix C3***).

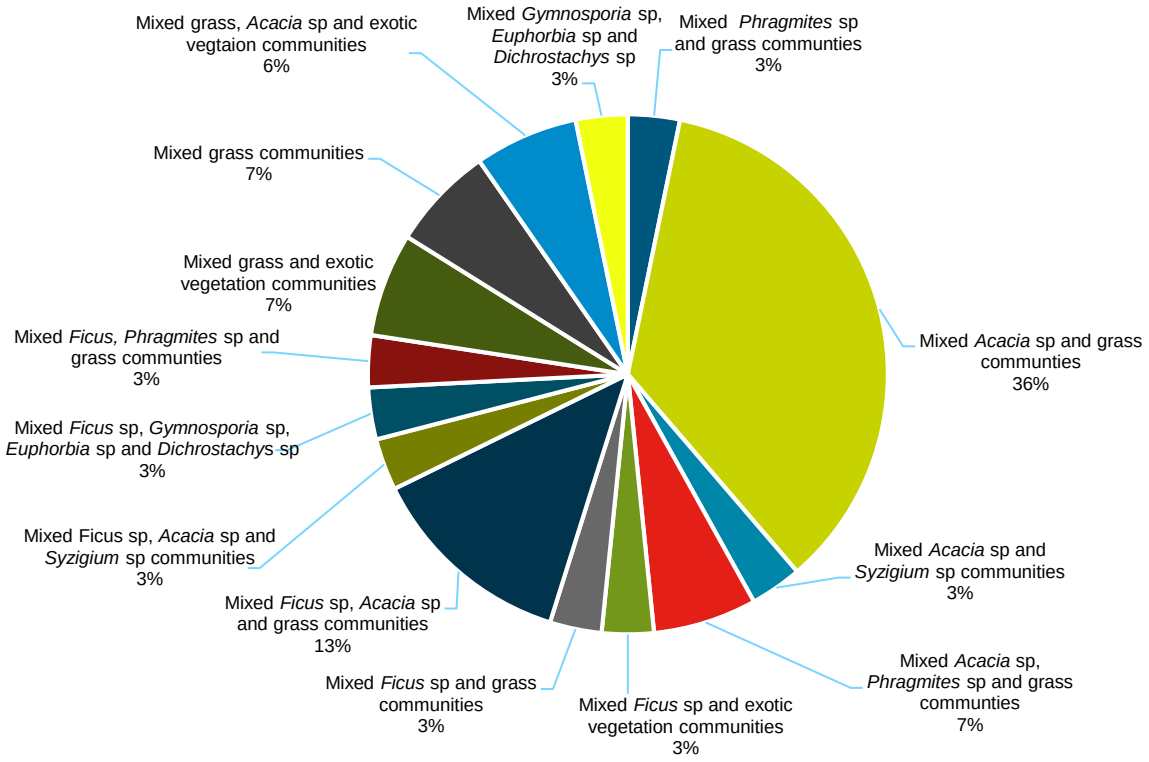


Figure 82: Proportion of various riparian vegetation communities assessed at a project level

8.2.11 River Present Ecological State (PES)

Based on the results of the IHI assessment, majority (55%) of the rivers assessed can be categorised as 'Largely Natural' ('B' PES Category) followed by Fair ('C' PES Category) rivers which comprise 35% and 'Natural' ('A' PES category) rivers which make up the remaining 10%. The results reflect the largely untransformed nature of many of the areas assessed, with many river ecosystems affected only by alien plant encroachment, some habitat clearing for roads and cultivation, altered catchment runoff regimes and limited erosion. Figure 83 shows the relative proportion and number of rivers in each PES category for river units visited and assessed.

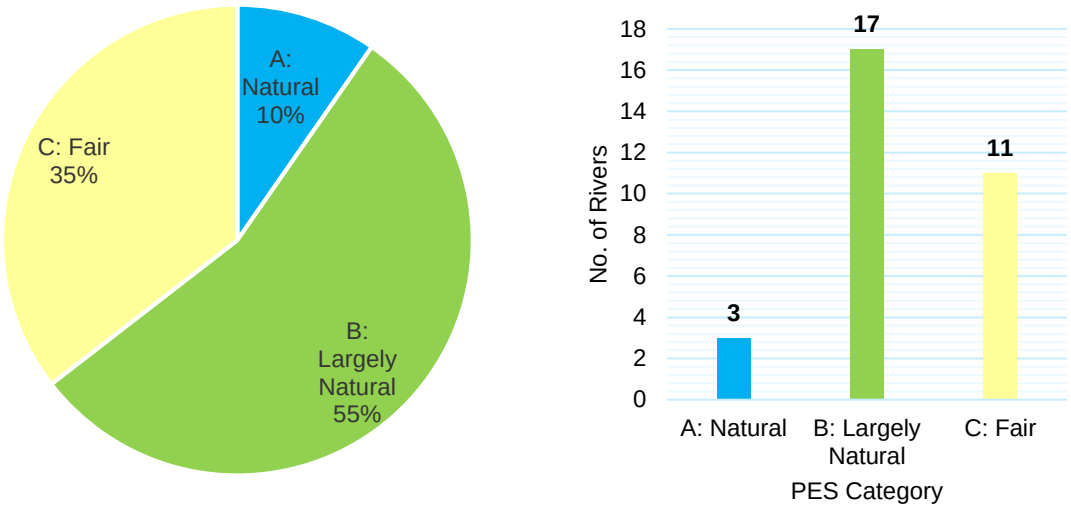


Figure 83: Condition of river units visited and assessed in detail across the entire project area

The variation in condition of rivers and streams across quaternary catchments assessed is presented in Figure 84. This shows that on average majority of the PES scores fall within the 'Largely Natural' PES range with the exception of average PES scores for rivers in quaternary catchments W42K, W44B, W51E, X13J and X14E which fall within the Fair PES range.

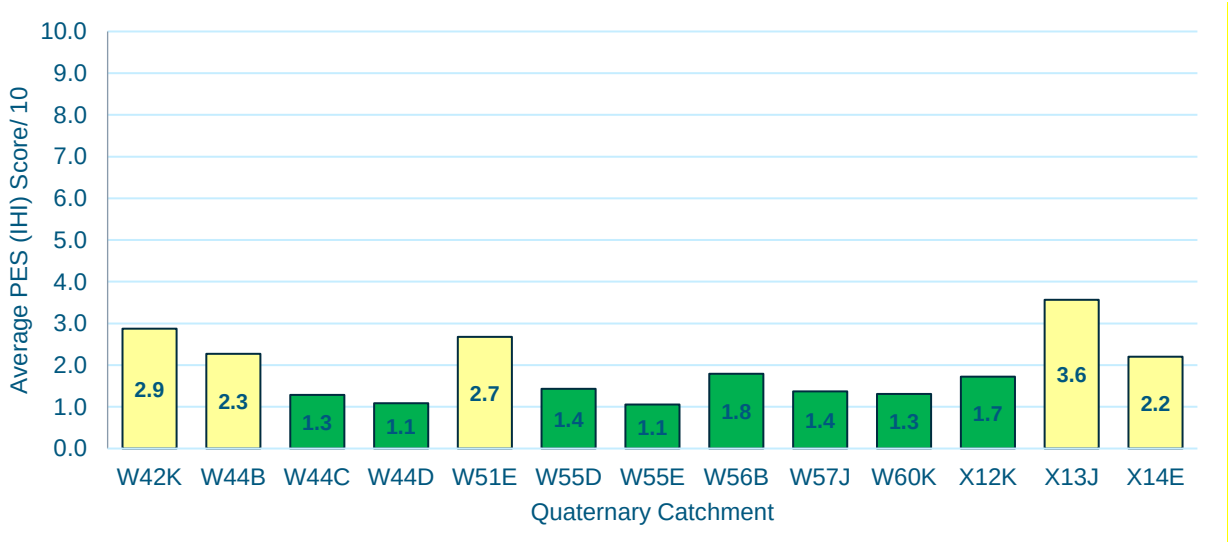


Figure 84: Graph showing the average PES (IHI) score for river units visited and assessed in detail per quaternary catchment (yellow=C PES Class and green=B PES Class)

The relative contribution of instream and riparian PES to the overall PES score is represented in Figure 85 which depicts the average instream and riparian PES (IHI) scores per quaternary catchment. This shows that for all rivers assessed, riparian habitat is more modified than instream habitat and contributes more to the overall river PES category. This is largely due to disturbance of the riparian zones from overgrazing, bank erosion, alien plant encroachment and direct clearing of riparian vegetation for roads, cultivation, and forestry.

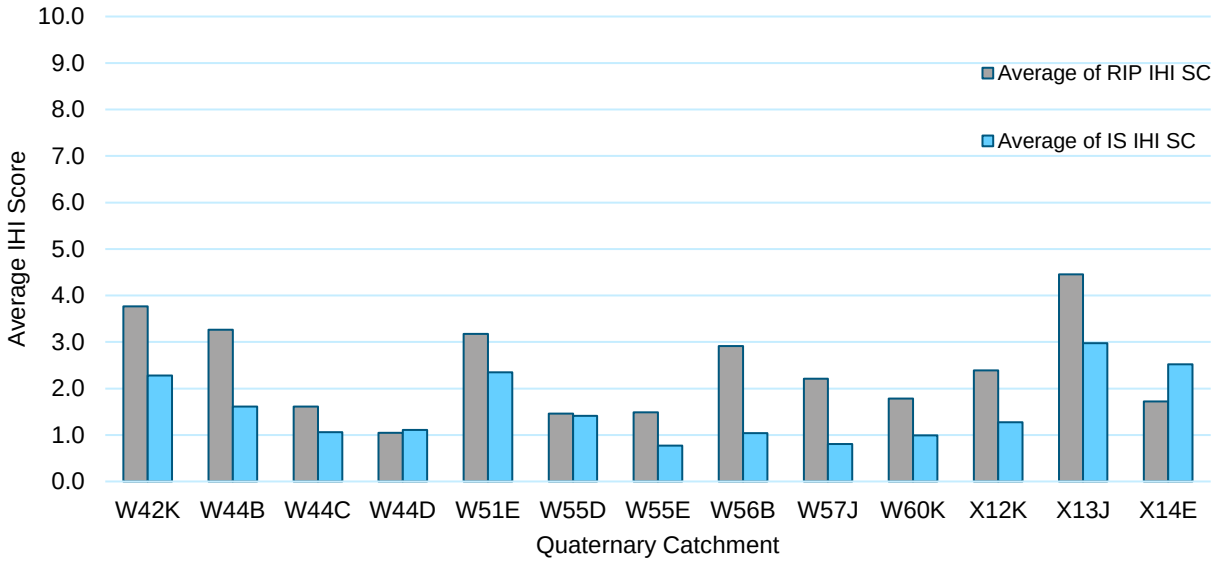


Figure 85: Graph showing the average instream (IS IHI SC) and riparian (RIP IHI SC) scores for river units visited and assessed in detail per quaternary catchment

Annexure 4 of the Aquatic Ecological Impact Assessment (***Appendix C3***) provides a summary of the PES and EIS rivers units visited and assessed in detail.

8.2.12 River Ecological Importance and Sensitivity (EIS)

A summary of the EIS of rivers and streams associated with the proposed corridor is presented in Figure 86 and Figure 87 below. This shows that most rivers (61.29%) have a low Moderate EIS rating, with equal amounts of High (19.35%) and Low (19.35%) EIS Rivers. Low EIS scores are typically associated with degraded seasonal channels which provide limited habitat for sensitive species of aquatic biota and have a low diversity of habitats and biota. High EIS ratings were typically linked with large rivers and streams that are largely intact and are characterised by a diversity of habitat for a diversity of species, many of which are sensitive according to DWS 2014.

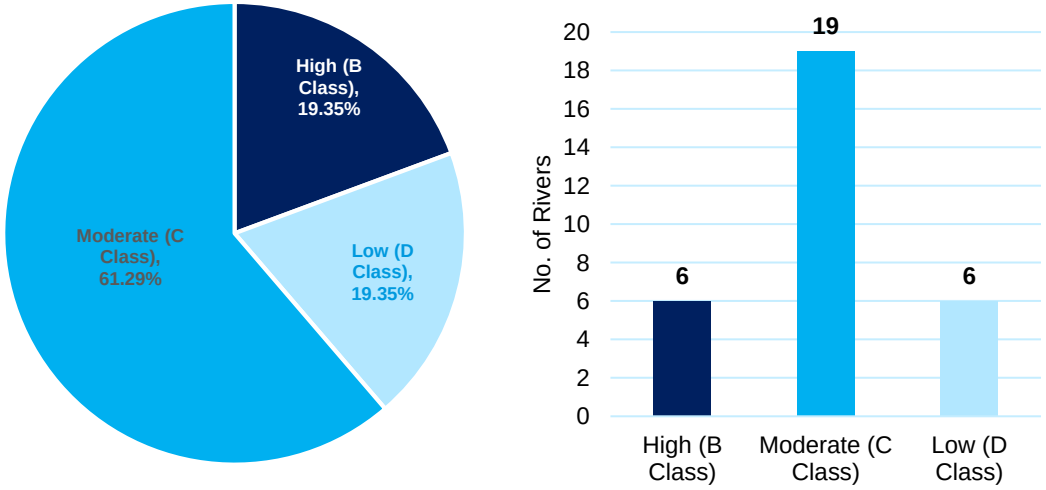


Figure 86: EIS of rivers and streams across the entire project area (for river units visited and assessed in detail only)

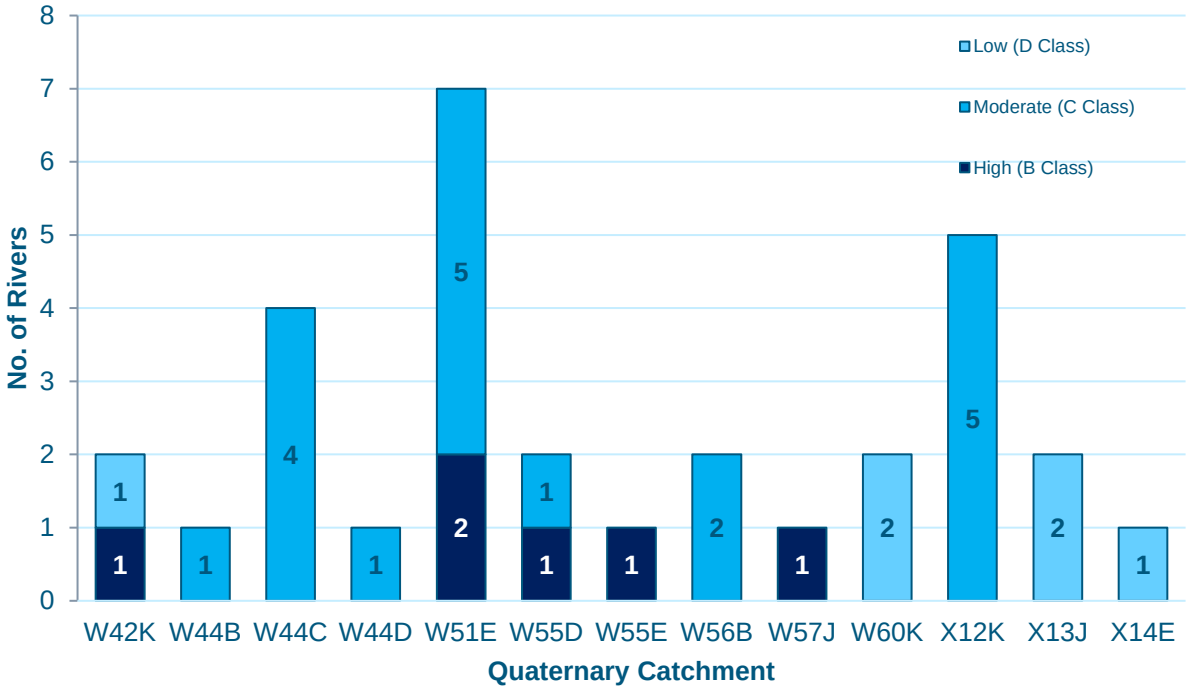


Figure 87: Number of rivers in each EIS class for each quaternary catchment (for river units visited and assessed in detail only)

8.2.13 Management Objectives Recommended Ecological Category

Based on an assessment of PES & EIS, preliminary management objectives were defined for water resources in the project focal area. This provides a broad indication as to the importance of maintaining or improving the condition and functionality of ecosystems based on available information. In most instances, the recommended management objective was to maintain existing habitat conditions whilst rehabilitation was recommended for highly important but impacted ecosystems. Whilst it is not necessarily the responsibility of the Applicant / Developer to ensure that these objectives are achieved, actions must not compromise the long-term objective for any of the watercourses in question. *Annexure 4 of the Aquatic Ecological Impact Assessment* (***Appendix C3***) provides a summary of the PES, EIS (if assessed) and management objective for all watercourses.

8.2.14 Potential Impacts

The nature of the water resource to be crossed by the proposed road will dictate the type or crossing and thus the type of impacts. Typical crossing types expected for this project have been summarised into categories in Table 26. Details of the locations of crossings and development type linked to each watercourse have been included in *Annexure 5 of the Aquatic Ecological Impact Assessment* (***Appendix C3***).

Table 26: Summary of proposed development types and associated activities

Type of Crossing	Description	Typical Application
Single span structures	Structures that span the width of the channel with no in-stream support and do not affect the bed of the river. Bank habitat can be maintained under the crossing if abutments are set back	Bridges over large perennial rivers
Span structures with instream supports	In-stream supports (piers) can be used to increase the crossing width where single span is not possible or prohibitively expensive. Bank habitat can be maintained under the crossing if abutments are set back	Bridges with instream piers and over large perennial rivers
Large portal (box) culvert crossing	Dimensions less than those of a bridge but with a span opening larger than 2m, or with a combined opening greater than 5m^2, and cater for perennial flows. Large box culverts can be open or closed at the base	Series of portal culverts across large perennial and seasonal rivers
Small closed pipe culverts	Closed culverts have an artificial invert (floor) and so have a greater impact on the bed and banks of the river. Closed culverts can be made from a variety of materials and come in a range of shapes (e.g. pipe, box, closed arch) and sizes. Installation of a closed culvert causes significant disruption to the river bed and, if not designed correctly, can cause a barrier to fish migration	Pipe culverts across small perennial, seasonal and ephemeral rivers
Fords / causeways	Fords are river crossings built at the level of the river bed. They can be made of natural materials (natural bed and bank material maintained) or they can be reinforced with artificial material (bed and / or banks).	Low-level structures within the bed of seasonal and ephemeral rivers
Fences within no instream infrastructure	Fences that span the river channel with fence poles / supports located on either bank of the channel	Fences over channelled watercourse types including all river types and channelled wetland types
Fences with instream foundations or footings	Fences that require the establishment of an instream foundation (equivalent to a ford for example) in order to support the fence. This is likely in large broad unchannelled wetland types	Low-level foundation structure. This is likely in large broad unchannelled wetland types

For the purposes of this assessment the 'physical habitat modification' associated with border control infrastructure is defined as the primary impact causing activity. The secondary impacts associated with this activity form part of the impact pathway that is initiated by this impact causing activity. For descriptive purposes an attempt had been made to sub-divide impacts associated with:

- Physical destruction and / or modification of aquatic habitat;
- Flow modification and erosion/sedimentation impacts; and
- Water quality impacts.

The significance of these impacts, however, has been assessed in terms of the 'ultimate consequences' to the receiving watercourse in terms of the following:

(i) Impacts to water resources and the ability to meet water resource management objectives;
(ii) Impacts to ecosystem conservation and the ability to meet of ecosystem conservation targets;
(iii) Impacts to species conservation and the ability to meet species conservation targets; and
(iv) Impacts to ecosystem goods and services of direct value to communities and resultant potential impacts to human health, safety and livelihood.

Impact 1: Physical destruction and modification of river and riparian habitat (construction)

Direct habitat destruction and modification impacts will result from border control infrastructure development as a result of vegetation clearing, infilling and bed and bank modifications. The most noteworthy direct impacts will arise from vegetation clearing, bed and bank modifications as a result of fill embankments and culvert or pier installation. At an individual watercourse unit level, direct impacts from linear projects of this nature are generally localised to watercourse crossings that occur within the construction servitude or development footprint. Direct impacts to aquatic vegetation / habitat caused by construction taking place within and across the river channel and riparian zone will likely include the following:

- Destruction or modification of instream habitat (biotopes) where piers or culverts are installed within the natural river bed (river bed modification).
- Destruction or modification of riparian vegetation and river banks (bank modification) at the approach to the bridge crossing from roads, bridge abutments and fill embankments.
- Unintentional physical destruction or modification of instream or riparian habitat outside of the construction zone caused by machinery and construction staff accessing areas upstream or downstream of watercourse crossings.
- Sedentary (slow moving) fauna such as invertebrates, slow moving reptiles and amphibians may be killed within the construction servitude or forced to migrate into adjoining habitats.

Based on the effective widths applied to development types proposed, fences collectively account for the greatest area of river and riparian habitat modification followed by roads. It is important to note that the calculation of area only applies to the physical footprint of the development not unintentional disturbances within the greater construction servitude. Table 27 summarises the area of riverine habitat to be affected by the various development categories.

Table 27: Summary of the area (ha) of riverine habitat to be directly impacted by the various planned development types

Province	Fences	Roads	Total
KZN	1.71	0.42	2.13
MP	2.06	1.09	3.16
Grand Total	**3.77**	**1.52**	**5.29**

While the area to be modified is a useful measure of the footprint of the development, it does not take into account the condition and status of the receiving environment. The area and condition of riverine habitat has been combined and reflected as a hectare equivalent of riverine habitat. Hectare equivalents per riverine vegetation type and threat status have been provided in Table 28 for KwaZulu-Natal. This indicates that Least Threatened vegetation types are those to be most impacted (0.618ha equivalents) by the proposed development followed by Critically Endangered (0.149ha equivalents), Endangered (0.007ha equivalents) and Vulnerable (0.006ha equivalents) vegetation types.

Table 28: Summary of the estimated hectare equivalent losses of riverine habitat per vegetation type in KwaZulu-Natal

Vegetation Types and Threat Status	Fences	Roads	Total
Critically Endangered	**0.019**	**0.130**	**0.149**
Alluvial Wetlands : Subtropical Alluvial Vegetation : Lowveld Floodplain Grasslands	0.000	0.000	0.000
Delagoa Lowveld	0.019	0.130	0.149
Endangered	**0.002**	**0.005**	**0.007**
Granite Lowveld	0.002	0.001	0.003
KaNgwane Montane Grassland	0.000	0.004	0.004

Vegetation Types and Threat Status	Fences	Roads	Total
Vulnerable	**0.002**	**0.003**	**0.006**
Western Maputaland Clay Bushveld	0.001	0.002	0.003
Zululand Lowveld	0.001	0.002	0.003
Least Threatened	**0.515**	**0.101**	**0.616**
Ithala Quartzite Sourveld	0.007	0.003	0.009
Makatini Clay Thicket	0.000	0.000	0.000
Northern Zululand Sourveld	0.045	0.058	0.103
Southern Lebombo Bushveld	0.462	0.040	0.502
Tembe Sandy Bushveld	0.001	0.001	0.002
Grand Total	**0.539**	**0.239**	**0.778**

Hectare equivalents per riverine vegetation type and threat status have been provided in Table 29 for Mpumalanga. This indicates that least vulnerable vegetation types are those to be most impacted (0.889ha equivalents) by the proposed development followed by least threatened (0.084ha equivalents) vegetation types.

Table 29: Summary of the estimated hectare equivalent losses of riverine habitat per vegetation type in Mpumalanga

Vegetation Types and Threat Status	Fences	Roads	Total
Vulnerable	**0.241**	**0.648**	**0.889**
Barberton Montane Grassland	0.021	0.052	0.073
Granite Lowveld	0.008	0.037	0.045
KaNgwane Montane Grassland	0.210	0.553	0.763
Swaziland Sour Bushveld	0.003	0.006	0.009
Least Threatened	**0.025**	**0.059**	**0.084**
Ithala Quartzite Sourveld	0.000	0.006	0.006
Northern Mistbelt Forest	0.000	0.000	0.000
Southern Lebombo Bushveld	0.025	0.053	0.078
Grand Total	**0.267**	**0.707**	**0.974**

A summary of the hectare equivalents per riverine vegetation type impacted has been provided in Table 30 for the project as a whole for each development class. This indicates that Vulnerable types are those to be most impacted, primarily in Mpumalanga through road development, followed by Least Threatened vegetation types, primarily in KwaZulu-Natal through fence development. Critically Endangered and Endangered vegetation types are the least impacted, associated with minor road and fence development in KwaZulu-Natal.

Table 30: Summary of the estimated hectare equivalent losses of riverine habitat per vegetation threat status across the entire study area

Vegetation Types and Threat Status	Fences	Roads	Total
KZN			
Critically Endangered	0.02	0.13	0.149
Endangered	0.00	0.00	0.007
Vulnerable	0.24	0.65	0.895
Least Threatened	0.54	0.16	0.700
KZN Total	**0.539**	**0.239**	**0.778**
MP			
Vulnerable	0.241	0.648	0.889

Vegetation Types and Threat Status	Fences	Roads	Total
Least Threatened	0.025	0.059	0.084
MP Total	**0.267**	**0.707**	**0.974**
Grand Total	**0.806**	**0.946**	**1.751**

Indirect / secondary impacts to aquatic vegetation / habitat caused by construction within and across the river channel and riparian zone may include the following:

- Temporary noise, dust and light disturbance which will cause local fauna to move away from the construction zone in the short-term.
- Temporary instream habitat fragmentation impacts from coffer dams and / or temporary diversions which can inhibit or reduce the mobility of aquatic fauna between successive river reaches in the short-term.

An increase in the hunting / poaching / trapping of fauna as well as the harvesting of indigenous wetland plants for various uses such as firewood / medicinal use may also be associated with large construction projects of this nature. Movement of aquatic biota (e.g. invertebrates, frogs and fish) may also be temporarily disrupted by temporary barriers during construction activities. Noise and dust caused by construction activities will also affect use of adjoining habitat by various species. In smaller aquatic ecosystems isolation may occur where habitat connectivity is limited (e.g. species in headwater systems, isolated from downstream habitat), thus affecting the feeding and breeding patterns.

Impact 1: Physical destruction and modification of river and riparian habitat (operations)

During the operational phase of the project any disturbance caused during construction is likely to promote the establishment of disturbance-tolerant species, including Invasive Alien Plants (IAPs), weeds and pioneer species within riverine habitats. Whilst initiated during construction, the persisting impact of IAPs and pioneer plants is generally considered a long-term operational issue. Since these species of plants typically have rapid reproductive turnover and are able to outcompete native species for environmental resources, alter soil stability, promote erosion, change litter accumulation and soil properties and promote or suppress fire, IAPs are widely recognised as one of the single largest impacts on biodiversity in South Africa. Encroachment by alien plants will result in the deterioration of freshwater habitat integrity if rehabilitation and monitoring are not implemented correctly.

Depending on the planned development type and the nature of the infrastructure design road bridges or culvert crossing and fence footings / foundations have the potential to reduce instream and riparian habitat connectivity. The highest potential impact of fragmentation is that associated with instream habitat and fauna such as fish and invertebrates which rely on movement between successive river reaches at varying spatial scales for feeding, breeding and habitat colonisation. Fauna making use of riparian corridors are significantly less affected by local fragmentation impacts associated with linear developments as they are able to make use of adjacent terrestrial habitat to undertake local or regional movements for various reasons.

River crossings may present barriers to species movement by creating low light conditions, higher velocities for species with poor swimming abilities, shallow flow depths, lengthy shallow uniform runs with no resting areas, or impassable height barriers for aquatic species. Culverts are also prone to blockages by river substrate and debris and may cause temporary barriers to species movement in this respect. If installed above the natural channel bed level, culverts can also impose height barriers to smaller instream fauna with poor jumping, swimming and crawling abilities.

The degree to which instream structures will impact on the movement of aquatic fauna depends on the type of river, nature of the planned infrastructure and local aquatic faunal populations. For example, the use of small closed pipe culverts across perennial rivers will likely inhibit the movement of some fish and

invertebrate species. Conversely, the use of smaller closed pipe culverts within ephemeral streams and drainage lines is unlikely to have any fragmentation impact as flows do not support any long-term aquatic faunal populations.

The selection, sizing and installation of crossing infrastructure are crucial in managing instream fragmentation impacts. This is inadvertently catered for through the hydrological design specifications of each crossing based on the premise that that if river hydrological functioning is maintained, aquatic fauna populations will not be affected. These design considerations have been dealt with in the following preliminary reports:

- *Pre-Construction Planning and Design Phase Recommendations for River Crossings (**Appendix B1**).*
- *Preliminary Freshwater and Terrestrial Habitat Assessment Report to Inform Re-alignments and No-Go Alternatives (**Appendix B3**).*

Impact 2: Physical destruction and modification of wetland habitat (construction)

Direct habitat destruction and modification impacts will result from border control infrastructure development as a result of vegetation clearing, excavation of wetland soils (substrate) infilling and where channels are present in wetlands, bed and bank modifications. The most noteworthy direct impacts will arise from vegetation clearing, wetland substrate excavation and infilling associated with the structural (road) foundations and culvert or other crossing structure installation. At an individual wetland unit level direct impacts from linear projects of this nature are generally localised to wetland crossings that occur within the construction servitude or development footprint. Direct impacts to wetland vegetation / habitat caused by construction taking place within and across the wetland's lateral extent will likely include the following:

- Destruction or modification of wetland habitat (vegetation and wetland soils) where the road foundations as well as culverts / other crossing structures such as vented drifts are installed within the wetland (wetland habitat modification). Vegetation is typically removed / destroyed by construction activities within the construction servitude and saturated soils may be compacted or their natural vertical stratification altered by the churning effect of heavy machinery or through excavation.
- Unintentional physical destruction or modification of wetland habitat outside of the construction zone caused by machinery and construction staff accessing areas upstream or downstream of wetland crossings. Heavy machinery can exert a significant impact on saturated wetland soils and associated vegetation by churning up soils and vegetation and by creating ruts on the surface.
- Sedentary (slow moving) fauna such as invertebrates, slow moving reptiles and amphibians may be killed within the construction servitude or forced to migrate into adjoining habitats.

Based on the effective widths applied to development types proposed, roads collectively account for the greatest area of wetland habitat modification followed by fences. It is important to note that the calculation of area only applies to the physical footprint of the development not unintentional disturbances within the greater construction servitude.

Table 31: Summary of the area (ha) of wetland habitat to be directly impacted by the various planned development types

Province	Fences	Roads	Total
KZN	0.53	1.31	2.01
MP	1.71	2.57	0.00
Grand Total	**1.40**	**3.02**	**4.59**

Table 32: Area of wetland habitat to be directly impacted by the various planned development types

Wetland HGM type	Fences	Roads	Total
KZN			
Channelled Valley Bottom	0.00	0.02	**0.02**
Flat	0.04	0.21	**0.29**
Floodplain	0.14	0.27	**0.41**
Pan / Depression	0.09	0.29	**0.42**
Seep	0.05	0.16	**0.23**
Un-channelled Valley Bottom	0.20	0.37	**0.64**
KZN Total	**0.53**	**1.31**	**2.01**
MP			
Channelled Valley Bottom	0.39	0.23	**0.62**
Floodplain	0.05	0.00	**0.05**
Pan / Depression	0.00	0.00	**0.00**
Seep	0.16	0.72	**0.88**
Un-channelled Valley Bottom	0.27	0.76	**1.02**
MP Total	**0.87**	**1.71**	**2.57**
Grand Total	**1.40**	**3.02**	**4.59**

While the area to be modified is a useful measure of the footprint of the development, it does not take into account the condition and status of the receiving environment. The area and condition of wetland habitat has been combined and reflected as a hectare equivalent[20] of wetland habitat. Hectare equivalents per wetland vegetation type (WetVeg)[21] and threat status has been provided in Table 31 for KwaZulu-Natal. This indicates that Least Threatened wetland vegetation types are those to be most impacted (1.28ha equivalents) by the proposed development followed by Endangered (0.65ha equivalents), Vulnerable (0.07ha equivalents) and Critically Endangered (0.02ha equivalents) wetland vegetation types.

Table 33: Summary of the estimated hectare equivalent losses of wetland habitat per vegetation type in KwaZulu-Natal

Vegetation Types and Threat Status	Fences	Roads	Total
Critically Endangered	**0.00**	**0.01**	**0.02**
Lowveld Group 2	0.00	0.01	**0.02**
Endangered	**0.21**	**0.44**	**0.65**
Lowveld Group 10	0.20	0.41	**0.61**
Mesic Highveld Grassland Group 5	0.01	0.03	**0.03**
Vulnerable	**0.02**	**0.04**	**0.07**
Lowveld Group 11	0.01	0.04	**0.05**
Lowveld Group 9	0.01	0.01	**0.01**
Least Threatened	**0.30**	**0.82**	**1.28**
Indian Ocean Coastal Belt Group 1	0.24	0.74	**1.12**
Swamp Forest	0.06	0.09	**0.17**
Grand Total	**0.53**	**1.31**	**2.01**

Hectare equivalents per wetland (WetVeg) vegetation type and threat status have been provided in Table 34 for Mpumalanga. This indicates that Endangered wetland vegetation types are those to be most impacted

[20] *Hectare equivalents are a measure that takes into account the area of habitat (in hectares) and the condition of that habitat to produce a hectare equivalent score of intact habitat. If for example a 10ha of wetland habitat is destroyed but the habitat is modified (5/10 for condition) the hectare equivalent would reflect a score of 5ha equivalents.*

[21] *The NFEPA Wetland Vegetation Group classification has been utilised.*

(1.43ha equivalents) by the proposed development followed by Critically Endangered (0.63ha equivalents) wetland vegetation types.

Table 34: Summary of the estimated hectare equivalent losses of wetland habitat per vegetation type in Mpumalanga

Vegetation Types and Threat Status	Fences	Roads	Total
Critically Endangered	**0.16**	**0.47**	**0.63**
Lowveld Group 3	0.13	0.46	**0.59**
Lowveld Group 8	0.03	0.01	**0.04**
Endangered	**0.55**	**0.87**	**1.43**
Mesic Highveld Grassland Group 5	0.55	0.87	**1.43**
Vulnerable	**0.15**	**0.33**	**0.48**
Lowveld Group 11	0.07	0.23	**0.30**
Lowveld Group 9	0.08	0.10	**0.17**
Least Threatened	**0.01**	**0.03**	**0.04**
Mesic Highveld Grassland Group 6	0.00	0.01	**0.02**
Sub-Escarpment Grassland Group 2	0.01	0.02	**0.03**
Grand Total	**0.87**	**1.71**	**2.57**

A summary of the hectare equivalents per wetland vegetation type impacted has been provided in Table 35 for the project as a whole for each development class. This indicates that Endangered wetland types are those to be most impacted, primarily in Mpumalanga through road development, followed by Least Threatened vegetation types, primarily in KwaZulu-Natal through road development. Critically Endangered and vulnerable wetland vegetation types are the least impacted, associated with road development in Mpumalanga.

Table 35: Summary of the estimated hectare equivalent losses of wetland habitat per vegetation threat status across the entire study area

Vegetation Types and Threat Status	Fences	Roads	Total
Critically Endangered	0.16	0.48	**0.64**
Endangered	0.76	1.31	**2.07**
Vulnerable	0.17	0.38	**0.54**
Least Threatened	0.31	0.86	**1.33**
Grand Total	**1.40**	**3.02**	**4.59**

Indirect / secondary impacts to wetland vegetation / habitat caused by construction within the wetland could potentially include the following:

- Temporary noise, dust and light disturbance which will cause local fauna to move away from the construction zone in the short-term.
- Temporary in-wetland habitat fragmentation impacts from coffer dams and / or temporary diversions in channelled wetland settings which can inhibit or reduce the mobility of aquatic fauna between successive river reaches in the short-term.

An increase in the hunting / poaching / trapping of fauna as well as the harvesting of indigenous wetland plants for various uses such as firewood / medicinal use may also be associated with large construction projects of this nature. Movement of aquatic biota (e.g. invertebrates, frogs and fish) may also be temporarily disrupted by temporary barriers during construction activities. Noise and dust caused by construction activities will also affect use of adjoining habitat by various species

Impact 2: Physical destruction and modification of wetland habitat (operations)

During the operational phase of the project any disturbance caused during construction is likely to promote the establishment of disturbance-tolerant species, including IAPs, weeds and pioneer species within wetland habitats, and particularly within the drier peripheries (temporary wet) of wetlands or within wetlands with a drier hydro-period. Whilst initiated during construction, the persisting impact of IAPs and pioneer plants is generally considered a long-term operational issue. Since these species of plants typically have rapid reproductive turnover and are able to outcompete native species for environmental resources, alter soil stability, promote erosion, change litter accumulation and soil properties and promote or suppress fire, IAPs are widely recognised as one of the single largest impacts on biodiversity in South Africa. Encroachment by alien plants will result in the deterioration of freshwater (wetland) habitat integrity if rehabilitation and monitoring are not implemented correctly.

Depending on the planned development type and the nature of the infrastructure design, road foundations, culvert / drift crossing structures and fence footings / foundations have the potential to reduce wetland habitat connectivity. The highest potential impact of fragmentation is that associated with wetland habitat (in particular channelised wetland habitat in which fluvial conditions exist) and fauna such as fish and invertebrates which rely on movement between successive channel reaches or upstream / downstream reaches of the wetland at varying spatial scales for feeding, breeding and habitat colonisation.

As with rivers, crossings of channelised wetland habitat may present barriers to species movement by creating low light conditions, higher velocities for species with poor swimming abilities, shallow flow depths, lengthy shallow uniform runs with no resting areas, or impassable height barriers for aquatic species. In all valley bottom and floodplain wetland HGM settings culverts are prone to blockages by river substrate and debris and may cause temporary barriers to species movement in this respect. If installed above the natural channel bed level, culverts can also impose height barriers to smaller instream fauna with poor jumping, swimming and crawling abilities.

The degree to which instream structures will impact on the movement of aquatic fauna depends on the wetland HGM form, nature of the planned infrastructure and local aquatic faunal populations. For example, the use of small closed pipe culverts across larger valley bottom and floodplain wetlands will likely inhibit the movement of some fish and invertebrate species. Conversely, the use of smaller closed pipe culverts within other wetland HGM forms or smaller wetlands is unlikely to have any fragmentation impact as these systems may not be associated with perennial flow and thus long-term aquatic faunal populations.

In conclusion the selection, sizing and installation of crossing infrastructure are crucial in managing instream fragmentation impacts. This is inadvertently catered for through the hydrological design specifications of each crossing based on the premise that that if in-wetland hydrological functioning is maintained, aquatic fauna populations will not be affected. These design considerations have been dealt with in the following preliminary reports:

- *Pre-Construction Planning and Design Phase Recommendations for River Crossings (**Appendix B1**).*
- *Proposed Upgrading of The Border Patrol Road Between South Africa, Swaziland And Mozambique & Associated Quarrying Activities: Preliminary Freshwater and Terrestrial Habitat Assessment Report to Inform Re-alignments and No-Go Alternatives (**Appendix B3**).*

Impact 3: Flow modification and erosion / sedimentation impacts (construction)

- Rivers

  During construction, flow, erosion and sedimentation impact are likely to occur as a result of the following activities:
  - Flow diversion;
  - Dewatering;

- Working within rivers and riparian zones; and
- Working within close proximity to rivers and riparian zones.

Direct flow modification impacts likely to take place may include:
- Coffer dams and / or temporary diversions can result in a reduction in flows downstream if environmental flows are not catered for, thus affecting the maintenance of key shallow riffle or run biotopes directly downstream of the bridge.
- Inundation or back-flooding upstream of coffer dams altering naturally occurring instream habitats such as sediment bars, riffles and runs.
- Abstraction of water for construction purposes, can also result in the reduction of flows downstream affecting the maintenance of key shallow water biotopes (runs and riffles) on which species rely.

Indirect flow-related erosion and sedimentation / turbidity impacts may include:
- Disturbed and exposed soils (not profiles) will be susceptible to erosion and entrainment in flows, resulting in an increase in water column turbidity and increased rates of bed sedimentation downstream.
- Disturbance of river bed and bank profiles associated within bridge construction is likely to render soil particles (i.e. sand, clay and silt) susceptible to suspension and transport downstream, resulting in the sedimentation and increased turbidity of downstream river reaches.
- Dewatering of coffer dams and temporary diversion of flows around instream work areas (usually required to ensure a ‘dry working area’) can focus flows downstream, thus altering the rate and distribution of flows and resulting in potential bed and bank scouring / erosion. This may also disconnect instream habitat reaches or microhabitats from flow or change the nature of flows in these biotopes.

Flow-related erosion (i.e. scouring) and / or sedimentation and turbidity impacts will be more pronounced during rainfall events and higher rainfall periods of the year and are directly linked with flow volumes and velocities. Some of the key ecological consequences associated with the sedimentation of freshwater habitat and increased water turbidity include:
- Partial to complete burial of aquatic vegetation and instream biotopes such as runs, riffles and pools due to sediment deposition.
- Reductions in soil saturation rates of areas buried with sediment and / or eroded.
- Colonisation by alien invasive and weedy plant species associated with recent erosional and depositional features.
- The creation of low light conditions reducing photosynthetic activity and the visual abilities of foraging instream aquatic biota.
- Increased downstream drift by benthic invertebrates causing localised reductions in population densities.
- Reduced density and diversity in benthic invertebrate and fish communities as a result of reduced water quality (suspended solids impacting intolerant taxa).

Given the need for construction works within a river channel, flow and associated erosion and sediment regime impacts will be largely unavoidable but short-term in nature and can be managed though the correct timing of construction and the implementation of key mitigation measures provided in the EMPr. Overall flow modification and sedimentation impacts will cause localised modifications to riverine habitat although this will unlikely result in a reduction of the current health (PES) and ecological importance and sensitivity (EIS) of these habitats.

- Wetlands
  During construction, flow related, erosion and sedimentation impacts are likely to occur as a result of the following activities:
  - Flow diversion;
  - Dewatering;
  - Working within wetlands; and
  - Working within close proximity to wetlands.

Direct flow modification impacts likely to take place could potentially include:
- Coffer dams and / or temporary diversions can result in a reduction in flows downstream if environmental flows are not catered for, thus affecting the saturation of downstream reaches of the wetland / wetland channel by preventing water inflows to downstream reaches. This impact particularly applies to channelled wetland systems in which water inflows are predominantly derived from the upstream channel.
- Inundation or back-flooding upstream of coffer dams altering the natural hydrology of the upstream reach of the wetland by flooding reaches of the wetland that are not naturally inundated.

Indirect flow-related erosion and sedimentation / turbidity impacts may include:
- Disturbed and exposed soils will be susceptible to erosion and entrainment in flows, resulting in an increase in water column turbidity and increased rates of sedimentation within downstream reaches of the wetland.
- Dewatering of coffer dams and temporary diversion of flows around instream work areas (usually required to ensure a 'dry working area') can focus flows downstream, thus altering the rate and distribution of flows and resulting in potential bed and bank scouring / erosion, especially in channelled wetland settings. The concentration of flows could lead to headcut initiation, especially where soils and overlying vegetation have been disturbed and removed by construction activities.

Flow-related erosion (i.e. scouring) and / or sedimentation and turbidity impacts will be more pronounced during rainfall events and higher rainfall periods of the year and are directly linked with flow volumes and velocities. The complete clearing of vegetation within the construction servitude within dynamic flow environments (especially within channelled wetland settings) during construction is likely to result in the transportation of significant volumes of silt into the downstream reaches of the wetland. The result of erosion and sedimentation impacts are likely to include the following:
- Partial to complete burial of wetland vegetation due to sediment deposition.
- Reductions in soil saturation rates of areas buried with sediment and / or eroded.
- Colonisation by alien invasive, weedy or pioneer terrestrial plant species associated with recent erosional and depositional features.
- The creation of low light conditions reducing photosynthetic activity and the visual abilities of foraging aquatic (wetland) biota.
- Reduced density and diversity in invertebrate and other wetland biota communities as a result of reduced water quality (suspended solids impacting intolerant taxa).

Impact 3: Flow modification and erosion / sedimentation impacts (operations)

- Rivers
  The primary impacts referred to here are associated with road and fence infrastructure that may permanently alter natural drainage patterns with an associated impact on aquatic habitat and biota. Instream infrastructure can alter the volume, timing and pattern of flows within the immediate river reach and downstream, ultimately affecting the rate of erosion and / or the distribution of sediment. Key flow modifications during the operation may include:

- Culverts (where employed) can result in concentrated flows and a subsequent increase in flow velocity and erosivity of flows downstream, which may result in scouring and possible long-term channel incision. Channel incision lowers the local water table causing desiccation (drying) of the riparian zone and a shift in plant communities.
- Undersized or blocked culverts may cause impoundment (increased saturation or inundation) on the upstream side of the road crossing and reduce water inputs downstream. This may alter instream biotopes upstream (causing pooling) and compromise sensitive riffle habitat downstream.
- Installation of culverts above or below the natural bed level may cause an increase or decrease in longitudinal profile of a watercourse and an increase or decrease in flow velocities at crossing points. This may result in sedimentation upstream if installed above the bed level and headward erosion if installed below the bed level.
- Scouring downstream of instream piers is also common, resulting in the formation of scour holes directly downstream of the pier structures and increased sediment delivery downstream.
- Scouring downstream of fence foundations may also result in a change in longitudinal profile of the river bed is created.

Road networks also intercept surface flows and increase peak discharge volumes and velocities of surface runoff through impermeable surfaces. This essentially changes volume and timing of peak flows within watercourses and the rate at which rivers channel transmit flows. This increase in peak discharge subsequently increases the stream power resulting in higher erosive force. Roads also alter the profile of drainage features, constrict and concentrate flows at low points (valleys) which causes increased velocity and flow erosivity, the ultimate result of which is localised scouring, bank erosion and channel incision.

The consequences of vertical incision can be summarised as follows:
- Headcut migration upstream and subsequent deepening of the stream channel.
- Relatively higher channel banks that may exceed critical height resulting in mass failure (bank erosion).
- Addition of sediment to the water column.
- Disconnection of floodplains from active stream channels.
- Lowering of the local water table and subsequent desiccation of adjacent areas.
- Locally increased channel slope and loss of instream biotope diversity.
- Drainage of shallow aquifers which affects riparian and wetland vegetation.
- Deposition of large masses of sediment downstream causing localized channel braiding, instability of the stream banks and alterations in water distribution and retention patterns in wetlands.

While the impacts discussed above are all potentially possible, where planning and design recommendations are strictly followed, these impacts are easily manageable and should not result extensive scouring, channel incision and sedimentation impacts in the long-term.

- Wetlands

  The primary impacts referred to in this section are associated with border control infrastructure that may permanently alter natural drainage patterns within the wetland that will result in a significant impact on wetland habitat integrity. Crossing structures and the foundation of the road and other infrastructure components can alter the distribution of water within wetlands (which is particularly important from a habitat integrity and wetland functionality perspective), and in channelised wetland settings can alter the volume, timing and pattern of flows within the immediate channel reach and downstream, ultimately affecting the rate of erosion and/or the distribution of sediment. Key flow and water distribution pattern modifications during the operational phase of the border control infrastructure project may include:

- The foundations of the road, and the body of the road which would typically be raised above the ground level within the wetland, can effectively act as an impounding feature in the wetland by preventing water flows from passing downstream of the of the structure. This is particularly significant in crossings where the road is aligned perpendicular to the direction of flows within the wetland. Should accommodation not be made in the design for flows to underpass the road then the hydrology of both the upstream and downstream sections of the wetland would be altered.
- Should insufficient numbers of culverts, or culverts of too small a size be included in the road design, the part of the reach immediately upstream of the road would become increasingly saturated with resultant changes in wetland vegetation that are associated with increased inundation and pooling. However more significantly the downstream reach of the wetland is deprived of water inputs and alteration of wetland vegetative composition typically results with die-off of wetland hydrophytes that are often replaced with terrestrial pioneer species that colonise the wetland. This has a resultant adverse effect on wetland habitat quality and the biotic composition of the wetland.
- Culverts can result in concentrated flows that can channelise wetland flows downstream of the culvert outlet. The scouring effect of the concentrated flows coupled with a subsequent increase in flow velocities can initiate gulley erosion in the downstream reach of the wetland. Such gulley initiation and channelisation is highly significant as the water table in the surrounding wetland is lowered and the eroded material causes excess sedimentation in downstream parts of the wetland. Other effects of such vertical incision in the wetland include:
  - Headcut migration upstream and subsequent deepening of the wetland channel (if the wetland is naturally channelised), or the channelisation of the wetland if the wetland is naturally unchannelled.
  - Relatively higher channel banks that may exceed critical height resulting in mass failure (bank erosion).
  - Addition of sediment to the water column.
  - Disconnection of floodplains from active stream channels.
  - Lowering of the local water table and subsequent desiccation of adjacent areas.
  - Drainage of shallow aquifers which affects riparian and wetland vegetation.
- This channelisation of flows is particularly significant in wetlands naturally characterised by diffuse flows. This process of channelisation typically lowers the water table in adjacent parts of the downstream reach, thus altering wetland habitat quality in the manner detailed above.
- The impounding effect of a road may alter the sediment balance within a wetland. Should the road design not allow for sediment to be delivered into the downstream section of the wetland, gulley erosion may result in this section of the wetland in order to restore the sediment balance within the downstream reaches of the wetland.
- Installation of culverts above or below the natural ground level within the wetland may cause an increase or decrease in flow velocities at crossing points, especially in channelled wetland settings. This may result in sedimentation upstream if installed above the bed level and headward erosion if installed below the bed level.
- A number of wetland HGM forms are characterised by seepage and sub-surface flows (interflow). In sloping wetland settings in particular, but also in wetland settings where the substrate is highly sandy, sub-surface foundations of structures such as roads can alter sub-surface hydrology by impounding sub-surface flows and preventing them from moving into downstream (downslope) parts of the wetland. The downstream reaches of the wetland are thus deprived of water inputs and can become desiccated, thus affecting wetland vegetation and wetland habitat quality.

It is important to note that impacts on the hydrology of a wetland are most pronounced in linear wetland systems characterised by movement of water through the system (i.e. valley bottoms, floodplains and seep wetlands). Wetland HGM forms including pan / depression wetlands and wetland flats are less likely to be adversely affected by hydrological impacts as there is typically no flow through these systems.

A road will also intercept surface flows from the catchment of the wetland and will increase peak discharge volumes and velocities of surface runoff through impermeable surfaces. This essentially changes volume and timing of peak flows and the rate at which the wetland (channel) transmits flows within wetlands as runoff from the catchment is often discharged into the wetland. This increase in peak discharge subsequently increases the stream power within channelised wetland settings resulting in higher erosive force. Roads also alter the profile of drainage features, constrict and concentrate flows at low points (valleys) which cause increased velocity and flow erosivity, the ultimate result of which is localised scouring, erosion and channel incision.

While the impacts discussed above are all potentially possible, where planning and design recommendations are strictly followed, these impacts are easily manageable and should not result extensive scouring, channel incision and sedimentation impacts in the long-term.

Impact 4: Water quality impacts (construction)

Construction phase water quality modifications may arise from a variety of sources, these include:

- Polycyclic Aromatic Hydrocarbons (PAHs) (Fluoranthene, Pyrene, and Phenanthrene) - from petrol / diesel leakages from vehicles or incomplete fuel combustion.
- Oils and grease - leakages from oil / grease stores and machinery / vehicles, spillages from poor handling and disposal practices.
- Heavy metals (Lead, Cadmium, Copper, Aluminium, Iron, Nickel, Zinc, Chromium and Manganese) - engine wear and fluid leakage, tire wear, break wear, vehicle component wear.
- Cement - spillages from poor mixing and disposal practices.
- Sewage – leakages from and / or poor servicing of chemical toilets and/or informal use of surrounding bush by workers.
- Suspended solids – suspension of fine soil particles as a result of soil disturbance and altered flow patterns (covered above).
- Solid waste - litter or discarded construction materials.

These pollutants / contaminants may enter the aquatic environment as a result of construction activities within or near watercourses (rivers and wetlands). The degree to which these pollutants will cause significant impacts depend on the type of pollutant, the likelihood of it occurring and the condition and sensitivity of the receiving aquatic ecosystem.

Impact 4: Water quality impacts (operations)

Based on the type of roads planned, suspended solid impacts are likely to be the most prominent impact to adjacent watercourses during road operation as sediment is transported *via* surface runoff during rainfall events into watercourses. This will result in high peaks in suspended solid concentrations which will stabilise following storm events. Rivers by nature experience natural peaks in suspended solids during rainfall events and are not particularity sensitive to slight increases associate with low density unpaved roads. The proper design of road stormwater systems will also aid in the management of this impact. Operation phase suspended solid impacts are likely to be of low to moderate intensity for a project of this nature and are unlikely to have a negative biotic response within the receiving river habitat.

While low usage unpaved roads are typically associated with low pollution risks, some heavy metals, PAHs and solid waste will accumulate on the road surface and be flushed into adjacent watercourses after rainfall events albeit to a very low level.

Collectively, operation phase water quality impacts will be of low intensity, limited to rainfall events with recovery of local water quality expected in affected watercourses in the short-term. Furthermore, existing

pollution levels of water resources in the study are considered to be fair to good due to the largely untransformed nature of majority of the study area. Watercourses are therefore relatively well suited to assimilate the expected small loads of pollution without significant impact to their health.

8.3 Terrestrial Ecological Assessment

This study was undertaken by Eco-Pulse Environmental Consulting Services (***Appendix C2***).

8.3.1 Desktop Flagging and Prioritisation

Due to the sheer extent (length) of the border patrol infrastructure proposed, it was not practically or financially feasible for all vegetation communities traversed by planned infrastructure to be visited in-field and assessed at a high level of detail. Key areas along the proposed infrastructure were therefore prioritised by the specialist team for field verification and collection of baseline information based on:

a) the 'sensitivity' of the receiving environment (informed by the Desktop Ecological Sensitivity); and
b) the 'threat' posed by the various road and fence activities. Sensitivity scores were obtained from the sensitivity analysis and threat scores were based on the development classification as indicated in Table 36 and Table 37 respectively.

Table 36: Rating applied to each sensitivity class

Sensitivity Class	Very High	High	Moderate	Low	Very Low
Sensitivity Score	1	0.8	0.6	0.4	0.2

Table 37: Summary of threat scores and ratings assigned to planned development infrastructure

Development Classification	Preliminary Risk Score	Preliminary Risk Rating
No fence to New Fence	0.1	Low
No Fence or Border Marker to New Border Marker		
Existing Track to 2m Track		
Existing Road to 5m Gravel Road		
Partial track to 2m Track		
No Road to 2m Track	0.3	Moderately-low
Existing Track to 5m Gravel Road		
Partial track to 5m Gravel Road		
No Road to 5m Gravel Road	0.5	Moderate

Sensitivity and threat scores (described above) were then integrated to generate a 'Flag Score' which was converted to a Flag Rating (Table 38) to inform which areas to prioritise for further verification (Figure 88):

Flag Score = (Sensitivity Score + Threat Score x 2) / 3

Table 38: Summary of various flag ratings and the associated level of assessment required

Flag Score	Flag Rating	Priority Rating
<0.4	Green Flag	Low priority area to visit / site visit not essential
>0.4 but <0.55	Orange Flag	Moderate priority area to visit
>0.55	Red Flag	High priority area to visit / site visit essential

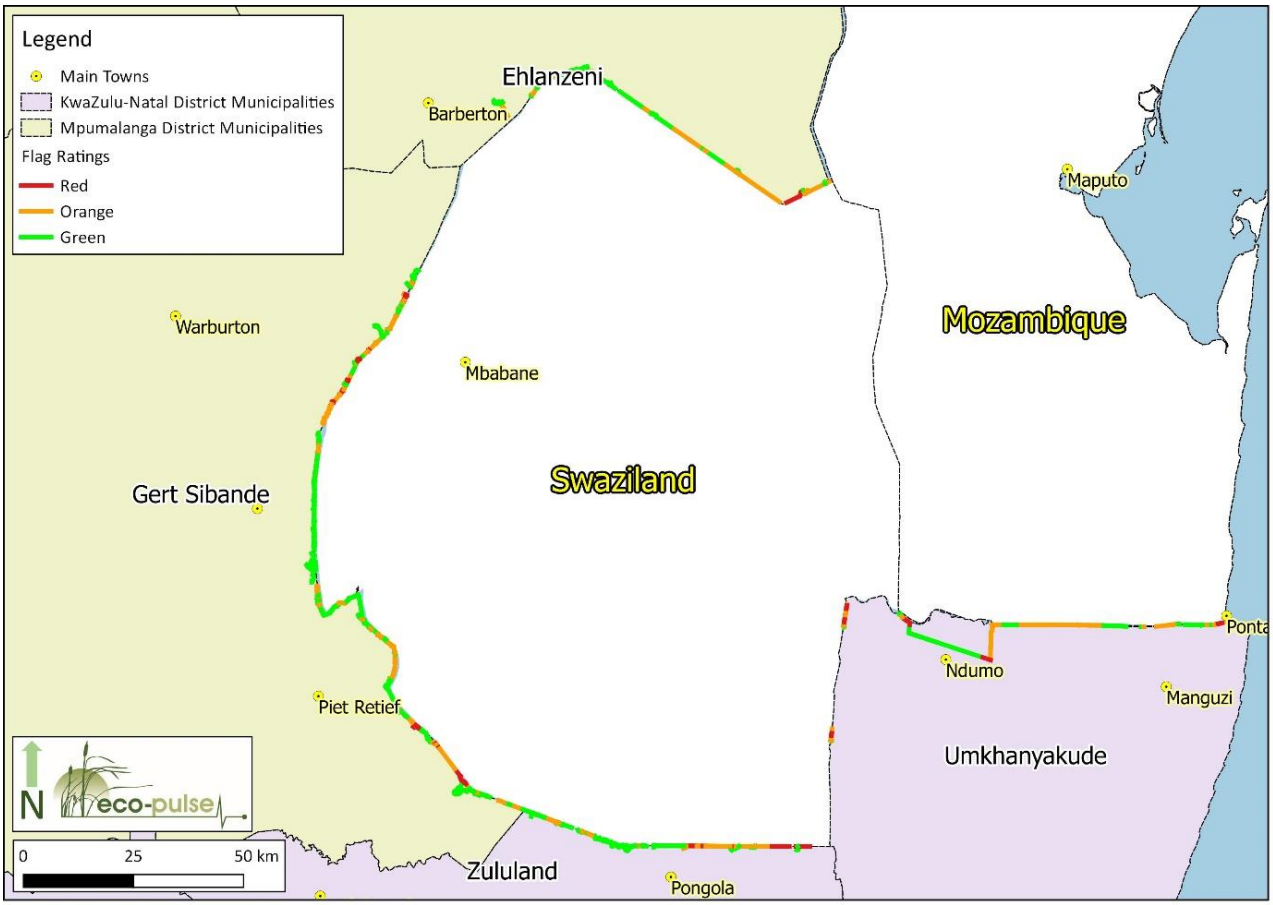


Figure 88: Map showing the different priority 'flag' ratings for different segments of the project prioritised for detailed field assessment

8.3.2 Vegetation Communities

A total of 26 vegetation types were identified within the study area. Of these, 13 are exclusive to KZN, 7 are exclusive to MP and 6 were found to be common to both KZN and MP. These are listed below, with the kilometre marker locations identified (i.e. where the vegetation types occur along the border road/fence alignment). Detailed descriptions of the individual vegetation types have been provided in *Annexure A of the Terrestrial Ecological Assessment* (***Appendix C2***).

Vegetation types exclusive to KZN:

1. Subtropical Seashore Vegetation (km 0.12- 0.15)
2. KwaZulu-Natal Dune Forests: Maputaland Dune Forest (km 0.15 – 1.0)
3. KwaZulu-Natal Coastal Forest: Maputaland Moist Coastal Lowlands Forest (km 2.6 – 2.8)
4. Maputaland Coastal Belt (km 1 – 2.3 & 3.5 – 19.3)
5. Maputaland Wooded Grassland (km 11.5 – 16.9)
6. Muzi Palm Veld and Wooded Grassland (km 19.3 – 24.6)
7. Maputaland Pallid Sandy Bushveld (km 24.6 - 32)
8. Tembe Sandy Bushveld (km 32 – 56)
9. Licuati Sand Forest: Eastern Sand Forest (km 33; 36.8 – 39.6 & 47.6 – 49)
10. Licuati Sand Forest: Western Sand Forest (km 56)
11. Western Maputaland Clay Bushveld (km 55; 65 – 78 & 159.5 – 168.2)
12. Western Maputaland Sandy Bushveld (km 57 – 60 & 159 – 163)

13. Makatini Clay Thicket (km 65 – 66, 69 – 70 & 76 – 78)

Vegetation types occurring within both provinces (KZN & MP):

1. Southern Lebombo Bushveld (km 78.7 – 81.6, 127.6 – 128.8; 154.6 – 156.5 & 509.4 – 522.3)
2. Lebombo Summit Sourveld (km 99 – 104.2, 128.8 – 130.4 & 522.3 – 523.5)
3. Zululand Lowveld (km 168.3 – 172, 494.6 – 509.4)
4. Northern Zululand Sourveld (km 172 – 177 & 199 – 218.2)
5. Delagoa Lowveld (km 82.8 - 86.7 & 177.2 – 194)
6. Ithala Quartzite Sourveld (km 194.7 – 199.6 & scattered between km 251.8 – 269.5 & 319)
7. KaNgwane Montane Grassland (km 209 – 211.5 & 218.2 – 405.3)

Vegetation types exclusive to MP:

1. Swaziland Sour Bushveld (km 405 – 406.3 & 482 – 484)
2. Barberton Montane Grassland (km 414 – 458)
3. Northern Mistbelt Forest (km 447 & 451)
4. Scarp Forest (km 458)
5. Kaalrug Mountain Bushveld (km 458.8 – 460.8)
6. Granite Lowveld (km 193 – 194.7 & 460.8 – 494.6)

8.3.3 Ecological Condition Assessment

A summary of the ecological condition assessment for KZN and MP vegetation types grouped according to their threat statuses is provided in Table 39 and Table 40 respectively.

For KZN, 75% of the vegetation the vegetation habitat falls within the ecological condition category of ‘largely intact’, ‘slightly modified’ and ‘moderately modified’. These are vegetation communities that are considered to be in generally ‘good’ condition. A further 16% is considered to be in poor condition and this is reflected in the ecological condition ratings of ‘largely modified’, ‘seriously modified / secondary’, whilst 9% of the areas are considered ‘transformed’ (i.e. under infrastructure, plantation forestry, sugarcane / crop cultivation, etc.). The comparatively low level of degradation of the vegetation / habitat in KZN is linked with:

(i) the numerous Protected Areas where vegetation types are formally protected (including Isimangaliso Wetland Park, Tembe Elephant Park, Ndumo Game Reserve, Usuthu Gorge Community Conservation Area, Pongolapoort Nature Reserve and numerous private game reserves);
(ii) limited agricultural practises along the border / coastal plain; and
(iii) limited number of human settlements.

For MP, only 45% of the vegetation along the 50m corridor was considered to be in ‘good’ condition, and this can be attributed to:

(i) high levels of vegetation transformation (forestry plantations);
(ii) historic transformation;
(iii) fewer Protected Areas; and
(iv) poor veld management by local communities.

Table 39: Summary of the ecological condition assessment for KZN vegetation types grouped according to their threat statuses

Threat Status (KZN)	Good Condition: 75%			Poor Condition: 25%			Grand Total (Ha / %)
	Largely Intact	Slightly Modified	Moderately Modified	Largely Modified	Seriously Modified / Secondary	Transformed	
Critically Endangered	0%	0%	3%	0%	0%	5%	89Ha / 8%
Endangered	3%	6%	7%	0%	4%	2%	240Ha / 22%
Vulnerable	4%	5%	3%	0%	0%	1%	148Ha / 14%
Least Threatened	16%	15%	12%	5%	7%	1%	617Ha / 56%
Grand Total (Ha / %)	258Ha 24%	295Ha 27%	261Ha 24%	60Ha 5%	120Ha 11%	100Ha 9%	1092Ha 100%

Table 40: Summary of the ecological condition assessment for MP vegetation types grouped according to their threat statuses

Threat Status (MP)	Good Condition: 45%			Poor Condition: 55%			Grand Total (Ha / %)
	Largely Intact	Sligh:tly Modified	Moderately Modified	Largely Modified	Seriously Modified / Secondary	Transformed	
Endangered	0%	0%	1%	0%	1%	0%	59Ha / 3%
Vulnerable	4%	1%	28%	9%	14%	14%	1377Ha / 27%
Least threatened	3%	2%	6%	3%	6%	7%	538 / 70%
Grand Total (Ha / %)	150Ha 8%	62Ha 3%	680Ha 34%	241Ha 12%	409Ha 21%	432Ha 22%	1974Ha 100%

8.3.4 Potential Occurrence of Conservation Important Plant Species

A two-phased approach was undertaken in assessing the occurrence of conservation important plant species. The initial phase was to undertake a desktop flora potential occurrence (POC) assessment through the interrogation of SANBI's online threatened species database (POSA) for the quarter degree grid square (QDGS) traversed by the proposed development infrastructure, including the following QDGS's: 2531CB, 2531CC, 2531CD, 2531DA, 2531DC, 2531DD, 2630BB, 2630BD, 2630DB, 2630DD 2631AA 2632CC, 2632CD, 2632DC, 2632DD, 2730BB, 2731AA, 2731AD, 2731BC, 2731BD and 2732AA.

Detailed information on the outputs of the desktop flora POC assessment is provided in *Annexure B of the Terrestrial Ecological Assessment* (***Appendix C2***).

The second step involved the undertaking of field visits to prioritised focal areas to sample vegetation, with a focus on verifying the results of the initial desktop POC assessment (i.e. confirming the presence of conservation important species flagged by the POC Assessment).

- A total of 33 threatened and protected plants were recorded at sampling points.
- A total of five (5) Critically Endangered plant species have been identified as potentially occurring within the project area but restricted to MP. Of these only *Aloe craibii* is likely to within the development area whilst others (*Adenium swazicum, Encephalartos heenanii, Encephalartos laevifolius* and *Siphonochilus aethiopicus*) are less likely to be encountered based on their habitat preferences.
- Four (4) Endangered plant species were identified as potentially occurring within the project area. Of these, 1 species (*Encephalartos lebomboensis*) is restricted to KZN Province whilst 4 (*Asclepias*

schlechteri, Brachystelma gerrardii, E. lebomboensis, and *Ocotea bullata*) occur in MP. *E. lebomboensis* is the only one regarded as being likely to occur whilst the probability of occurrence is lower for other species (possible).

- Numerous Vulnerable plants species have been identified as potentially occurring within the project area. 13 are considered likely to occur in the project area: 12 within MP and 1 in KZN. The remainder are less likely to be encountered within the project area vegetation types.
- In terms of other species of conservation concern[22], numerous species were identified as potentially occurring the project area. Of the 47 plant species flagged, only 2 (*Elaeodendron transvaalensis* and *Crinum stulmanii*) were confirmed as being present within the project area, and 19 are regarded as being likely to be present. The remainder are least likely to be encountered within the project area.
- A total of 26 nationally and provincially protected species (of Least Concern) were confirmed as being present within the project area. Of these 12 were recorded in KZN and 22 in MP.

Table 41 provided below summarises the results of the POC assessment.

Table 41: Summary of the potential occurrence assessment for conservation important species of flora

Threat Status	Total	Province	Flora Potential Occurrence Assessment			
			Confirmed in field	Likely	Possible	Unlikely
Critically Endangered	5	KZN	0	None	None	None
		MPU	0	*Aloe craibii*	*Adenium swazicum, Encephalartos heenanii, Encephalartos laevifolius & Siphonochilus aethiopicus*	None
Endangered	4	KZN	0	None	*Encephalartos lebomboensis*	None
		MPU	0	*Encephalartos lebomboensis*	*Asclepias schlechteri, Brachystelma gerrardii & Ocotea bullata*	None
Vulnerable	30	KZN	0	*Freesia laxa subsp. azurea*	5 Species	1 Species
		MPU	0	*Clivia miniata var. miniata, Ozoroa barbertonensis, Asclepias velutina, Aspidonepsis shebae, Aloe chortolirioides var. chortolirioides, Aloe kniphofioides, Rhynchosia rogersii, Hypoxis patula, Thorncroftia thorncroftii, Ocotea kenyensis & Cyphia bolusii*	11 Species	1 Species
Other Species of Conservation Concern	47	KZN	1 Species	4 Species	8 Species	4 Species
		MPU	1 Species	15 Species	11 Species	9 Species
	26	KZN	12 Species	Not Assessed		

[22] *Other species of conservation concern includes those categorised as Near Threatened, Critically Rare, Rare and Declining.*

Threat Status	Total	Province	Flora Potential Occurrence Assessment			
			Confirmed in field	Likely	Possible	Unlikely
Least Concern but Protected		MPU	22 Species	Not Assessed		

Of the 33 threatened and protected plants that were recorded at sampling points, 6 are nationally protected trees of Least Concern including 1 Near Threatened tree (*Elaeodendron transvaalense*) and 1 tree that has not been evaluated in terms of its threat status and 24 are provincially protected plants including 1 forb considered Declining (*Crinum stuhlmanii*), 20 forbs and shrubs of Least Concern and 3 forbs of unknown threat status owing to failure to identify plants to their species level. Nationally protected trees require a licence in respect of protected trees from the KwaZulu-Natal and Mpumalanga DAFF whist provincially protected plants located in KwaZulu-Natal require Ordinary Permits from EKZNW and those located in Mpumalanga require a plant permit from MTPA if they are to be destroyed or handled during the construction phase. Basic information on protected species recorded in provided in Table 42 and Figure 89 below.

Table 42: Basic information on identified conservation-important plant species and their location

No.	Botanical name	Common name	Plant type	Conservation status	Legislation[23]	Province
1.	*Afzelia quanzensis*	Pod Mahogany	Tree	LC Protected Tree	NFA	KZN
2.	*Agapanthus sp.*			Unknown	MTPA	MPU
3.	*Aloe arborescens*	Kranz Aloe	Succulent herb	LC	MTPA	MPU
4.	*Aloe dewetii*		Succulent herb	LC	MTPA	MPU
5.	*Aloe maculata*	Soap Aloe	Succulent herb	LC	NNCO & MTPA	KZN & MPU
6.	*Aloe marlothii*	Mountain Aloe	Succulent tree	LC	NNCO & MTPA	KZN & MPU
7.	*Aloe parvibracteata*		Succulent herb	LC	NNCO	KZN
8.	*Aloe suprafoliata*		Succulent herb	LC	MTPA	MPU
9.	*Balanites maughamii subsp. maughamii*	Green Thorn	Tree	Not Evaluated, Protected Tree	NFA	KZN & MPU
10.	*Boophone disticha*	Poison Bulb	Bulbous herb	LC	MTPA	MPU
11.	*Breonadia salacina*	Matumi	Tree	LC Protected Tree	NFA	KZN
12.	*Brunsvigia sp.*		Bulbous herb	Unknown	MTPA	MPU
13.	*Crinum delagoense*	Candy-striped Crinum	Bulbous herb	LC	NNCO	KZN
14.	*Crinum stuhlmanii*		Bulbous herb	Declining	NNCO	MPU
15.	*Elaeodendron transvaalense*	Bushveld Saffron	Tree	NT Protected Tree	NFA	KZN
16.	*Eucomis autumnalis*	Pineapple Lily	Bulbous herb	LC	MTPA	MPU
17.	*Gladiolus cf. crassifolius*	Thick-leaved Gladiolus	Bulbous herb	LC	MTPA	MPU
18.	*Gladiolus densiflorus*		Bulbous herb	LC	NNCO	KZN
19.	*Huernia hystrix subsp. hystrix*	Toad Plant	Succulent herb	LC	NNCO	KZN
20.	*Ledebouria asperifolia*	Large Ledebouria	Succulent herb	LC	NNCO & MTPA	KZN & MP
21.	*Ledebouria floribunda*		Succulent herb	LC	MTPA	MPU
22.	*Ledebouria ovatifolia*	Icubudwana (z)	Succulent herb	LC	MTPA	MPU
23.	*Ornithogalum sp.*			Unknown	NNCO	KZN

[23] ***NFA:*** *National Forest Act, 1998 (Act No. 84 of 1998)*; ***NNCO:*** *Natal Nature Conservation Ordinance, 1975 (No. 15 of 1974)*; ***MNCA:*** *Mpumalanga Nature Conservation Act, 1998 (No. 10 of 1998)*

No.	Botanical name	Common name	Plant type	Conservation status	Legislation[23]	Province
24.	*Protea caffra subsp. caffra*	Common Sugarbush	Shrub	LC	MTPA	MPU
25.	*Protea roupelliae* subsp. *roupelliae*	Silver Sugarbush	Shrub	LC	MTPA	MPU
26.	*Sclerocarya birrea subsp. caffra*	Marula	Tree	LC Protected Tree	NFA	KZN & MPU
27.	*Sideroxylon inerme* subsp. *inerme*	White Milkwood	Tree	LC Protected Tree	NFA	KZN
28.	*Watsonia cf. pulchra,*		Herb	LC	MTPA	MPU
29.	*Watsonia watsonioides*		Herb	LC	MTPA	MPU
30.	*Xerophyta retinervis*	Monkey's Tail	Herb	LC	MTPA	MPU
31.	*Gunnera perpensa*	River pumpkin	Creeper	Declining	NNCO	MPU
32.	*Ficus trichopoda*	Swamp fig	Tree	LC Protected Tree	NFA	KZN
33.	*Barringtonia racemosa*	Powder puff tree	Tree	LC Protected Tree	NFA	KZN

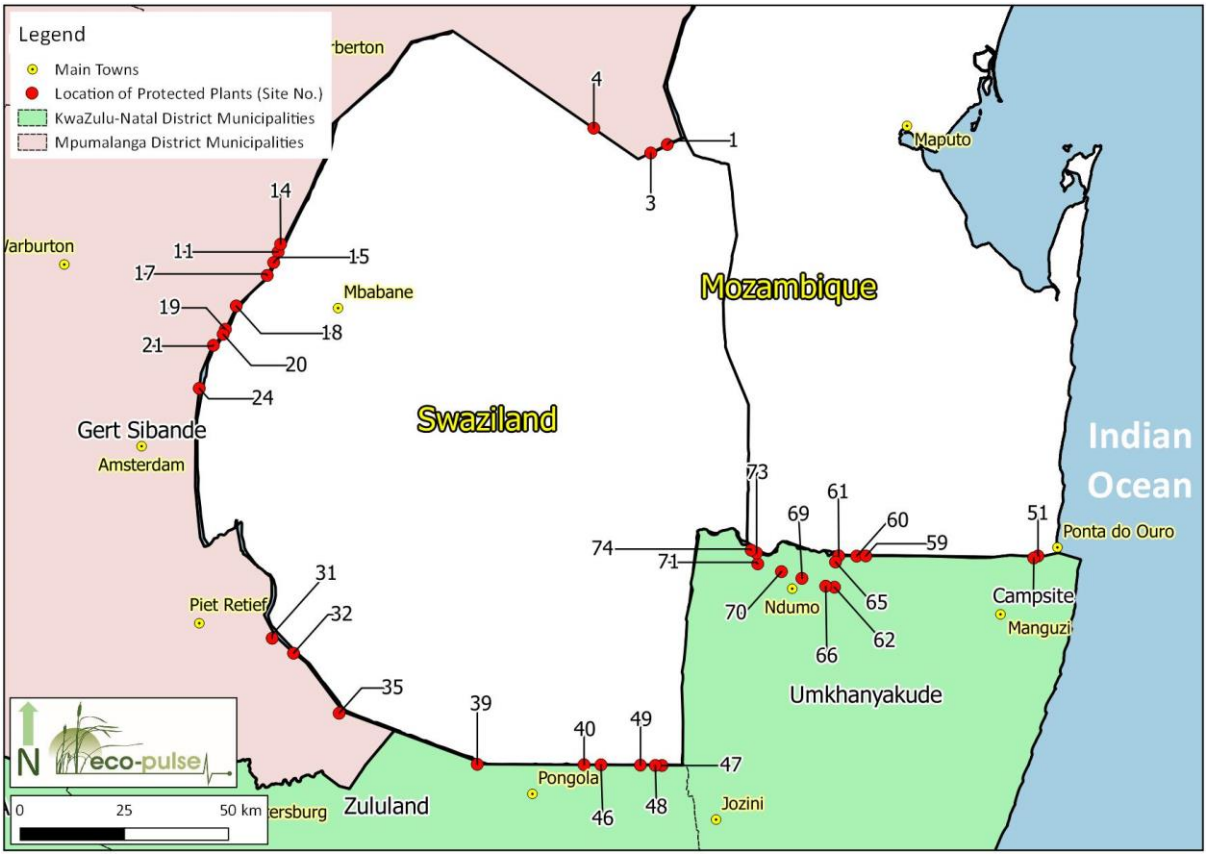


Figure 89: Spatial distribution of protected and conservation-important plants in the study area (*Note that the numbered labels indicate the location of 'field sampling sites' 1-74 and do not reflect actual plant numbers)*

8.3.5 Ecological Importance and Sensitivity (EIS) of Vegetation Communities

The EIS results for KZN indicate that 64% of the vegetation communities fall within a moderate to high EIS range, of which 8% are considered to be highly important and sensitive to external disturbance, 21% are considered to be of moderately-high EIS and 35% of moderate EIS. The relatively high importance / sensitivity for most vegetation communities encountered in KZN can be linked back to the generally good ecological condition of the majority of vegetation communities within the KZN portions of the study area (75%). A total of 9% of vegetation types were considered to be 'transformed' by agriculture / development land use and were not rated in terms of EIS as these transformed areas provide minimal ecological functioning or habitat to support key species or ecological processes.

Table 43: Summary of EIS assessment for KZN vegetation types identified within the study area

KZN Vegetation Type	EIS Ratings					Transformed
	High	Moderately-High	Moderate	Moderately-Low	Low	
Delagoa Lowveld	1%	32%	3%			64%
Granite Lowveld		55%		45%		
Ithala Quartzite Sourveld			82%	1%		16%
KaNgwane Montane Grassland		69%	5%	21%		
KwaZulu-Natal Coastal Forests : Maputaland Moist Coastal Lowlands Forest	2%	98%				
KwaZulu-Natal Dune Forests : Maputaland Dune Forest	100%					
Lebombo Summit Sourveld	82%					18%
Licuati Sand Forests : Eastern Sand Forest			54%		43%	3%
Licuati Sand Forests : Western Sand Forest			75%	8%	17%	
Makatini Clay Thicket			100%			
Maputaland Coastal Belt		69%		21%		9%
Maputaland Pallid Sandy Bushveld			83%	6%	11%	
Maputaland Wooded Grassland		100%				
Muzi Palm Veld and Wooded Grassland			81%			19%
Northern Zululand Sourveld			25%	41%	35%	
Southern Lebombo Bushveld			100%			
Subtropical Seashore Vegetation			100%			
Tembe Sandy Bushveld			42%	28%	30%	
Western Maputaland Clay Bushveld	39%	26%	28%			8%

KZN Vegetation Type	EIS Ratings					Transformed
	High	Moderately-High	Moderate	Moderately-Low	Low	
Western Maputaland Sandy Bushveld			64%	5%	31%	
Zululand Lowveld		100%				
Grand Total	8%	21%	35%	15%	12%	9%

Within the MP sections of the study area, only 39% of the vegetation communities fall within the moderate to high EIS range, of which a mere 5% are considered to be highly important and sensitive to external disturbance, 1% of moderately-high EIS and 33% being of moderate EIS. This is attributed to the most vegetation communities (55%) being in poor condition. A total of 22% of vegetation types were considered to be 'transformed' by agriculture / development land use and were not rated in terms of EIS as these transformed areas provide minimal ecological functioning or habitat to support key species or ecological processes.

Table 44: Summary of EIS assessment for MP vegetation types identified within the study area

MPU Vegetation Type	EIS Ratings					Transformed
	High	Moderately-High	Moderate	Moderately-Low	Low	
Barberton Montane Grassland	28%		13%			59%
Granite Lowveld			4%	29%	62%	5%
Ithala Quartzite Sourveld				16%	55%	29%
Kaalrug Mountain Bushveld				81%	19%	
KaNgwane Montane Grassland	1%	1%	42%	15%	21%	20%
Lebombo Summit Sourveld		23%		6%	5%	65%
Northern Mistbelt Forest			99%			1%
Scarp Forest				100%		
Southern Lebombo Bushveld			40%	26%	31%	3%
Swaziland Sour Bushveld				95%	5%	
Zululand Lowveld	12%	20%	57%	9%		3%
Grand Total	5%	1%	33%	17%	22%	22%

8.3.6 *Potential Occurrence of Conservation Important Fauna*

A total of 60 (sixty) individual species of conservation important (Red Data listed) species were considered as potentially occurring in the study area. A review of the habitat requirements / preferences and species specific habits / behaviour was reviewed in order to assess the 'potential ecological risk' posed by the border patrol infrastructure. This highlighted key 'priority' species to inform the impact assessment and mitigation (i.e. species at moderate to high risk of impact).

Detailed information on the outputs of the desktop fauna POC assessment is provided in *Annexure B of the Terrestrial Ecological Assessment* (***Appendix C2***).

- ***Amphibians***
  The desktop fauna POC assessment identified only two (2) amphibian species of conservation concern (Red-Data listed: Near Threatened - NT, Vulnerable - VU) likely to occur in the study area, with most conservation important frogs not occurring in KZN as far north as the study area. Potential frogs include

the Spotted Shovel-nosed Frog (*Hemisus guttatus*, VU) for KZN and MP and Giant Bullfrog (*Pyxicephalus adspersus*, NT) for MP. Based on their habitat preferences and behaviour, neither of these are considered key or 'priority' species for the project (from an impact and mitigation perspective).

- ***Avifauna***
  The desktop fauna POC assessment identified thirty six (36) bird species of conservation concern (Red-Data listed: NT, VU, Endangered - EN, Critically Endangered - CR) likely to occur in the study area.

  Most species have a threat status of 'Vulnerable' (VU) with two species considered 'Critically Endangered' (i.e. Blue Swallow and Eurasian Bittern) and generally occur across MP and KZN. Key or 'priority' bird species for the project (from an impact and mitigation perspective), include:
  - African grass owl (*Tyto capensis*, VU);
  - Various species of Vulture, including Hooded Vulture (*Necrosyrtes monachus*, VU), Lappet-faced Vulture (*Aegypius tracheliotos*, VU), White-backed Vulture (*Gyps africanus*, VU), Whiteheaded Vulture (*Aegypius occipitalis*, VU);
  - Eurasian (Great) Bittern (*Botaurus stellaris*, CR);
  - Saddle-billed Stork (*Ephippiorhynchus senegalensis*, EN);
  - Southern Ground-Hornbill (*Bucirvus leadbeateri*, VU); and
  - White-backed Night-Heron (*Gorsachius leuconotus*, VU).

  Refer to *Annexure F of the Terrestrial Ecological Assessment (**Appendix C2**)* for details on habitat preferences, behaviour and risks posed by road and fence infrastructure to the individual species listed above.

- ***Mammals***
  The desktop fauna POC assessment identified fourteen (14) mammals species of conservation concern (Red-Data listed: NT, VU, EN, CR) likely to occur in the study area. Four (4) key or 'priority' mammal species for the project (from an impact and mitigation perspective), include:
  - Oribi (*Ourebia ourebi*, EN);
  - Samango Monkey (*Cercopithecus albogularis erythrarchus*, NT);
  - Tonga Red Bush Squirrel (*Paraxerus palliatus tongensis*, EN); and
  - Blue Duiker (*Cephalophus monticola*, VU).

  Refer to *Annexure F of the Terrestrial Ecological Assessment (**Appendix C2**)* for details on habitat preferences, behaviour and risks posed by road and fence infrastructure to the individual species listed above.

- ***Reptiles***
  The desktop fauna POC assessment identified eight (8) reptile (snake and lizard) species of conservation concern (Red-Data listed: NT, VU) likely to occur in the study area. One (1) key or 'priority' reptile species for the project (from an impact and mitigation perspective), include:
  - Nile crocodile (*Crocodylus niloticus*, VU).

  Refer to *Annexure F of the Terrestrial Ecological Assessment (**Appendix C2**)* for details on habitat preferences, behaviour and risks posed by road and fence infrastructure to the individual species listed above.

8.3.7 Potential Impacts

The potential impacts to the mapped terrestrial habitats and local terrestrial biodiversity resulting from the proposed activities can be grouped into the following four (4) impact categories:

(i) Impact 1: Physical habitat destruction and modification impacts;
(ii) Impact 2: Indirect erosion, sedimentation and pollution impacts;
(iii) Impact 3: Impacts on biodiversity processes (connectivity); and
(iv) Impact 4: Ecological disturbance and nuisance impacts.

Impact 1: Physical habitat destruction and modification impacts (construction)
The construction of the border patrol road and fence will require partial to complete clearing of the vegetation / habitat within the construction servitude, with the width of disturbance / clearing varying depending on the proposed activity. The construction of the border patrol road will result in the irreversible transformation of a 3 – 5.5m wide construction footprint to either a quadbike track or gravel road.

The construction of the border fence will entail removing the existing fence (where relevant), excavations to found new fence posts and installation of (i) a new 2.4m high veterinary-grade fence line, or (ii) a new Clearview® fence, or (iii) mesh fence. At specific sites, an additional elephant-proof fence will be installed. Furthermore, a 10m wide corridor will need to be cleared in order to serve as a 'Detection Zone' established along the entire border fence within South Africa to allow for patrols to effectively monitor the border. All woody vegetation within the proposed detection zone will need to be removed. The construction of the fence will therefore will result in the destruction and / or modification of a 10 – 13m wide area along the border.

A summary of the total area to be irreversibly transformed by each of the proposed development options within each province is provided in Table 45 below. In terms of total area of habitat to be irreversibly transformed, the construction of the border control fence infrastructure will have the largest footprint followed by the border patrol road.

Table 45: Summary of the transformation area (expressed in ha) for each development activity within each province

Province	Vegetation Threat Status	Fence (ha)	Road (ha)
KwaZulu-Natal	Critically Endangered	8.49	7.29
	Endangered	16.37	18.79
	Vulnerable	19.07	8.09
	Least Threatened	71.63	32.03
	Sub Total (ha)	**115.56**	**66.2**
Mpumalanga	Endangered	1.28	0.74
	Vulnerable	183.7	97.44
	Least threatened	14.65	11.52
	Sub Total (ha)	**199.63**	**109.69**
Combined (KZN & MP)	**Grand Total (ha)**	**315.19**	**175.9**

The impacts on vegetation will be most significant in areas that are still largely natural and which contain or support important fauna and flora. Given that the total area of transformation includes already transformed areas and vegetation communities in different conditions and with variable sensitivities and risk to different anthropogenic pressures, it is important to standardise the extent of area to be transformed using the concept of "Hectare Equivalents". For the purposes of this assessment, "a hectare equivalent is a quantitative expression of the ecological condition of a terrestrial vegetation functional area under a given land use and / or a measure of terrestrial vegetation functional area". A practical example of the application of hectare equivalents is provided in Text Box 2 below:

Text Box 2: Practical example of the application of 'Hectare Equivalents' (H.E)

If one converts all ecological condition ratings to numerical weighted values from 0 - 1 such that (i) largely intact / pristine becomes 1, (ii) slightly modified becomes 0.9 (iii) moderately modified becomes 0.7, (iv) largely modified becomes 0.5, (v) seriously modified becomes 0.8 and (vi) critically modified / transformed becomes 0. When you multiply the value of the ecological condition of a particular vegetation community by its area, the result will be a 'weighted' value indicating the equivalent amount of intact habitat within that particular unit. For example, if a 10ha vegetation community was assessed as being in a largely modified state (weighted 0.5) then it is equivalent to 5ha of pristine habitat (i.e. 10ha x 0.5 = 5 H.E.). If the same vegetation community was in a pristine condition (1) then it is equivalent to 10ha of pristine habitat (i.e. 10ha x 1 = 10 H.E.). Should the entire 10ha area be critically modified / transformed then it is equivalent to 0ha of pristine habitat (i.e. 10ha x 0 = 0 H.E.).

A summary of the Hectare Equivalents (H.E.) assessment results are provided in Table 46, below. The results indicate that the construction of the border patrol road infrastructure will have the largest ecological impact / footprint followed by the border control fence.

Table 46: Summary of the transformation area for each development activity expressed in hectare equivalents (H.E)

Province	Vegetation Threat Status	Fence (H.E.)	Road (H.E.)
KwaZulu-Natal	Critically Endangered	1.18	1.99
	Endangered	3.66	12.66
	Vulnerable	7.72	6.47
	Least Threatened	25.07	21.03
	Sub Total (H.E.)	**37.62**	**42.16**
Mpumalanga	Endangered	0.24	0.04
	Vulnerable	25.00	50.70
	Least threatened	4.25	6.04
	Sub Total (H.E.)	**29.49**	**56.78**
Combined (KZN & MP)	**Grand Total (H.E.)**	**67.11**	**98.94**

In addition to terrestrial vegetation and habitat that will be irreversibly lost within the development footprint, there are likely to be additional areas that will be temporary modified or disturbed. These are (i) areas adjoining the construction footprint but within the construction servitude (used as stockpile and work areas) or (ii) areas off-site to be used as temporary sites camps and equipment / plant lay-down areas for the duration of the construction phase. Following the completion of construction, these areas will be rehabilitated and should, over time, return to their pre-development state if rehabilitation is successful. If rehabilitation is undertaken poorly, these areas may become overrun by weeds and IAPs and thus fail to return to their pre-development state resulting in the net loss of functional habitat. Areas with a high IAP seed source and propagules will be of higher risk than those without IAP seed sources.

Both the permanent loss and temporary modification of habitat during the construction phase will likely result in the loss of threatened as well as nationally / provincially protected plant species. If these species are not rescued and translocated to areas outside the construction servitude or replaced then their loss could possibly increase their risk of extinction, particularly those with a threat status of CR, EN and VU.

Impact 1: Physical habitat destruction and modification impacts (operations)

Whilst no planned direct habitat destruction impacts are expected during the operational phase, poor rehabilitation efforts, poor design and construction of infrastructure as well as poor management of the operational phase will likely result in the gradual modification of onsite and adjoining terrestrial habitats. During operation, the spread of IAPs and weeds into remaining untransformed vegetation is a particular risk

/ concern and which can alter vegetation composition and structure by replacing and outcompeting native species.

Following construction, the potential disturbance of soil and vegetation within natural areas (and adjacent habitats) encourages the establishment of pioneer vegetation, in many cases creating an ideal opportunity and optimal conditions for weeds and IAPs to invade both disturbed and adjacent undisturbed areas. IAPs likely to be a problem (based on their confirmed presence during focal field surveys) may include the following NEM:BA listed species: *Chromolaena odorata, Lantana camara, Tithonia diversifolia*, *Rubus cuneifolius* and *Ricinus communis*.

Impact 2: Indirect erosion, sedimentation and pollution impacts (construction)

Construction activities will involve the clearing and stripping of topsoil and vegetation within the construction servitude and result in the exposure of bare areas and soil stockpiles to the elements (rain and wind). This is likely to lead to localised soil erosion and result in sedimentation of adjacent terrestrial habitat and the probable smothering of vegetation. Some of the key ecological effects related to the erosion / deposition of sediment may include:

- Habitat alteration due to increased sediment deposition or erosion of areas;
- Reductions in photosynthetic activity and primary production caused by sediments impeding light penetration;
- Reduced density and diversity of organisms as a result of habitat degradation, blanketing of sites and the establishment of more tolerant taxa or exotic species; and
- Exposure disturbed sites to invasion by weeds and other undesirable plants

During the construction phase, there is also the risk that soils, water and vegetation may be contaminated by pollutants. Potential contaminants and their relevant sources are listed below:

- Hydrocarbons – leakages from petrol / diesel stores and machinery / vehicles, spillages from poor dispensing practices;
- Oils and grease - leakages from oil / grease stores and machinery / vehicles, spillages from poor handling and disposal practices;
- Cement - spillages from poor mixing and disposal practices; and
- Sewage – leakages from and/or poor servicing of chemical toilets and/or informal use of surrounding bush by workers.

If above mentioned contaminants are poorly handled or mismanaged during the construction phase, there is a risk that small areas of the construction soils and surfaces will be contaminated. During rainfall events, such contaminants could be washed into adjacent intact terrestrial habitats. If significant concentrations of contaminants are spilled / leaked and washed into adjacent habitats there could be plant die-offs and / or increased levels of plant stress which could decrease the completive ability of the affected plants and ultimately result in changes in plant species composition in favour of more tolerant species likely manifesting in increased abundances of ruderals, weeds and / or IAPs.

Impact 2: Indirect erosion, sedimentation and pollution impacts (operations)

During the operational phase of the border patrol road, stormwater generated by the compacted gravel surface will be conveyed and discharged into adjoining terrestrial habitats via point source outlets. This will result in the concentration of runoff and an increase in the velocities of runoff discharged into the environment, ultimately resulting in enhanced risk of erosion and sedimentation. Erosion risks will be most apparent on erodible slopes (steep slopes and / or erosive soils. Furthermore, the concentrated discharge of surface runoff at outlets will likely alter the natural soil moisture levels and alter species composition in favour of opportunistic and / or water loving species. Areas affected by sedimentation will be susceptible to

the establishment of ruderals, weedy plants and IAPs which could alter the species composition of the vegetation community and ultimately contribute to habitat degradation outside of the development servitude.

Pollution impacts during the operational phase of the project could be associated with the use of the road by vehicles (4x4s, trucks, quad bikes, etc.). Well-used roads are known to generate numerous pollutants, namely: nutrients, heavy metals, polycyclic aromatic hydrocarbons (PAHs), Volatile Organic Compounds (VOCs) such as benzene, toluene, ethylbenzene, xylene, and methyl tert-butyl ether (MTBE). Such pollutants generally enter the environment via surface runoff, particularly during a first flush of rain. Acting either as a fertilizer (nitrogen), growth stimulator (carbon dioxide) or pollutant (heavy metals), vehicular emissions can influence plant stress and growth and play a significant role in transforming road verge plant populations and increasing the intensity and extent of edge effects.

Given that the border patrol road will attract limited traffic volumes, low concentrations of pollutants will be generated. Therefore, the intensity of this impact is expected to be particularly low / negligible and unlikely to have a noticeable influence on terrestrial vegetation / habitat unless a major accidental fuel spill event occurs from a patrol vehicle for example.

Impact 3: Impacts on biodiversity processes (construction)
The construction of the border patrol road and fence will require partial to complete clearing of the vegetation / habitat within the construction servitude, with the width of disturbance / clearing varying depending on the proposed activity. The destruction of 172ha of terrestrial vegetation may result in the direct loss of small sedentary / slow-moving faunal species such as invertebrates, chameleons, hatchlings, and other young faunal species utilising the habitat. Given that a large portion of the road is an upgrade of the existing road infrastructure and that mobile faunal species are likely to relocate away from the disturbance-causing activities and thus avoid being harmed, the probability and intensity of the construction impact on faunal species is likely to be limited to the reduction in habitat, with direct mortalities unlikely in most cases.

Impact 3: Impacts on biodiversity processes (operations)
Vegetation clearing and the permanent transformation of natural habitat not only reduces the availability of habitat (refugia / breeding / nesting sites) and food for local wildlife but may also temporarily or even permanently restrict corridor movement between natural areas through associated fragmentation of natural habitat and the severing of natural ecological linkages / corridors. This will be of particular significance where relatively un-impacted areas may be affected, especially for existing local wildlife movement corridors.

The effect of fragmentation will generally be greater for fauna than for flora and is typically lower for grasslands when compared with wooded / forest communities. Where no permanent structure is planned, impacts on habitat connectivity and species movement are likely to be very limited and temporal.

The most obvious direct impact of the border road is the risk of potential direct collisions of border patrol vehicles with wildlife crossing roads. The probability and frequency of such incidences occurring is likely to be low given that the border roads will not convey heavy vehicular traffic (limited to occasional single patrol vehicles most probably).

The border fence impacts on wildlife are therefore likely to be the most significant for this project. Whilst border fences are meant to be impenetrable for people, as a consequence they do the same for many animals, especially large-bodied ones. Fences can typically result in the following impacts on wildlife[24][25]:

[24] *Mbaiwa, J.E. and Mbaiwa, O.I. 2006. The effects of veterinary fences on wildlife populations in the Okavango Delta, Botswana. International Journal of Wilderness. Volume 12 (3): pp17-23. December 2006.*
[25] *Ferguson, K. & Hanks, J. eds., 2010. Fencing Impacts: A review of the environmental, social and economic impacts of game and veterinary fencing in Africa with particular reference to the Great Limpopo and Kavango-Zambezi Transfrontier Conservation Areas. Pretoria: Mammal Research Institute. Available online at: http://www.wcs-ahead.org/gltfca_grants/grants.html.*

- Impermeable fences can fragment habitat into small islands of resources, and prevent access to critical resources (such as food, water, cover, breeding grounds) or increase the energy required for wildlife to take advantage of resources;
- Impedes mobility / restricts the movement of native wildlife, particularly migratory species (such as such as wildebeests, zebras, giraffes, buffalo, and tsessebes, etc.) as well as restricts the frequency of movements of localized populations of common species;
- Disrupts the feeding, migration, breeding and social patterns of wild animals, cause genetic isolation and alter behaviours that may be important to the long-term survival of the populations or species involved;
- Result in faunal mortalities (animals typically die from dehydration and entanglement / impalement in the fence);
- Can result in increased incidences of poaching (animals trapped by fences become easy targets for poachers); and
- There could be a variety of additional indirect effects, such as increase in physiological stress, all impacting on species demographics and population growth.

The results of the desktop fauna POC (Potential Occurrence) assessment (which focused on Red Data listed / endangered species), has highlighted a number of avifauna (birds), small and large mammals and reptiles of conservation concern, as well as two amphibians (frogs). Impacts to individuals can vary based on the animal's age, season, and resource availability, with the impact of a fence design at the species level determined largely by the animal's agility and behaviour (Arizona Game & Fish Department):

- Large carnivores (with their low-density occurrences, huge home ranges and long-distance dispersal) and large herbivores (especially those inclined to traveling far and wide) are especially vulnerable to fence impacts[26].
- Most bird injuries or mortalities from fencing are due to lack of visibility. For example, raptors in pursuit of prey and waterfowl or wading birds attempting to land on a water body, are particularly vulnerable to fence impacts[27]. Electrically charged fences (hot wires) also have the potential to electrocute animals such as small birds landing on the wires. Fencing that crosses watercourses may also dramatically reduce usability for bats, which typically drink on-the-fly and the presence of an obstacle may eliminate accessibility, present a hazard, or increase the energy expenditure for obtaining water[28]
- Most amphibians and reptiles are not hampered by conventional livestock fencing; however there are exceptions if relatively fine mesh fencing is extended securely to the ground[29].

An additional threat to wildlife comes from snaring, often using fence wire meant to protect these species. Poachers may also take advantage of border fences when pursuing animals, by chasing and trapping fast-moving animals against the fence (Ferguson & Hanks, 2012). According to Ferguson and Hanks (2010), the impacts of fencing can only be gauged by access to good quality data produced as a result of integrated research projects and much more research is required on the impacts of fence construction on large mammal behavioural and population ecology, including studies that span pre- to post fence time periods.

Based on the findings of the desktop fauna POC (Potential Occurrence) assessment undertaken, key habitats in KZN and MP likely to harbour fauna of conservation concern (Red Data listed / endangered) include:

- Grasslands (e.g. host a variety of birds, antelope and reptiles);
- Open and wooded savannah (antelope such as Oribi, reptiles);
- Forests (e.g. endangered squirrels, Samango Monkey, species of endangered birds and snakes); and

[26] *Trouwborst, A., Fleurke, F. and Dubrulle, J. 2016. Border fences and their impacts on large carnivores, large herbivores and biodiversity: an international wildlife law perspective. RECIEL 25 (3). 2016. ISSN 2050-0386.*
[27] *www.azgfd.gov/w_c/documents/110125_AGFD_fencing_guidelines.pdf.*
[28] *Ibid Footnote 27.*
[29] *Ibid Footnote 27.*

- Wetlands (mainly threatened frogs as well as reptiles such as Nile crocodile).

Impact 4: Ecological disturbance and nuisance impacts (construction)
The construction of the border patrol road will require use of heavy machinery to excavate and move / place construction materials. Such activities are known to generate substantial amounts of dust, noise and vibrations. Local wildlife (fauna) generally respond to disturbances caused by human activities according to the magnitude, timing, and duration of the particular disturbance.

Anthropogenic activities occurring within a close proximity to natural habitats containing fauna (wildlife) can lead to both the physical disturbance of habitats supporting animal life by construction machinery / labourers as well as the disturbance of fauna due to noise and artificial light pollution at the site during construction. Locally common species are likely to be less sensitive to noise / light disturbance.

Impact 4: Ecological disturbance and nuisance impacts (operations)
Ecological disturbances and nuisance impacts during the operational phase of the project will likely be limited to only the use of the road infrastructure by patrol vehicles. This activity will generate limited noise impacts at a low frequency of occurrence, which may have a negligible impact on faunal species that are sensitive to noise pollution.

Positive impacts on biodiversity
The proposed border fence, barrier obstacle structure and patrol road is also likely to result in a number of positive impacts to biodiversity. Fencing if correctly maintained can of course have short-term positive benefits for conservation, such as giving protection to highly endangered or 'expensive to replace' species such as rhino at risk of poaching and extinction, and reducing the incidents of human-wildlife conflict and disease.

8.4 Heritage

A Heritage Impact Assessment was conducted by Active Heritage (***Appendix C4***).

8.4.1 Pre-colonial Archaeology

Archaeological sites occur throughout the project area along the border with Swaziland and Mozambique. These include five Early Stone Age, eight Middle Stone Age, five Later Stone Age, two Later Iron Age, one Rock Art, and four Later Iron Age / Historical period sites (Table 47). The highest heritage rating for all these sites in applies to the globally significant Border Cave Site.

Table 47: List of archaeological sites in the project area

Site Name	Site Type	Grading	Longitude	Latitude	Mitigation
MSA & RA (Shelter)	Prehistoric	Grade 111A	S 26° 52’ 27.72”	E 32° 11’ 34.43”	Maintain a buffer zone of at least 50m around this site
MSA (open air site)	Prehistoric	Grade 11A	S 26° 50’ 57.71”	E 32° 8’ 4.94”	Maintain a buffer zone of at least 10m around this site
ESA, MSA, LSA, RA (Border Cave) (Cave Site)	Prehistoric	Provincial	S 26° 48’ 1.08”	E 32° 0’ 12.24”	Maintain a buffer zone of at least 50m around this site
MSA (open air site)	Prehistoric	Grade 111A	S 27° 1 ’ 13.66”	E 31° 59’ 35.51”	Maintain a buffer zone of at least 10m around this site
MSA (open air site)	Prehistoric	Grade 11A	S 27° 8’ 27.40”	E 31° 59’ 11.29”	Maintain a buffer zone of at least 10m around this site
LSA (open air)	Prehistoric	Grade 111A	S 27° 8’ 27.40”	E 31° 58’ 39.99”	Maintain a buffer of at least 30m around this site)
LSA (open air)	Prehistoric	Grade 111A	S 27° 17’ 53.33”	E 31° 58’ 51.06”	Maintain a buffer of at least 10m around this site
MSA, HIS (open air and stone structures)	Prehistoric and indigenous historical	Grade 111A	S 27° 40’ 28.30”	E 31° 21’ 45.90”	Maintain a buffer zone of at least 30m around this site
LIA, HIS (stone-walled structures) and open air	Prehistoric and indigenous historical	Grade 111A	S 27° 17’ 16.06”	E 31° 21’ 2.08”	Maintain a buffer zone of at least 30m around this site
LIA, HIS (stone-walled structures) and open air	Prehistoric and indigenous historical	Grade 11A	S 27° 16’ 55.60””	E 31° 21’ 0.26”	Maintain a buffer zone of at least 30m around this site
HIS	Indigenous Historical	Grade 11A	S 27° 15’ 42.43”	E 31° 15’ 28.36”	Maintain a buffer zone of at least 30m around this site
LSA (open air). Few stone flakes	Prehistoric	Grade 11A	S 25° 58’ 8.79”	E 31 50’ 25.28”	Maintain a buffer of at least 10m around this site. Should this not be possible

Site Name	Site Type	Grading	Longitude	Latitude	Mitigation
					then the Developers can motivate for a phase two HIA with an option of making a surface collection of the artefacts prior to development
ESA (open air)	Prehistoric	Grade 11A	S 25° 56’ 16.73”	E 31° 48’ 44.24”	Maintain a buffer zone of 10m around this site
LSA (open air) (Figure 92)	Prehistoric	Grade 11A	S 25° 55’ 58.49”	E 31° 48’ 20.97”	Maintain a buffer zone of 10m around this site
MSA (open air) (Figure 91)	Prehistoric	Grade 11A	S 25° 56’ 23.53”	E 31° 48’ 9.75”	Maintain a buffer zone of 10m around this site
ESA (open air)	Prehistoric	Grade 11A	S 25° 54’ 54.25”	E 31° 47’ 40.80”	Maintain a buffer zone of 10m around this site
LSA (open air). Few stone flakes on surface	Prehistoric	Grade 11A	S 25° 52’ 36.80”	E 31° 45’ 31.29”	Maintain a buffer zone of 10m around this site. Should this not be possible then the Developers can motivate for a phase two HIA with an option of making a surface collection of the artefacts prior to development
MSA (open air)	Prehistoric	Grade 11A	S 25° 52’ 35.81”	E 31° 45’ 29.18”	Maintain a buffer zone of 10m around this site
MSA (open air)	Prehistoric	Grade 11A	S 25° 49’ 56.32”	E 31° 41’7.29”	Maintain a buffer zone of 10m around this site

Site Name	Site Type	Grading	Longitude	Latitude	Mitigation
ESA (open air)	Prehistoric	Grade 11A	S 25° 45’ 10.20”	E 31° 15’ 53.15”	Maintain a buffer zone of 10m around this site
ESA (open air)	Prehistoric	Grade 11A	S 25° 47’ 10.23”	E 31° 12’ 16.75”	Maintain a buffer zone of 10m around this site

Figure 90: Border cave site[30]

Figure 91: Middle Stone Age flake (left), dates between 40 000 and 200 000 years ago, situated in the north-eastern section of the footprint. Early Stone Age hand axe (right), dates between 1.5mill and 300 000 years, situated in the northern section of the project area

[30] *Picture accessed from https://alchetron.com/Border-Cave.*

Figure 92: Later Stone Age flake, made by the Khoisan or their immediate ancestors, situated in the northern section of the project area

Figure 93: Later Iron Age stone-walled structure situated in the extreme southern section of the project area

8.4.2 Graves

Nine grave sites have been located in the immediate environs of the proposed border control infrastructure route (Table 48). These include two cemeteries and three graveyards. Although the cemeteries contain modern graves (i.e. younger than 60 years old) it also had older graves that are protected by National Heritage legislation.

Table 48: List of grave sites identified in the project area

Site Type	Grading	Longitude	Latitude	Mitigation
Unmarked graves. Appears to be older than 60 years	Grade 111C	S 25° 57' 18.96"	E 31° 50' 40.52"	Maintain a buffer zone of at least 10m around this site
Modern graveyard with marked graves. Some are older than 60 years	Grade 111C	S 25° 57' 18.96"	E 31° 50' 40.52"	Maintain a buffer zone of at least 30m around this site
Modern rural cemetery with marked graves. Some are older than 60 years (Figure 94)	Grade 111C	S 25° 52' 23.04"	E 31° 41' 47.63"	Maintain a buffer zone of at least 30m around this site
Unmarked graves. Appear to be older than 60 years	Grade 111C	S 26° 9' 48.13"	E 31° 0' 14.30"	Maintain a buffer zone of at least 10m around this site
Unmarked grave indicated by stone heap. Appears to be older than 60 years	Grade 111C	S 26° 11' 37.52"	E 30° 58' 35.44"	Maintain a buffer zone of at least 10m around this site
Unmarked grave indicated by stone heap. Appears to be younger than 60 years	Grade 11C	S 26° 25' 42.65"	E 30° 47' 34.46"	Maintain a buffer of at least 30m around this site
Marked singular grave. Indicated by headstone with marking. Younger than 60 years old	Grade 11C	S 26° 52' 58.54"	E 30° 55' 48.91"	Maintain a buffer of 10m around this grave
Family Cemetery (Du Pisanie family). Old and new graves – well marked with headstones (Figure 95)	Grade 111C	S 26° 52' 58.54"	E 30° 55' 48.91"	Maintain a buffer of 30m around this cemetery
Family graveyard. Old and new graves with clearly marked headstones	Grade 111C	S 26° 53' 40.41"	E 30° 56' 54.72"	Maintain a buffer of 30m around this graveyard

Figure 94: Rural graveyard situated in the western section of the project area, contains both marked and unmarked graves. The marked graves are younger than 60 years old

Figure 95: Du Pisanie Family Cemetery, situated in the south western section of the project area

8.4.3 Cultural Landscapes and Sense of Place

No evidence for any known cultural landscapes exist along the proposed route. It can be argued that the areas around existing border posts could be classified as cultural landscapes, however, the existing evidence is not convincing. It is nevertheless proposed that the Applicant / Developer initiates a Phase Two Heritage Impact Assessment, by a built heritage specialist, before any development takes place in the immediate environs of existing border posts.

8.4.4 Living Heritage

Systematic ethnographic surveys of the project area may produce natural and man-made features with living heritage values. In addition, it is important to refer to indigenous perceptions relating to the 'symbolic water complex'. This complex of beliefs occurs amongst all indigenous groups (African and Khoisan descendants)

along the eastern seaboard and further afield[31]. It has also been documented amongst Zulu, Swazi, and Thonga groups and is therefore relevant to the project area[32]. It is also almost certain that some of the prominent mountains and other natural features in the greater project area may have 'living heritage" values. However, the consultant could not find any 'living heritage' sites in the near environs of the proposed project.

8.4.5 Potential Impacts

Early Stone Age, Middle Stone Age, Later Stone Age, Rock Art, historical sites as well as graves occur in the project area. The known heritage sites in the project area have been rated as between Grade 11 and Grade 111 (Table 47 and Table 48). One heritage site, the internationally known Border Cave, has a Provincial heritage rating and it has also been considered for UNESCO World Heritage Site nomination. None of these sites may therefore be altered without mitigation under the auspices of the relevant Provincial Heritage Agency. Border Cave may not be changed or altered under any circumstances and a buffer zone of 50m must be maintained around this important site. A buffer zone of 50m must also be maintained around the one identified rock art site. All the other sites should have a buffer zone of at least 10m. Should it not be possible to maintain these buffer zones then the Applicant / Developer may motivate for a Phase Two Heritage Impact Assessment of the relevant sites. This second phase heritage impact assessment may involve a rescue excavation or the collection of the surface artefacts under the auspices of the relevant provincial heritage agency.

A second phase heritage assessment will be necessary in order to initiate a grave exhumation and reburial process – where necessary. This process will also include the application of a permit from the relevant Provincial Heritage Agency and extensive community consultations.

Attention is drawn to the South African Heritage Resources Act, 1999 (Act No. 25 of 1999) and the KwaZulu-Natal Heritage Act (Act No. 4 of 2008), which requires that operations that expose archaeological or historical remains as well as graves and fossil material should cease immediately, pending evaluation by the Provincial Heritage Agency.

8.5 Palaeontology

A Desktop Palaeontology Impact Assessment was conducted by Dr Gide (***Appendix C5***).

8.5.1 Kaapvaal and Natal Metamorphic province

The Kaapvaal and Natal Metamorphic province consist of igneous rock thus contain no fossils. The palaeontological significance of this group is thus zero.

Archaean microfossils and microbial trace fossils (bacterial borings) have been documented from cherts and volcanic glasses in the Fig Tree Group and Onverwacht Group of the Barberton Sequence in Mpumalanga.

8.5.2 The Pongola Supergroup

Stromatolites are found in the Nsuze group. Stromatolites are layered mounds, columns and sheet-like sedimentary rocks. These structures were originally formed by the growth of layer upon layer of cyanobacteria, a single-celled photosynthesizing microbe. Cyanobacteria are prokaryotic cells (simplest form of modern carbon-based life). Stromatolites are first found in Precambrian rocks and are known as the

[31] *Bernard, P. 2010. Messages from the Deep: Water Divinities, Dreams and Diviners in Southern Africa. Unpublished PhD thesis. Rhodes University.*

[32] *Ibid*

earliest known fossils. The oxygen atmosphere that we depend on was generated by numerous cyanobacteria photosynthesizing during the Archaean and Proterozoic Era.

8.5.3 The Natal Group

To date no fossils have been found from this group.

8.5.4 Karoo Supergroup

- ***The Dwyka Group***
  The Dwyka Group is characterised by trackways, mostly produced by fish and arthropods (invertebrates). Other trace fossils include fossilized faeces of chondrichthyian (cartilaginous) fish. Body fossils include foraminifera and single-celled radiolarians, bryozoans, sponges, primitive starfish, nautiloids (marine invertebrates similar to the living Nautilus), cephalopods, gastropods, bivalves brachiopods and palaeoniscoid fish. Fossil plants have also been found, including lycopods, moss, leaves and stems. Fossil spores and pollens as well as fossilized wood. Body fossils are generally scarce and most of the Dwyka sediments are of low overall palaeontological sensitivity.

- ***The Ecca Group***
  Pietermaritzburg Formation
  Generally body fossils are absent from this formations but trace fossils have been recorded from the upper layers of the Pietermaritzburg Formation. The Vryheid Formation is known for the rich coal deposits which developed due to the accumulation of plant material. Invertebrate ichnofossils (trace fossils) have been described from this formation. Trace fossils as well as the bivalve *Megadesmus* have been described from the Volksrust Formation.

- ***Beaufort Group***
  The flood plains of the Beaufort Group (Karoo Supergroup) are internationally renowned for the early diversification of land vertebrates and provide the worlds' most complete transition from early "reptiles" to mammals.

  The Balfour Formation has an abundant assemblage of vertebrates. Fossils of the Balfour Formation include vertebrates from the *Daptocecphalus* and *Lystrosaurus* Assemblage Zones (AZ)[33][34][35][36]. Several important trace fossil assemblages, comprising vertebrate tracks and casts of vertebrate burrows have also been described from this formation[37][38].

  The Middleton Formation is known for its *Glossopteris* fossils plant assemblages. At their peak development during the Permian these plants inhabited a diversity of ecological niches, which includes riverine forests which was dominated by conifers, cycadeoids and ginkos. Diverse assemblages of insects are also recorded from this formation. This formation is represented by a rich assemblage of

[33] *Rubidge, B.S (ed). 1995. Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Stratigraphy Biostratigraphic Series 1. Council for Geoscience, South Africa.*
[34] *Macrae, C. 1999. Life etched in stone. Fossils of South Africa. 305 pp. The Geological Society of South Africa, Johannesburg.*
[35] *McCarthy, T & Rubidge, B. 2005. The Story of Earth Life: A southern African perspective on a 4.6-billion-year journey. Struik. Pp 333*
[36] *Johnson, M.R., Annhauser, C.R., and Thomas, R.J. 2006. The Geology of South Africa. GeolSoc S Africa. Council for Geoscience, Pretoria.*
[37] *Groenewald, G. H. 1996 Stratigraphy and Sedimentology of the Tarkastad Subgroup, Karoo Supergroup of South Africa. Unpubl PhD Thesis, University of Port Elizabeth.*
[38] *Johnson, M.R., Annhauser, C.R., and Thomas, R.J. 2006. The Geology of South Africa. GeolSoc S Africa. Council for Geoscience, Pretoria.*

vertebrates found in the *Pristerognathus, Tropidostoma* and *Cistecephalus* Assemblage Zones of the Karoo Basin[39][40][41].

The *Eodicynodon* and *Tapinocephalus* Assemblage Zones are present in the Kroonap Formation. The *Eodicynodon* AZ is characterised by *Eodicynodon* and *Tapinocaninus* fossils. The *Tapinocephaus* AZ has a rich diversity of Therapids, Dinocephalia, while fish, amphibia and plant fossils are also present. The *Lystrosaurus* AZ also includes the Palingkloof Member (*Daptocephalus* AZ, Adelaide Subgroup)[42]. The lower Palingkloof Member is palaeontologically important as it precedes the Permo-Triassic Extinction Event which is the contender for the greatest Mass Extinction in history. This extinction almost destroyed the vertebrate fauna and killed off the diverse glossopterid plants. The fossil heritage of the Early Triassic Katberg Formation is thus also palaeontological significant because they document the recovery of terrestrial biotas succeeding the catastrophic end-Permian Mass Extinction event (approximately 251 million years ago).

The *Lystrosaurus AZ* (Katberg / Verkykerskop Formations) is named after the dicynodont *Lystrosaurus* which contributes up to 95% of fossils found in this biozone[43]. The *Lystrosaurus* AZ is also known for the small captorhinid parareptiles *Procolophon* and a crocodile-like early archosaur, *Proterosuchus*. Armour-plated "labyrinthodont" amphibians (e.g. *Lydekkerina*) are also present in this biozone as well as small true reptile owenettids, therocephalians, and early cynodonts (e.g. Galesaurus, Thrinaxodon). This biozone is also characterized by vertebrate and invertebrate burrows. Invertebrate burrows are represented by aquatic and land living organisms while tetrapod burrows include various cynodonts, procolophonids and *Lystrosaurus* (Groenewald 1991, Groenewald and Kitching, 1995, Damiani, et al. 2003, Abdala, et al. 2006). Vascular plants in this biozone are generally rare but petrified wood (*"Dadoxylon")* and leaves of glossopterid progymnosperms and arthrophyte ferns (*Schizoneura, Phyllotheca*) are present.

The *Cynognathus* AZ (Burgersdorp / Driekoppen formations) is dominated by amphibians, reptiles and therapsids. The Burgersdorp biotas include rich freshwater vertebrate fauna, fish groups as well as large capitosaurid and trematosuchid amphibians. The reptile fauna includes lizard-like sphenodontids, rhynchosaurs, and primitive archosaurs. Therapsids include *Kannemeyeria* and numerous small to medium-sized carnivorous and herbivorous therocephalians and advanced cynodonts. Tetrapod trackways and burrows are also present.

8.5.5 The Stormberg Group

The Molteno Formation is world renowned for its Mesozoic *Dicroidium* assemblages (plant fossils). The Elliot Formation is known for its early dinosaur and mammal remains while the Clarens Formation is known for dinosaur fossils and footprints. This group has a high palaeontological sensitivity.

8.5.6 Drakensberg Group and Lebombo Group

Jurassic Drakensberg and Lebombo Groups and associated dolerite have an igneous origin and contain no fossils. The palaeontological significance of this group is thus zero.

The Mzamba Formation comprises of shark teeth, vertebrate remains and charred wood remains (bored by Teredoa gastropod).

[39] *Ibid Footnote 33.*
[40] *Macrae, C. 1999. Life etched in stone. Fossils of South Africa. 305 pp. The Geological Society of South Africa, Johannesburg.*
[41] *Ibid Footnote 35.*
[42] *Ibid Footnote 33.*
[43] *Botha, J. AND Smith, R. 2006. Rapid vertebrate recuperation in the Karoo Basin of South Africa following the end-Permian extinction. Journal of African Earth Sciences 45 (4-5): 502-514.*

8.5.7 Zululand Group

The Zululand Groups is known for ammonite fossils (large snail-like animals up to one metre in size) which thrived in the warm ocean. These ammonite shells are common in almost all exposures of Cretaceous rocks.

The Makatini Formation contains large wooden fossil logs that are extensively drilled by Teredo wood boring organisms. The overlying Mzinene Formation with a rich invertebrate fauna, including ammonites, bivalves, gastropods, echinoids and nautiloids. Large wooden fossil logs that are extensively drilled by Teredo wood boring organisms are commonly found in the formation. Fine grained sediments contain bored fossil tree trunks, small plant fragments as well as marine invertebrates. This formation has a high palaeontological sensitivity. Scientists interpret the palaeo-environment as shallow-marine.

The upper St Lucia Formation contains an abundance of echinoid, bivalve, gastropod and cephalopod remains as well as fossil logs, plant fragments, reptile bones and at least 62 ostracod species and is much more fossiliferous than the underlying Mzinene Formation.

8.5.8 Maputuland Group

The Maputuland Group forms a layer of Tertiary and Cretaceous sequences. The less detailed subdivision of Wolmarans and Du Preez (1986)[44] of the Maputuland Group will be used for reasons of simplicity, preferred to the more detailed subdivision of Johnson et al (2006)[45].

The largest portion of the Uloa Formation consists of approximately 5 metres of unbedded calcirudite, known as the “Pecten Bed”, due to the richness of the bivalve *Aeqipectenuloa*. Brachiopods, coralline algae, corals, echinoids, foraminifera and Gastropods are present in this formation, as well as isolated teeth of the extinct giant shark *Carcharodon megalodon*[46]. This group has a high palaeontological sensitivity.

No fossils have been documented from the Muzi Formation. The Bluff Formation has local fossiliferous zones whereas the Berea Formation, Masotcheni Formation and recent alluvial and sand deposits, do not contain significant fossil remains.

The Port Durnford Formation contains a sequence of carbonaceous muds and sand, comprising fossils of terrestrial vertebrates for example antelope, buffalo, elephant, hippopotamus, rhinoceros as well as marine fossils including crustaceans and fish, foraminifera, marine molluscs and fragments of turtles and crocodiles. This group has a high palaeontological sensitivity.

The Bluff Formation is a nearly unbroken outcrop with fossils recorded from small deposits of coral limestone. The Berea Formation is not known to contain significant fossil vertebrates but petrified wood has been described from this Formation.

In the recent alluvium, sand and calcrete and Masotcheni Formation of the coastal plains of Kwazulu-Natal no significant fossil remains have been described.

8.5.9 Quaternary Superficial Deposits

Cenozoic deposits are largely confined to coastal areas where very rich assemblages of marine fossils (KwaZulu-Natal and Eastern and Western Cape coasts) are recorded (MacRae, 1999; Johnson et al, 2006).

[44] *Wolmarans LG. and Du Preez JW. 1986 The Geology of the St Lucia Area. Explanation: Sheet 27.532 (1:250 000), Geological Survey of South. Africa.*
[45] *Johnson, M.R., Annhauser, C.R., and Thomas, R.J. 2006. The Geology of South Africa. GeolSoc S Africa. Council for Geoscience, Pretoria.*
[46] *Ibid Footnote 45.*

But, numerous forms of superficial deposits of Late Caenozoic (Miocene to Pliocene to Recent) age occur in the Karoo Basin (Partridge et al. 2006). From a Palaeontological point of view the Quaternary superficial deposits have been relatively neglected in the past but they may sometimes contain important fossil biotas. These superficial deposits contain pedocretes (colluvial slope deposits, wasted surface gravels, river alluvium or/and wind-blown sands) as well as spring and pan sediments. The Quaternary fossil assemblages are typically sparse, low in diversity, and occur over a wide geographic area. These fossil biota may include bones, teeth and horn cores of mammals and reptiles, non-marine bivalves and gastropods, ostrich egg shells, trace fossils (faeces and termitaria), and plant remains in organic-rich alluvial horizons. This Group has a high Palaeontological sensitivity.

8.5.10 Potential Impacts

The proposed project is underlain by various sedimentary rocks of which the Quaternary and the Undifferentiated Karoo has a high Palaeontological sensitivity as well as the Zululand Group with a very high palaeontological sensitivity. The various intrusive rocks have an igneous origin and are thus unfossiliferous and have a zero palaeontological sensitivity.

No fossiliferous outcrops were found in the development footprint. For this reason, a low palaeontological sensitivity is allocated to the development footprint. Although fossils are uncommon and only occur periodically, a solitary fossil may be of scientific value as many fossil taxa are known from a single fossil. The recording of fossils will expand the knowledge of the Palaeontological Heritage of the development area.

The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the proposed development will be of a low significance in palaeontological terms. It is therefore considered that the proposed Swaziland-Mozambique Border Patrol Road and Mozambique Barrier Structure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

In the unlikely event that fossil remains are uncovered during any phase of construction, either on the surface or unearthed by new excavations and vegetation clearance, the ECO in charge of these developments ought to be alerted immediately. These discoveries should be protected (preferably in situ) and the ECO must report to SAHRA so that appropriate mitigation (e.g. recording, collection) can be carried out by a professional palaeontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies proposed by SAHRA.

9 IMPACT ASSESSMENT

9.1 Introduction

Impact assessment must take into account the nature, scale and duration of effects on the environment, whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages from planning, through construction and operation to the decommissioning phase. Where necessary, the proposal for mitigation or optimisation of an impact is noted. A brief discussion of the impact and the rationale behind the assessment of its significance is provided in this section.

The EIA of the project activities is determined by identifying the environmental aspects and then undertaking an environmental risk assessment to determine the significant environmental aspects. The environmental impact assessment is focussed on the following phases of the project namely:

- Planning Phase;
- Construction Phase; and
- Operational Phase.

As the project entails the upgrading of existing infrastructure and development of new infrastructure for border control and patrolling which will be permanent, decommissioning is not applicable to this project, as border control infrastructure is a continuous requirement to secure the borders of sovereign states. In time infrastructure may be replaced by new infrastructure or technologies, but this will be addressed at the time that such new infrastructure / technology becomes available or is needed to be developed.

No comparative assessment of alternatives has been undertaken as motivated in Section 5.5 as the border control infrastructure is required to be placed immediately alongside the international boundary or existing fence or from the 1:20 year flood line or a river, as the primary aim of the infrastructure is to secure the border (in the case of fencing) and to allow the patrolling of the border (in the case of the border patrol road and associated infrastructure including the footpath that replaces the road along certain sections of the alignment and detour roads). It is thus technically not feasible to locate this infrastructure away from the border, as the purpose of securing the border and in particular the patrolling of the border which requires visibility of the border will not be achieved.

9.2 Impact Assessment Methodology

The potential environmental impacts associated with the project will be evaluated according to its nature, extent, duration, intensity, probability and significance of the impacts, whereby:

- ***Nature:*** A brief written statement of the environmental aspect being impacted upon by a particular action or activity;
- ***Extent:*** The area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales. This is often useful during the detailed assessment phase of a project in terms of further defining the determined significance or intensity of an impact. For example, high at a local scale, but low at a regional scale;
- ***Duration:*** Indicates what the lifetime of the impact will be;
- ***Intensity:*** defines the magnitude of the impact;
- ***Probability:*** Describes the likelihood of an impact actually occurring; and
- ***Cumulative:*** In relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

The criteria to be used for the rating of impacts are provided in Table 49.

Table 49: Criteria and numerical values for rating environmental impacts

Score	Rating	Description
Intensity (I) – defines the magnitude of the impact		
16	**High**	*Natural, cultural and social functions and processes are altered to extent that they permanently cease. Impact affects the continued viability of the systems / components and the quality, use, integrity and functionality of the systems / components permanently ceases and are irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible, rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.* Impact may cause: ▪ Loss of human life. ▪ Deterioration in human health. ▪ High impacts to ecosystems and environment resulting in: - Critical / severe local scale (or larger) modification / degradation and / or collapse. - Critical / severe local scale (or larger) modification (reduction in level) of ecosystem services and / or loss of ecosystem services.
8	**Moderately-High**	*Natural, cultural and social functions and processes are altered to extent that they are severely impaired and may temporarily cease. Impact affects the continued viability of the systems/components and the quality, use, integrity and functionality of the systems / components are severely impaired and may temporarily cease. High costs of rehabilitation and remediation, but possible.* Impact may cause: ▪ Loss of livelihoods. ▪ Individual economic loss. ▪ Moderately-high impacts to ecosystems and environment: - Large local scale (or larger) modification / degradation and / or collapse. - Large local scale (or larger) modification (reduction in level) of ecosystem services and/or loss of ecosystem services.
4	**Moderate**	*Affected environment is altered, but natural, cultural and social functions and processes continue albeit in a modified way. Impact alters the quality, use and integrity of the systems / components but the systems / components still continue to function but in a moderately modified way (integrity and functionality impaired but major key processes / drivers somewhat intact / maintained).* Moderate impacts to ecosystems and environment: ▪ Moderate local scale (or larger) ecosystem modification / degradation and / or collapse. ▪ Moderate local scale (or larger) modification (reduction in level) of ecosystem services and/or loss of ecosystem services.
2	**Moderately-Low**	*Affected environment is altered, but natural, cultural and social functions and processes continue albeit in a slightly modified way. Impact alters the quality, use and integrity of the systems / components but the systems / components still continue to function, although in a slightly modified way. Integrity, function and major key processes / drivers are slightly altered but are still intact / maintained.* Moderately-low impacts to ecosystems and environment: ▪ Small but measurable local scale (or larger) ecosystem modification / degradation. ▪ Small but measurable local scale (or larger) modification (reduction in level) of ecosystem services and / or loss of ecosystem services.
1	**Low**	*Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected.* Negative change to onsite characteristics but with no impact on: ▪ Human life. ▪ Human health.

Score	Rating	Description
		▪ Local water resources, local ecosystem services and / or key ecosystem controlling variables. ▪ Threatened habitat conservation / representation. ▪ Threatened species survival.
Extent (E) – relates to the extent of the impact		
5	**Global**	The scale / extent of the impact is global / worldwide.
4	**National**	The scale / extent of the impact is applicable to the Republic of South Africa.
3	**Regional**	Impact footprint includes the greater surrounding area within which the site is located (e.g. between 20 - 200km radius of the site).
2	**Local**	Impact footprint extends beyond the cadastral boundary of the site to include the areas adjacent and immediately surrounding the site (e.g. between a 0 - 20km radius of the site).
1	**Site**	Impact footprint remains within the boundary of the site.
Duration (D) – relates to the duration of the impact		
5	**Permanent**	The impact will continue indefinitely and is irreversible.
4	**Long-term**	The impact and its effects will continue for a period in excess of 30 years. However, the impact is reversible with relevant and applicable mitigation and management actions.
3	**Medium-term**	The impact and its effects will last for 10 - 30 years. The impact is reversible with relevant and applicable mitigation and management actions.
2	**Medium-short**	The impact and its effects will continue or last for the period of a relatively long construction period and / or a limited recovery time after this construction period, thereafter it will be entirely negated (3 – 10 years). The impact is fully reversible.
1	**Short-term**	The impact and its effects will only last for as long as the construction period and will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 3 years). The impact is fully reversible.
Probability (P) – relates to the likelihood of the impact occurring		
1	**Definite**	More than 75% chance of occurrence. The impact is known to occur regularly under similar conditions and settings.
0.75	**Highly Probable**	The impact has a 41 - 75% chance of occurring and thus is likely to occur. The impact is known to occur sporadically in similar conditions and settings.
0.5	**Possible**	The impact has a 10 - 40% chance of occurring. This impact may / could occur and is known to occur in low frequencies under the similar conditions and settings.
0.2	**Unlikely**	The possibility of the impact occurring is low with less than 10% chance of occurring. The impact has not been known to occur under similar conditions and settings.
0.1	**Improbable**	The possibility of the impact occurring is negligible and only under exceptional circumstances.

Significance is determined through a synthesis of impact characteristics. Significance is also an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact significance is expressed as the impact intensity, extent and duration against the probability/likelihood of the impact taking place (Table 50).

Impact significance = (impact intensity + impact extent + impact duration) x impact probability

Table 50: Impact significance categories

	Class	Description
+	Any value	Any positive / beneficial 'impact', i.e. where no harm will occur due to the activity being undertaken.
–	Low 0 - 4.9	A low impact has no permanent impact of significance. Mitigation measures are feasible and are readily instituted as part of a standing design, construction or operating procedure.
	Moderately Low 5 – 7.9	Mitigation is possible with additional design and construction inputs.
	Moderate 8 – 12.9	The design of the site may be affected. Mitigation and possible remediation are needed during the construction and / or operational phases. The effects of the impact may affect the broader environment.
	Moderately High 13 – 17.9	Generally unacceptable unless offset / compensated for by positive gains in other aspects of the environment that are of critically high importance (i.e. national or international importance only). Strict conditions and high levels of compliance and enforcement are required. The potential impact will affect a decision regarding the proposed activity and requires that the need and desirability for the project be clearly substantiated to justify the associated ecological risks.
	High 18 - 26	Permanent and important impacts likely to be a fatal flaw. Impacts should be avoided and limited opportunity for offset / compensatory mitigation.
Status		Denotes the perceived effect of the impact on the affected area.
Positive (+)		Beneficial impact.
Negative (-)		Deleterious or adverse impact.
Neutral (/)		Impact is neither beneficial nor adverse.
It is important to note that the status of an impact is assigned based on the *status quo* – i.e. should the project not proceed. Therefore, not all negative impacts are equally significant.		

The suitability and feasibility of all proposed mitigation measures will be included in the assessment of significant impacts. This will be achieved through the comparison of the significance of the impact before and after the proposed mitigation measure is implemented. Mitigation measures identified as necessary will be included in an EMPr.

9.3 Potential Impacts and Significance

The following sections will provide a description of the potential impacts as identified by the specialist assessment, EAP and through the PPP as well as the assessment according to the criteria described in Table 49 and Table 50.

9.3.1 Planning Phase Impacts

Table 51: Planning phase impacts

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP	
Planning & Design	**Aspect:** Detail design of border control infrastructure (road, fence and stormwater infrastructure) including access routes, construction camps / lay-down areas, borrow pits **Impact:** Impact on fauna and flora, watercourses, Protected Areas	**Without**	16	3	4	1	**-23.00**	**High**
		With	4	3	3	0.5	**-5.00**	**Moderately Low**
		Best practice design measures: ▪ Road design recommendations: - The detail design of border patrol zone must utilise transformed areas as much as possible to minimise increased habitat destruction. - Cut and fill must be kept to a minimum as far as practically possible (taking into account road operational safety requirements) in order to reduce the extent of habitat clearing and reduce the risk of secondary impacts associated with habitat clearing (e.g. soil erosion, weed and IAP infestation). - Where possible, road batters must be shaped to a 1:3 slope in order to minimise erosion. Slopes steeper than 1:2 are more prone to erosion and washouts and if saturated, the entire slope may fail. - Drainage culverts beneath roads can be modified to allow small vertebrate species and amphibians to safely cross roads. Animals are able to move through the culverts on shelves and floating docks or through wildlife tunnels built parallel to the culvert. The additional cost for these modifications is minimal in comparison to the overall cost of the structure, although theft is a potential challenge. To prevent access to the road, the drainage culverts beneath roads can be modified with mesh fencing. ▪ Border fence design recommendations: - Ideally, replace the existing fence with the new border fence rather than clearing new areas for this purpose. - If the opportunity arises and cost allows, it may make sense to place fences in relation to iso-height contours or water points rather than ignoring these variables through the construction of a perfectly straight fences. - Fences should be devised and planned that can mimic curvilinear ‘natural’ boundaries, yet still effectively constrain the movement of animals and their pathogens. - High visibility helps wildlife negotiate fences. Visibility is especially important in grasslands and near rivers, streams and wetlands to protect low-flying birds, such as owls and waterfowl. It is						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
		recommended that increased fence visibility be considered in areas with high bird traffic / activity and across watercourses (rivers and wetlands) or fences with previous known bird / mammal mortalities. Fence design could incorporate the following to increase fence visibility: o Enclosing the wire in a light weight length of white high-density polyethylene (HDPE) pipe; o Attaching reflective or colourful weather-resistant and 'audible' flagging materials such as plastic strips / flappers, plastic flags, metal tags, aluminium cans, etc.); and o The barbs on existing barbed fences can be covered with tubing, particularly in entanglement hot spots. - Fence design should include a suitable mesh size that will be large enough for small mammals, reptiles and amphibians to pass through. Alternatively, underpasses can be considered in fence design (further engineering input required). - For smaller vertebrates, reptiles and amphibians, low-level mesh fences can be added to guide the individuals towards passages. Fine-meshed fencing buried at the bottom has been successfully used in association with pipe culverts for small animal connectivity under roads / fences. Rope bridges across roads have proven successful for a number of arboreal species across the world. These overpasses / bridges may be particularly effective for the Samango Monkey and are cost-effective to install. - The fence must be kept clear of vegetation in order to prolong its lifespan and for easy monitoring. ▪ Construction camp/s and lay-down areas - Any camps / lay-down areas that are proposed out of the 50m application corridor must be subject to the appropriate environmental licencing. - No construction camps / lay-down areas must be developed in high-sensitivity areas (refer to Sensitivity Maps – ***Appendix K***). - The location of the construction camps and lay-down areas must be approved by the Environmental Control Officer (ECO) prior to implementation. - The layout of construction camps / lay-down areas including material storage areas, stockpiling areas, spoil areas will need to be determined in the detailed design phase. - No construction camps / lay-down areas must be established in Protected Areas. ▪ Access routes - No new construction access routes must be created, and no clearing of vegetation to widen an access road (outside of the approved construction right-of-way) will be permitted. As such					

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP	
		construction access routes must be included in the environmental compliance auditing scope of the EO and ECO. - Any internal patrol roads / access routes within Protected Areas must be included as part of the Reserve Management Plan. - No development or construction is permitted in a nature reserve or World Heritage Site without the prior written approval of the relevant management authority. ▪ Borrow pits - No borrow pits must be developed in Protected Areas. - New borrow pits need to undergo the relevant licencing process according to the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002). ▪ Abstraction of water - Only municipal or other approved / licenced sources of water must be used for construction on the construction site and in the construction camps. - No water must be abstracted from wetlands for use in construction activities without prior approval by the Department of Water and Sanitation (DWS), subject to acquiring a relevant Water Use Licence in terms of Section 21 of the National Water Act for taking water from a water resource. - Excavating trenches or pits within wetlands or rivers for the purpose of intercepting groundwater or diffuse surface flows to facilitate water abstraction is not permitted. - Water for human consumption must be available at the site offices and at other convenient locations on site where work occurs.						
	Aspect: Pre-construction activities including site preparation **Impact:** Impact on protected fauna and flora	**Without**	**8**	**4**	**5**	**1**	**-17.00**	**Moderately High**
		With	**4**	**4**	**5**	**0.5**	**-6.50**	**Moderately Low**
		Key mitigation measures: ▪ Prior to transformation or temporary disturbance of vegetation communities, a plant search and rescue / relocation exercise must be undertaken (by a qualified and experienced ecologist prior to construction activities occurring). This will be essential in mitigating the potential loss of protected / conservation important flora. The appointed ecologist must:						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
		- Visit priority vegetation communities as documented in the *Terrestrial Ecological Assessment* (***Appendix C2***). - Identify and geo-reference the location of all threatened and protected plants at risk of destruction / damage; - Identify plant species that can be 'rescued' and 'translocated' versus those which are unlikely to survive displacement; - Identify vegetation communities that qualify as a 'natural forest' as defined by DAFF; - Prepare a suitable plant rescue relocation plan that considers species requirements and identifies suitable receiving areas for rescued plants; - Apply for appropriate plant permits and licences from the relevant authorities; and assist with undertaking the relevant plant rescue and relocation. ▪ Conservation-important plants falling just outside the construction footprint must be fenced off / demarcated to minimise any accidental impacts such as destruction. The following techniques can be used to demarcate protected plants: fencing off or using perimeter stakes and high visibility netting / barrier tape. ▪ The request made by the MTPA (for the Mpumalanga portion of the route) is to plant the rescued plant species soon after removal into the adjacent area where they may survive, thereby avoiding the risk of potentially introducing exotic species and pathogens into the environment (*pers comm* Mervyn Lotter). ▪ If growing / supporting rescued plants in nurseries should be required, then these should be sterilised appropriately before re-introduction into the wild. ▪ All applications for licences in respect of protected trees and natural forest must be made to the relevant Provincial DAFF office. For threatened and specially protected plants, an application for a plant permit must be made to the EKZNW if plants are located within the KZN Province and the MPTA if plants are located within the MP Province. ▪ Based on the findings of the desktop fauna POC (Potential Occurrence) assessment undertaken, key habitats in KZN and MP likely to harbour fauna of conservation concern (Red-Data listed/endangered) include: - Grasslands (e.g. host a variety of birds, antelope and reptiles); - Open and wooded savannah (antelope such as Oribi, reptiles); - Forests (e.g. endangered squirrels, Samango Monkey, species of endangered birds and snakes); and - Wetlands (mainly threatened frogs as well as reptiles such as Nile crocodile).					

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP	
		▪ Most of the grassland, forest and wetland habitats with more intact vegetation could potentially harbour Red Data listed fauna and these areas will need to be the focus of search and recovery exercises. A programme to undertake such an exercise should be developed and implemented by an ecologist prior to construction commencing on sections of new road / fence. This plan can be structured and undertaken in a phased-manner and aligned with the construction programme.						
	Aspect: Preparation of servitude for construction. **Impact:** Unnecessary impact on fauna and vegetation in and adjacent to the construction servitude	**Without**	**16**	**2**	**2**	**0.75**	**-15.00**	**Moderate**
		With	**4**	**1**	**2**	**0.50**	**-3.50**	**Low**
		Key mitigation measures: ▪ The construction area must be clearly designated in sensitive environmental areas (in particular wetlands and open areas such as grasslands) and no extension of the permitted construction footprint (as specified in the engineering construction methodology) must be allowed. ▪ All wetland boundaries must be clearly designated prior to construction commencing. ▪ Stipulations of the BAR with respect to the minimisation of the construction footprint in the highly sensitive parts of the alignment must be strictly adhered to. These areas include: - Protected Areas (Ndumo Game Reserve, Pongola Nature Reserve, Songimvelo Nature Reserve) - narrowed to 15m. - Wetlands in the Witkoppies-Berbice area: between km 241 and km 242 the corridor has been narrowed on the eastern side of the road centreline to avoid impacting the riparian zone of the Mozana River (W42K-R05). Between km 242.5 and km 243 where the patrol road crosses, and runs close to the wetland W42K-W13, the corridor has been narrowed to 15m to avoid affecting this wetland unnecessarily. Around km 242, the corridor has similarly been narrowed, except in the vicinity of the outlets of wetlands W42K-W11 and W42K-W12, in order to allow for the recommendation that the patrol road cross these wetlands at the point at which they narrow to minimise the area of wetland habitat that is transformed. - Detour roads located in Protected Areas e.g. Songimvelo Nature Reserve, the corridor width has been narrowed to 15m i.e. 7.5m either side of the centreline. ▪ The construction servitude must be limited to the proposed development footprint. This working servitude must accommodate all construction-related activities, including materials storage. ▪ The outer edge of the construction servitude / working area (as defined above) must be clearly demarcated for the entire construction phase using a brightly coloured hazard fence (snow netting) or string or twine with bows made of danger tape at 1 – 3m intervals.						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP	
		▪ Site demarcations must remain position until the completion of construction works. ▪ The location of stockpile areas, and equipment lay-down areas must be agreed to and demarcated to the satisfaction of the ECO prior to the clearing. A recommended setback distance of at least 50m from the active river channel edge is recommended. ▪ All areas outside (including up-stream and downstream) of this demarcated construction servitude must be considered 'No-Go' areas. Any contractors found working inside the No-Go areas must be fined as per fining schedule / system setup for the project. ▪ The demarcation work must be signed off by the ECO before any work commences.						
	Aspect: Design of infrastructure for watercourses (culverts, bridges, drifts etc.) **Impact:** Impact on watercourses i.e. flow, modification, erosion etc.	**Without**	**16**	**3**	**5**	**1**	**-24.00**	**High**
		With	**8**	**3**	**2**	**0.5**	**-6.50**	**Moderately Low**
		Key mitigation measures: ▪ Wetland crossing design considerations - All specifications made in the *Aquatic Ecological Impact Assessment* (***Appendix C3***) and WULA technical documents and WUL specifying the type and number of culverts within each specific wetland must be strictly adhered to. - The construction RoW for each individual wetland crossing as specified in the WULA technical documents and WUL must be strictly adhered to. - Coarse bedding material or geotextile wrapped dump rock must be used wherever the roads crosses wetland characterised by diffuse subsurface flows. Based on the nature of wetlands in the study area, this is likely to include most wetlands, in particular unchannelled valley-bottoms. - A series of portal (preferably) culverts must be installed across the width of any broad unchannelled valley bottom wetlands so as to maintain diffuse surface flows to downstream wetland areas. - For large floodplains and channelled valley bottom wetland systems characterised by intermittent or infrequent overtopping of its banks, design must include secondary culverts on the floodplain or flood bench features outside the main channel to facilitate flooding across the full width of the valley floor. - Crossings that are installed below the natural ground level are to be constructed with an appropriate drop inlet structure on the upstream side to ensure that headcut erosion does not develop as a result of the gradient change from the natural ground level to the invert level of the culvert. - In some instances it may be appropriate to construct a drop inlet structure on the upstream side of the culvert with overflow walls raised slightly above the natural ground level. This will encourage the						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
		development of an area that will remove sediment from the water as well as lead to the establishment wetland habitat that will enhance water quality. - Under no circumstance should a river or wetland be impounded / dammed in such a manner as to totally restrict the flow and cause flooding / inundation upstream of the road embankment. This includes the impoundment of sub-surface flows (interflow). - Where existing roads are utilised as the border patrol road, an assessment of whether sufficient numbers of existing culverts are located across the extent of the wetland as crossed by the road must be made. If insufficient numbers of existing culverts are located within the existing road structure to allow flows across the width of the wetland to be maintained, additional culverts must be included in the design of the upgraded road. - Fill embankments located within watercourses features such floodplains, flood benches or flood terraces as well as the larger valley bottom wetland features should incorporate culverts to allow for the dissipation of flood water across there features during flood events. - Fill embankments must be stabilised and vegetated with good grass cover as per the rehabilitation guidelines for the project. - Where possible, road batters must be designed to a minimum of a 1:3 slope in order to minimise unstable eroding slopes. Slopes steeper than 1:2 are more prone to erosion, slumping and washouts. ▪ The Pre-Construction Planning and Design Phase Recommendations for River Crossings guideline must be considered during the detail design phase for river crossings (***Appendix B1***).					

9.3.2 Soils

Table 52: Impact on soils

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
Construction	**Aspect:** Construction activities (site clearing and establishment of lay-down areas and construction camp/s)	**Without**	**4**	**1**	**2**	**0.75**	**-5.25**	**Moderately Low**
		With	**2**	**1**	**1**	**0.5**	**-2.00**	**Low**
		Key mitigation measures:						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
	Impact: Physical degradation due to the removal and compaction of soil during construction activities	▪ All stockpile areas must be established within the approved 50m application corridor/ road reserve / construction servitude. The stockpiles may only be placed within demarcated stockpile areas, which must fall within the demarcated construction area. The contractor shall, where possible, avoid stockpiling materials in vegetated areas that will not be cleared. ▪ Erosion / sediment control measures such as silt fences or low soil berms must be placed around the stockpiles to limit sediment runoff from stockpiles. ▪ Subsoil and topsoil must be stockpiled separately. Stockpiled soil must be replaced in the reverse order to which it was removed (subsoil first followed by topsoil). ▪ Stockpiles of construction materials must be clearly separated from soil stockpiles in order to limit any contamination of soils. ▪ The stockpiles must only be placed within demarcated stockpile areas at least 50m away from delineated watercourses to prevent unnecessary sedimentation of the watercourses. ▪ Any topsoil removed from watercourses must be stockpiled separately from subsoil material and be stored appropriately for use in rehabilitation activities. ▪ Channel bed and bank materials are not to be removed from the watercourse or used for construction purposes. Bed material disturbed during construction should be stockpiled for use in rehabilitation. ▪ Stockpiled soils must be kept free of weeds and must not be compacted. ▪ The stockpiled soil must be kept moist using some form of spray irrigation on a weekly to bi-weekly basis. ▪ The height of stockpiles must be limited to 2m to avoid soil compaction and destruction of soil micro-organisms. ▪ When locating the construction camp and equipment yard, watercourses and areas susceptible to soil erosion and /or water contamination must be avoided. The camp must be situated at least 100m away from the edge of the nearest watercourse. ▪ No material must be stored or equipment repaired beyond the boundaries of the contractor lay-down area.						
	Aspect: Construction activities (site clearing).	**Without**	**8**	**1**	**1**	**0.75**	**-7.50**	**Moderately Low**
		With	**2**	**1**	**1**	**0.5**	**-2.00**	**Low**
	Impact: Physical degradation due to soil: erosion as a result of exposed soil and topsoil	**Key mitigation measures:** ▪ Vegetation / soil clearing and stripping activities must only be undertaken during agreed working times and permitted weather conditions.						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
		▪ Any vegetation clearing must be done immediately before construction activities to avoid prolonged exposure of the soil to weather elements. ▪ Construction activities must be scheduled to minimise the duration of exposure to bare soils on site, especially on steep slopes. ▪ The unnecessary removal of groundcover from slopes must be prevented, especially on steep slopes. ▪ All bare slopes and surfaces to be exposed to the elements during clearing and earthworks must be protected against erosion using rows of silt fences, sandbags, hay bales and / or earthen berms spaced along contours at regular intervals. The spacing interval must be smaller for steeper slopes and if required the ECO must advise in this regard. ▪ Erosion rills and gullies must be filled-in with appropriate material and silt fences or fascine work must be established along the gulley for additional protection until grass has re-colonised the rehabilitated area. ▪ All erosion control measures must be regularly maintained and monitored weekly and sediment accumulating behind the structures must be removed and redistributed to ensure that structures do not fail.						
	Aspect: Construction activities **Impact:** Soil pollution	**Without**	**8**	**1**	**1**	**0.75**	**-7.50**	**Moderately Low**
		With	**2**	**1**	**1**	**0.50**	**-2.00**	**Low**
		Key mitigation measures: ▪ Construction materials at risk of spilling must be stored in appropriate containment structures (e.g. drip-trays). ▪ Hazardous storage and re-fuelling areas must be bunded. The bund wall must be high enough to contain at least 110% of any stored volume. ▪ Mixing and / or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or on an impermeable surface and must be protected from the ingress and egress of stormwater. ▪ Cement / concrete batching is to be done on an impervious surface such as wooden shutter boards or heavy duty sail. No batching activities shall occur directly on the ground. The site for batching must be approved by the ECO. ▪ Drip-trays must be placed beneath standing machinery / plant. ▪ No refuelling, servicing or chemical storage must occur outside the established construction camp/s.						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
		▪ Spillages of fuels, oils and other potentially harmful chemicals must be cleaned up immediately and contaminants properly disposed of using appropriate spill kits. Any contaminated soil from the construction site must be removed and rehabilitated or disposed appropriately at the nearest landfill site.						
	Aspect: Earthworks **Impact:** Impacts associated with earthworks i.e. slope stability, cut and filling, construction in problem soils, hard rock etc.	**Without**	**16**	**3**	**4**	**0.5**	**-11.50**	**Moderate**
		With	**4**	**2**	**4**	**0.5**	**-5.00**	**Moderately Low**
		Key mitigation measures: ▪ It is recommended that earthworks be carried out according to the guidelines provided in the Standard Specifications for Road and Bridge Works for State Road Authorities, 1998 drafted by South African Committee of Land Transport Officials (COLTO). ▪ Cuts: - For preliminary design purposes all permanent cuts in the unconsolidated sediments must be limited to a maximum batter of 1:2 (26º). Cuts within more cohesive materials may be steepened to 1:1,5 (33º) provided the slope profile and back-slope has been assessed to be stable. - Permanent cuts in weathered, firmly bedded bedrock could generally be laid back at a batter of 1:1 (45º) or 1:0,5 (68º) depending on the height and profile of the cutting and nature of the rock mass exposed therein. - Where the above batters cannot be practically accommodated, consideration may need to be given to the use of lateral support if the risk is sufficiently high. The most suitable retaining solutions would depend on the location and accessibility of the problem area and availability of local materials. ▪ Fills: - New fills must be founded on a stable foundation material and the fill embankment slopes must be laid back at a batter appropriate to the fill materials therein. A generic 1:2 (26º) fill embankment batter could be used in the preliminary design of any substantial fills, but the profile stability would need to be confirmed if ground conditions are poor. - Where the natural slope exceeds about 1:6 (10º), new fills will need to be constructed on level benches cut into the natural slope. - New fill should be built up using G10 material or better (G7 – G8 material as proposed will be suitable in this regard) and compacted to 95% Mod AASHTO dry density for each layer of the fill. It is likely that a loose layer thickness of 300mm would be ideal for the specified G7-G8 materials.						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P
		- In areas where soft compressible sand / silt / clay and / or shallow ground water conditions are present (i.e. wetland / marshy areas) compaction of the subgrade and initial fill layers may prove highly problematic resulting in “pumping”. Where such adverse conditions are encountered it may become necessary to import a pioneer layer or additional layers of fill if the pumping cannot be addressed by reducing the size and vibration of the compaction plant. ▪ Drainage: - The proposed border road, footpaths and access routes, where upgraded, must be graded such that stormwater is effectively carried off and away from the road surface into side channels. - Concentrated runoff onto unprotected batters must be strictly avoided. - Where seepage is encountered within cuts or out of fills it must be dealt with symptomatically as and when encountered. Where more persistent seepage is encountered (i.e. along prominent drainage lines, wetlands) it may be necessary to install subsoil cut-off drains or drainage blanket / rock pioneer layers to aid drainage below the road platform. - More detailed drainage recommendations must be provided during the detail design phase. ▪ Hard rock: - Some sections of the route, most notably Amsterdam to Oshoek and the Barberton Mountain range, host substantial expanses of hard rock outcrops. Careful consideration is needed to be given on how to deal with these regions, as excavation of un-weathered sheet granite or whale-back outcrops will require explosives from the outset, whilst the anticipated stormwater runoff will make it undesirable to construct new fill layers thereon. ▪ A geotechnical investigation must be initiated in the detail design phase. ▪ On-site inspections and evaluations by an experienced engineering geologist / geotechnical engineer must be carried out so that stability problems can be timeously identified and remedied.					

9.3.3 Geohydrology

Table 53: Geohydrology impacts

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
Construction	**Aspect:** ▪ Improper storage of fuels, chemical etc. ▪ Construction equipment, vehicles, workshop and wash bay areas. ▪ Inadequate ablutions. **Impact:** Groundwater contamination as a result of: ▪ Spillage of fuels, lubricants and other chemicals. ▪ Construction equipment and vehicles, will be a likely source of pollution as a non-point source. ▪ Lack of provision of ablutions that may lead to the creation of informal ablutions.	Without	8	2	1	0.75	-8.25	Moderate
		With	2	2	1	0.5	-2.50	Low
		Key mitigation measures: ▪ Potentially hazardous substances must be stored on an impervious surface in a designated bunded area, able to contain 110% of the total volume of materials stored at any given time. ▪ Material safety data sheets (MSDSs) must be available for all hazardous materials. ▪ The integrity of the impervious surface and bunded area must be inspected regularly and any maintenance work conducted must be recorded in a maintenance report. ▪ Employees must be provided with absorbent spill kits and disposal containers to handle spillages. ▪ Employees and contractors must be trained on the correct handling of spillages and precautionary measures that need to be implemented to minimise potential spillages. ▪ All earth-moving vehicles and equipment must be regularly maintained to ensure their integrity and reliability. No repairs must be undertaken beyond the contractor lay-down area. ▪ Immediate reporting and rectification of any incident that might lead to pollution. ▪ An Emergency Preparedness and Response Plan must be developed and implemented if an incident occurs. ▪ Access to storage areas on-site must be restricted to authorised employees only. ▪ Contractors must be held liable for any environmental damages caused by spillages. ▪ The construction workforce must have adequate sanitation facilities. ▪ The sanitation facilities must be on-site before the extended workforce is employed to ensure that no unauthorised sanitation practices are undertaken on-site. ▪ Potential construction practices that might lead to groundwater contamination must be conducted on areas with impervious surfaces to avoid infiltration of contaminated substances into the groundwater aquifer. ▪ All contaminated stormwater must be treated before being discharged into the surrounding natural environment.					

9.3.4 Terrestrial Ecology

Table 54: Terrestrial ecology impacts

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
Construction	**Aspect:** Clearing of vegetation for the construction of border control infrastructure **Impact:** Physical destruction and / or modification of terrestrial habitat	Without	16	1	5	1	-22.00	High
		With	8	1	5	0.50	-7.00	Moderately Low
		Key mitigation measures: ▪ Defining the construction / development footprint and 'No-Go' areas: - The clearing of (woody) vegetation has been limited to the patrol zone which is generally 10m - 15m in width. Other parts of the declared servitude will not be cleared of vegetation for the purposes of border control. - The construction / work servitude must accommodate all construction-related activities, including materials storage and soil stockpiles. - Access must be confined to the existing road infrastructure and disturbed areas. - Vegetation clearing / stripping within the construction footprint must only be done as the construction front progresses. - The extent of disturbance must be limited to the extent of the construction footprint. No areas outside the construction footprint must be cleared unless authorised. - Where required (particularly in open areas such as grasslands), the construction servitude must be demarcated using a high visibility materials (brightly coloured shade cloth or orange hazard netting) to prevent any accidental destruction or modification of terrestrial habitat outside the construction servitude. All demarcation work must be signed off by the ECO. ▪ All bare surfaces across the border patrol must be checked for IAPs every two weeks and IAPs removed by hand pulling / uprooting and adequately disposed. ▪ Construction servitude width recommendations: - For the construction of a 5.5m patrol road, a maximum construction servitude of 10m is recommended. - For the construction of a 2m quad bike track a maximum construction servitude of 5m is recommended.					

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
		- For construction of the border fence, maximum construction servitude of 10m is recommended. This must include a 3m wide corridor in foreign countries and a 7m wide corridor within South Africa. ▪ In the Golela area, no work must occur within 3m of the railway line without an approval from Transnet Freight Rail. ▪ All temporary site camps must be established on disturbed habitats of low or moderately low EIS subject to approval by the ECO. ▪ No new construction access routes must be created, and no clearing of vegetation to widen an access road (outside of the approved construction right-of-way) will be permitted. ▪ Any contractors found working inside the No-Go areas must be fined as per fining schedule / system setup for the project.						
	Aspect: Construction activities associated with the clearing of vegetation **Impact:** Indirect erosion, sedimentation and pollution impacts	**Without**	**16**	**2**	**2**	**0.75**	**-15.00**	**Moderately High**
		With	**4**	**2**	**1**	**0.50**	**-3.50**	**Low**
		Key mitigation measures: ▪ Erosion control measures: ▪ Vegetation / soil clearing activities must only be undertaken during agreed working times and permitted weather conditions. ▪ Any vegetation clearing should be done immediately before construction activities to avoid prolonged exposure of the soil to weather elements. ▪ All bare slopes and surfaces to be exposed to the elements during clearing and earthworks must be protected against erosion using rows of sediment barriers (e.g. silt fences, sandbags, hay bales, earthen diversion berms). ▪ Sediment barriers must be regularly maintained and cleaned so as to ensure effective drainage. ▪ After every rainfall event, the contractor must check the site for erosion damage and rehabilitate this damage immediately. Erosion rills and gullies must be filled-in with appropriate material and re-shaped. ▪ Pollution prevention measures: ▪ Construction materials at risk of spilling must be stored in appropriate containment structures (e.g. drip-trays, bunds). ▪ Hazardous storage and re-fuelling areas must be bunded. The bund wall must be high enough to contain at least 110% of any stored volume.						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
		▪ Mixing and / or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or on an impermeable surface and must be protected from the ingress and egress of stormwater. ▪ Cement / concrete batching is to be done on an impervious surface such as wooden shutter boards or heavy duty sail. No batching activities shall occur directly on the ground. Furthermore, the site for batching must first be approved by the ECO. ▪ Drip-trays must be placed beneath standing machinery / plant. ▪ No refuelling, servicing or chemical storage must occur outside the established construction camp / lay-down areas. ▪ Spillages of fuels, oils and other potentially harmful chemicals must be cleaned up immediately and contaminants properly disposed of using appropriate spill kits. Any contaminated soil from the construction site must be removed and rehabilitated or disposed appropriately.						
	Aspect: Construction activities **Impact:** Impact on biodiversity connectivity - alteration of ecological processes that are important for the maintenance of terrestrial biodiversity (flora and faunal species)	**Without**	**16**	**2**	**5**	**1**	**-23.00**	**Moderately High**
		With	**8**	**2**	**5**	**0.75**	**-11.25**	**Moderate**
		Key mitigation measures: ▪ Due to the sheer extent of the project a search and recovery / walkthrough process before construction is strongly recommended for biodiversity “hotspots” based on the outcomes of the fauna POC assessment. ▪ Any fauna that are found within the construction zone must be moved to the closest point of natural or semi-natural habitat outside the construction corridor. ▪ Refer above to mitigation measures for physical habitat destruction.						
	Aspect: Construction activities **Impact:** Ecological disturbance and nuisance impacts	**Without**	**8**	**2**	**2**	**0.75**	**-9.00**	**Moderate**
		With	**2**	**1**	**2**	**0.50**	**-2.50**	**Low**
		Key mitigation measures: ▪ Education of workers / employees onsite on not to harm wildlife unnecessarily will assist in mitigating this impact. Contractor induction and staff / labour environmental awareness training needs are to be identified and implemented through staff / contractor environmental induction training. This must include as a minimum, basic environmental training based on the requirements of the EMPr, including training on avoiding and conserving local wildlife.						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
		▪ No wild animal may under any circumstance be hunted, snared, captured, injured, killed, harmed in any way or removed from the site. This includes animals perceived to be vermin (such as snakes, rats, mice, etc.). ▪ Any fauna that are found within the construction zone must be moved to the closest point of natural or semi-natural habitat outside the construction corridor. ▪ The handling and relocation of any animal perceived to be dangerous / venomous / poisonous must be undertaken by a suitably trained individual. ▪ All vehicles accessing the site should adhere to a low speed limit (40km/hr is recommended) to avoid collisions with susceptible species such as reptiles (snakes and lizards). ▪ No litter, food or other foreign material must be disposed of on the ground or left around the site or within adjacent natural areas and must be placed in demarcated and fenced rubbish and litter areas that are animal-proof. ▪ Workers accessing the site must conduct themselves in an acceptable manner while on site, both during work hours and after hours. ▪ Temporary noise pollution must be minimized by ensuring the proper maintenance of equipment and vehicles, and tuning of engines and mufflers as well as employing low noise equipment where possible.						
Operations	**Aspect:** Operational use of border infrastructure and maintenance activities **Impact:** Impacts relating to maintenance activities i.e. proliferation of IAPs, clearance of vegetation to maintain the detection zone	**Without**	**16**	**2**	**4**	**1**	**-22.00**	**High**
		With	**4**	**1**	**2**	**0.50**	**-3.50**	**Low**
		Key mitigation measures: ▪ An operational maintenance management plan must be developed for the servitude and infrastructure to guide maintenance of the developed infrastructure and to ensure that budget provision for environmental operational management of the servitude is implemented. ▪ Invasive Alien Plants (IAP) eradication and control - All IAPs that have colonised the border patrol zone must be removed. A Maintenance Contractor must be appointed to undertake the removal of IAPs and maintenance of the border control infrastructure (fence, road, detection zone). - A detailed IAP Eradication and Control Plan must be included into the Operational Maintenance Management Plan. - Herbicides must be utilised where hand pulling / uprooting is not possible. Only herbicides which have been certified safe for use in wetlands by independent testing authority are to be used.						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P
		- Two species – *Flaveria bidentis* (Smelter's bush) and *Parthenium hysterophorus* (Famine weed) have been identified as being particularly high risk, especially in terms of the importing of road (calcrete) substrate which may carry seeds of these two species, and in terms of the entry of vehicles into the construction servitude from other areas which are likely to carry the seeds of the same species. - Soil for construction activities (in the KZN-section of the route) must be sourced from a source free of Famine weed and Smelter's bush. - In the event that these two species are recorded on site, the following mitigation measures must be undertaken: o Pull the entire plant out including roots before flowering and place it in a bin bag. Protective gloves, facemasks and protective clothing must be used. o Burn all uprooted plants once dry in a controlled environment. Alternatively, spray all emerging plants and leaves with a registered herbicide such as *Access 240 SL*. - It is recommended that bi-annual alien plant clearing be undertaken by the Applicant for the first year post-rehabilitation. Thereafter, alien plant clearing must be undertaken annually until such a time that further risks of alien invasion resulting from disturbance factors are considered negligible. - Refer to the IAP Eradication and Control Method Statement included in the EMPr (***Appendix J***). ▪ Maintenance of detection zone - Grass mowing: Grass mowing particularly on gentle to flat areas has been identified as a preferred method to keep grass short and maintaining a clear detection zone. In this regard, it is recommended that tall grass be mowed bi-annually. The first cut can be made prior to the start of the wet season (August – September) and the second cut towards the end of the wet season (February - March). - Veld burning: In areas where mowing is not feasible, veld burning may be a viable alternative used to maintain visibility within the detection zone. This requires a cool burn (downwind fire) that will proceed through the grassland as quickly as possible so as to cause the least damage to herbaceous plants. Grass must be burnt only in winter (May - June) when temperatures are low. A firebreak system must be implemented to ensure effective management of controlled burns. ▪ Maintenance of road infrastructure: The border patrol road (including quad bike tracks) must be inspected daily by SANDF and DAFF personnel while undertaking their daily patrols. Should any damage be detected, maintenance / repairs of the road infrastructure must be undertaken by the DPW Maintenance Contractor that will be appointed for this purpose.					

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
		▪ Maintenance of stormwater infrastructure: Stormwater infrastructure must be inspected preferably on an annual basis prior to the start of the rainy season. Blocked infrastructure must be unblocked while silted structures must have excess sediment removed. ▪ Maintenance of the border fence: The border fence must be inspected by SANDF personnel while undertaking their patrols. Should any section of the fence be damaged and require replacement, this must be undertaken by the DPW Maintenance Contractor.						
	Aspect: Operational use / presence of border control infrastructure **Impact:** Indirect erosion, sedimentation and pollution impacts	**Without**	**16**	**2**	**3**	**0.75**	**-15.75**	**Moderately High**
		With	**4**	**1**	**3**	**0.50**	**-4.00**	**Low**
		Key mitigation measures: ▪ An Operational Maintenance Management Plan must be developed for the servitude and infrastructure to guide maintenance of the developed infrastructure and to ensure that budget provision for environmental operational management of the servitude is implemented. ▪ All SANDF and other vehicles utilising the patrol road must be properly maintained to prevent leaks of fuel and other pollutants into the environment. ▪ Erosion control and slope stability concerns: - Where soil erosion or embankment instability concerns persist, particularly in rehabilitated areas and areas with steep terrain, such areas must be monitored to inform the need for further intervention. Interventions such as slope stabilisation or additional habitat / vegetation rehabilitation may need to be undertaken as per the Conceptual Rehabilitation Plan for Terrestrial Habitats (appended to the EMPr – ***Appendix J***).						
	Aspect: Operational use / presence of border control infrastructure **Impact:** Fauna trapped in fences, fragmentation of habitat, impeded mobility of wildlife, e.g. from accessing drinking water	**Without**	**16**	**2**	**4**	**0.75**	**-16.50**	**Moderately High**
		With	**8**	**2**	**4**	**0.5**	**-7.00**	**Moderately Low**
		Key mitigation measures: ▪ The extent of disturbance must be limited to the extent of the construction footprint. No areas outside the construction footprint must be cleared unless authorised. ▪ A search and recovery / walkthrough process preferably after detail design, before construction must be undertaken at biodiversity “hotspots” based on the outcomes of the desktop fauna POC assessment.						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
		Most of the grassland, forest and wetland habitats with more intact vegetation could potentially harbour Red Data listed fauna and these areas must be the focus of search and recovery exercises. ▪ Animals trapped in fences - Border patrol personnel must be educated on monitoring for faunal impacts, such as noting incidences where antelope and larger reptiles and birds (raptors and birds of prey, cranes, owls, etc.) become entangled or electrocuted by the border fence. This will assist in informing adaptive fence management, whereby known "hotspots" where faunal collisions and deaths associated with the fence occur can be identified and fence management reconsidered in these areas to reduce wildlife impacts where possible. - Animals that have become entangled and / or died and are still attached to the fence must be removed immediately to prevent further impacts to predators and scavengers that could themselves become entangled / injured whilst trying to feed off of animal carcasses attached to the fence. ▪ No road and fence must be constructed along the Usuthu River as requested by the EKZNW – this will allow animals to access the river. ▪ Refer to design recommendations for fences in Table 51.						
	Aspect: Operational use / presence of border control infrastructure **Impact:** Positive impact on biodiversity features (especially within Protected Areas) by upgrading fences ensuring reduced occurrences of illegal activities such as poaching etc. removal of fences at a later stage (e.g. TFCAs and merging of the Ndumo Game Reserve and the Usuthu CCA)	**Without**	**4**	**4**	**4**	**0.5**	**+6.00**	**Moderately Low**
		With	**8**	**4**	**4**	**0.5**	**+8.00**	**Moderate**
		Key mitigation measures: ▪ All border control infrastructure must be maintained to acceptable standards to ensure illegal crossings do not occur. ▪ Public access to the newly developed patrol zone and associated road infrastructure must be strictly prohibited, especially within, or in the immediate vicinity of Protected Areas. ▪ Provision for removal of fencing infrastructure within core areas of the Lubombo TFCA and Resource Area: - As per the agreements reached in the BA consultation process between DPW, the end users (DAFF and SANDF) and EKZNW, the international border fence, and where relevant, other fencing will be removed once formal agreement is reached between the governments of South Africa and Mozambique and Swaziland to remove the international border fence and other fencing (i.e. any impediments to the free movement of wildlife) within the core area of the Lubombo TFCA Resource						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P
		Area. Such removal must only be permitted once the boundary fencing of the relevant Protected Areas on both sides of the border is adequately secured. - The removal of fencing within the core area of the TFCAs must be included in the Operational Management Maintenance Plan in order to ensure that fence removal is not associated with residual environmental impacts such as dumping of fencing material that could injure wildlife, etc.					
Cumulative	Cumulative impacts of the planned infrastructure development are expected to have a highly significant impact on terrestrial habitat	▪ Biodiversity offsets may be warranted for this project, given the potentially large extent of permanent transformation of threatened vegetation types involved. Once the residual impacts have been quantified for the project, an Offset Framework will need to be compiled for the project once the detail design is completed, prior to construction. This framework will amongst other things include: - A detailed screening of the preliminary offset options; - Selection of preferred offset option/s; - Preparation of an indicative budget for implementing the selected offsets and for the long-term management of the offset areas (approximately 30 years) – if applicable. - Review of legal requirements associated with undertaking the proposed offsets, particularly under the NEMA and the National Water Act (NWA). - Clarification of offset commitments; and - Compilation of a detailed Offset Implementation Plan that encompasses securing the offset sites and the compilation of detailed offset rehabilitation and conservation management plans.					

9.3.5 Freshwater Resources

Table 55: Freshwater resources impacts

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
Construction	**Aspect:** Construction activities within watercourses. **Impact:**	**Without**	**16**	**1**	**4**	**1**	**-21.00**	**High**
		With	**8**	**1**	**4**	**1**	**-13.00**	**Moderately High**
		Key mitigation measures:						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P
	Physical destruction and / or modification of aquatic habitat	▪ Prior to the stripping, infilling, excavation and re-shaping of the aquatic habitat within the development footprint / corridor, a search and rescue of indigenous flora and fauna must be undertaken prior to habitat destruction. ▪ The ECO will need to mark any indigenous wetland and riparian trees or sensitive plant species adjacent to the construction servitude that must not be damaged during construction. ▪ All cleared and trimmed vegetation shall be removed from the watercourse upon completion of clearing in order to prevent the risk of flooding / snagging. ▪ Vegetation clearing / stripping within the construction footprint must only be done as the construction front progresses. ▪ The extent of disturbance must be limited to the extent of the construction footprint. No areas outside the construction footprint may be cleared. ▪ Construction servitude width recommendations: - For the construction of a 5.5m patrol road, a maximum construction servitude of 10m is recommended. - For the construction of a 2m quad bike track a maximum construction servitude of 5m is recommended. - For construction of the border fence, maximum construction servitude of 10m is recommended. This must include a 3m wide corridor in foreign countries and a 7m wide corridor within South Africa. ▪ Demarcations and 'No-Go' areas: ▪ At watercourse crossings, the outer edge of the construction servitude / working area / corridor as defined above must be clearly demarcated for the entire construction phase using plastic orange bonnox / other hazard fencing. All areas outside of this demarcated corridor must be considered 'No-Go' areas. ▪ Under no circumstances must any watercourse / wetland outside of the permitted construction footprint be impacted by temporary access roads. In this regard, all temporary access routes located outside of the construction servitude must be existing access roads. ▪ Watercourses / wetlands outside of the demarcated construction area (i.e. water resources downslope downstream of the infrastructure upgrade) are strictly 'No-Go' areas. These areas must not be accessed by machinery or workers for any reason. This includes water resources originally rated as of low to very low risk during the desktop mapping and risk screening. ▪ Any contractors found working inside the 'No-Go' areas (areas outside the working servitude) should be fined as per fining schedule / system setup for the project. ▪ Watercourse areas outside of the construction corridor that are disturbed during the construction phase must be rehabilitated immediately. All disturbed areas must be prepared and then re-vegetated to the satisfaction of the ECO as per the relevant re-vegetation / re-planting plan.					

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P
		▪ Where stream channels have been disturbed, the channels should be re-graded, stabilised using erosion control measures and re-vegetated. ▪ As part of the finalisation of the EMPr, detailed method statements must be compiled for all construction activities confirmed to occur within the watercourses. The methods statements include but not limited to: - Method statement for rehabilitation of disturbed watercourses / wetlands. - Method statement for road construction within a watercourse / wetland. - Method statement for temporary coffer dams and flow diversions. ▪ Any direct modification of wetland and river channels for the installation of culverts and road drainage must be limited to the construction servitude. ▪ Indigenous wetland and riparian vegetation removed from the road footprint and suitable for rehabilitation activities must be carefully removed and stored in an appropriate facility for rehabilitation purposes. ▪ All cleared and trimmed vegetation must be removed from the watercourse upon completion of clearing in order to prevent the risk of flooding / snagging. ▪ All alien invasive vegetation that has colonised the construction site must be removed, preferably by uprooting. ▪ All bare surfaces across the construction site must be checked for alien invasive plants at the end of every month and alien pants removed by hand pulling / uprooting and adequately disposed. ▪ For wetlands that are saturated at the time of construction it is recommended that a form of running track be constructed into the wetland to allow such heavy machinery to move and work within the construction footprint without exerting excess impacts on wetland soils and vegetation. Running tracks can be constructed from materials such as bogmats or crushed stones to form a raised track above the ground level of the wetland. It is important that the material utilised to create the running track be fully removed from the wetland at the completion of construction at each site (wetland). ▪ Witkoppies-Berbice area: - A deviation of the patrol road around a highly sensitive floodplain wetland (W42K-W14) (associated with the Mozana River) and associated seepage wetland (W42K-W15__500m) has been included in the alignment between km 243-244. Accordingly, no road or footpath infrastructure must be aligned across these wetlands. Only the international border fence is aligned along the section of the international border that traverses the floodplain wetland W42K-W14, to avoid impacts on this wetland; no further fencing must be developed within these wetlands.					

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P
		- Between km 242.5 and km 243 where the patrol road crosses, and runs close to the wetland W42K-W13, the corridor has been narrowed to 15m to avoid affecting this wetland unnecessarily. - Between km 241 and km 242 the corridor has been narrowed on the eastern side of the road centreline to avoid impacting the riparian zone of the Mozana River(W42K-R05). - Around KM 242 the corridor has similarly been narrowed, except in the vicinity of the outlets of wetlands W42K-W11 and W42K-W12, in order to allow for the recommendation that the patrol road cross these wetlands at the point at which they narrow to minimise the area of wetland habitat that is transformed. ▪ For the design of the international border fence that traverses the floodplain wetland W42K-W14, the following measures are specified: - The footprint of the fence must be limited to the fence footings within the wetland. These must be designed to accommodate flood flows and inundation for large parts of the year. - Due to the inundated nature of this wetland, it is recommended that a running track made from coarse stone material be constructed along the fence line to allow the movement of construction workers and equipment into this wetland, and to minimise damage to wetland substrate and vegetation. This running track must be fully removed from the wetland once construction of the fence is complete. - For the patrol road crossings of wetlands W42K-W11 and W42K-W12, it is strongly recommended that the patrol road be aligned to cross these wetlands at the point at which they narrow (becoming channelised) to enter the Mozana River, thus minimising loss of functional wetland habitat (-27.181909°; 31.129403° for W42K-W11; -27.180944°; 31.128726° for W42K-W12). At these crossing points it is recommended that stone gabion basket structures be utilised to stabilise the headcuts (related to the drop in levels and exacerbated by cattle movement) that are present in the wetlands at these locations. ▪ A conceptual Rehabilitation Plan for Aquatic Habitat construction phase is provided as an Annexure to *the Aquatic Ecological Impact Assessment* (***Appendix C3***). A detailed construction phase rehabilitation plan must be compiled by a suitably qualified and experienced ecologist and appended to the EMPr prior to construction commencing.					

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
	Aspect: Construction activities within watercourses. **Impact:** Flow modification and erosion / sedimentation impacts	**Without**	**16**	**2**	**2**	**1**	**-20.00**	**High**
		With	**8**	**2**	**1**	**0.50**	**-5.50**	**Moderately Low**
		Key mitigation measures: ▪ It is recommended that construction across watercourses take place preferably during the dry / winter months where possible to reduce risk of erosion and sedimentation associated with summer rainfall in the region. ▪ A method statement must be compiled by an aquatic specialist in conjunction with the appointed contractor to guide the flow diversion process from start to finish. This method statement must be approved by the ECO. ▪ Diversions shall be temporary in nature with no permanent walls, berms or dams being installed. ▪ Stormwater and erosion control measures must be implemented during the construction phase to ensure that erosion and sedimentation impacts to the water resources are minimised or possibly avoided. In this regard, the following measures should be implemented: - Vegetation / soil clearing activities must only be undertaken during agreed working times and permitted weather conditions. If heavy rains are expected, clearing activities must be put on hold. - Construction activities must be scheduled to minimise the duration of exposure bare soils on site, especially on steep slopes. - Runoff generated from cleared and disturbed areas / slopes that drains into watercourses must be controlled using erosion control and sediment trapping measures like silt fences, sandbags, earthen berms and synthetic logs, particularly where slopes are exposed. These control measures must be established at regular intervals perpendicular to the slope to break surface flow energy and reduce erosion as well as trap sediment. - Sediment barriers (e.g. silt fences, sandbags, hay bales, earthen filter berms, retaining walls and check dams) must be established to protect water resources from erosion and sedimentation impacts from upslope. Sediment barriers must be regularly maintained and cleared so as to ensure effective drainage. - Berms, sandbags and / or silt fences employed must be maintained and monitored for the duration of the construction phase and repaired immediately when damaged. The berms, sandbags and silt fences must only be removed once vegetation cover has successfully re-colonised the disturbed areas post-rehabilitation.					

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
		- Any flow diversions are to be done so in such a manner that water does not result in concentrated flow downslope that could cause soil erosion. - Trenches or excavations must be closed and compacted immediately after construction is completed. ▪ During construction, the contractor must check the site for erosion damage after every rainfall event, and rehabilitate this damage immediately. ▪ No building material, soils or rubble must be disposed of within any watercourse, including rivers, streams and riparian habitats. ▪ Upon completion of the construction activities within the watercourse, all temporary structures must be removed immediately and the disturbed soils, beds, banks and vegetation rehabilitated in line with a detailed rehabilitation plan. Under no circumstances must temporary structures be left in situ for more than a day after completion and rehabilitation must commence within a day of completion. ▪ Detailed stormwater management and erosion controls are provided in the EMPr (***Appendix J***).						
	Aspect: Construction activities within watercourses. **Impact:** Impacts on water quality due to potential contaminants (hydrocarbons; oils and grease; cement; bitumen; sewage; suspended solids and solid waste) released into watercourses	**Without**	**8**	**2**	**1**	**0.75**	**-8.25**	**Moderate**
		With	**4**	**2**	**1**	**0.2**	**-1.40**	**Low**
		Key mitigation measures: ▪ Hazardous storage and refuelling areas must be bunded prior to their use on site during the construction period following the appropriate SANS codes. The bund wall must be high enough to contain at least 110% of any stored volume. ▪ The surface of the bunded surface must be graded to the centre so that spillage must be collected and satisfactorily disposed of. ▪ Fire prevention facilities must be present at all hazardous storage facilities. ▪ The proper storage and handling of hazardous substances (e.g. fuel, oil, cement, bitumen, paint, etc.) must be administered. Storage containers must be regularly inspected to prevent leaks and all hazardous storage must take place in a bunded area or within drip trays to prevent soil / water contamination. ▪ Mixing and / or decanting of all chemicals and hazardous substances must take place on trays, shutter boards or on impermeable surfaces and must be protected from the ingress and egress of stormwater. ▪ Drip trays must be utilised at all dispensing areas. ▪ 44-gallon drums must be kept on site to collect contaminated soil. These must be disposed of at a registered hazardous waste site.						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
		▪ Refuelling, servicing or chemical storage must not occur within 50 m of the delineated watercourse habitat or within the 100-year flood line, whichever is applicable. ▪ Vehicles transporting concrete, asphalt or any other bituminous product must not be washed on site. ▪ Vehicle maintenance must not take place on site unless a specific bunded area with an oil filter trap is constructed at the site camp for such a purpose. ▪ Correct emergency procedures and cleaning up operations must be implemented in the event of accidental spillage. ▪ If a water pump is required, the water pump must operate inside or on top of a drip tray to prevent any spillage of fuel and limit the risk of soil / water contamination. The drip tray will need to be lined with absorbent pads and checked daily while in use. ▪ All equipment to be used within the sensitive working areas must be checked daily for oil and diesel leaks before gaining access to these working areas. ▪ An emergency spill response procedure must be formulated and staff must be trained in spill response. All necessary equipment for dealing with spills of fuels / chemicals must be available at the site. Spills must be cleaned up immediately and contaminated soil / material must be disposed of appropriately at a registered site. ▪ Waste from chemical toilets must be disposed of regularly (at least once a week) and in a responsible manner by a registered waste contractor. ▪ Workers need to be encouraged to use toilet facilities provided and not the natural environment. ▪ Toilets must not be located within the 1:100 year flood line of a watercourse or closer than 50m or from any natural water bodies including rivers, streams, riparian areas and wetlands.					
Operations		**Without**	**16**	**1**	**3**	**0.75**	**-15.00**	**Moderately High**
		With	**4**	**1**	**3**	**0.50**	**-4.00**	**Low**

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P
	Aspect: Operational use of border infrastructure and maintenance activities **Impact:** Impacts relating to maintenance activities i.e. proliferation of IAPs, clearance of vegetation to maintain the detection zone	**Key mitigation measures:** ▪ An operational maintenance management plan must be developed for the servitude and infrastructure to guide maintenance of the developed infrastructure and to ensure that budget provision for environmental operational management of the servitude is implemented. ▪ IAP eradication and control - The control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs. - Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment. - The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner. - It is recommended that bi-annual annual alien plant clearing must be undertaken by the Applicant / Developer for the first year post-rehabilitation. Thereafter, alien plant clearing must be undertaken annually until such a time that further risks of alien invasion resulting from disturbance factors are considered negligible. - Refer to the IAP Eradication and Control Method Statement included in the EMPr (***Appendix J***). ▪ Maintenance of fences - Blocked or obstructed fences crossing channels must be inspected and cleared of sediment and debris annually. - Erosion headcuts, eroding river banks and scouring downstream for fence foundations in watercourses (where applicable) must be stabilised immediately to avoid damage to watercourses and fence infrastructure. - Major structural maintenance of fences (i.e. replacement or major repairs) within watercourses must take into account the construction phase mitigations measures outlined in this report. ▪ Maintenance of the border detection zone - Grass mowing: Grass mowing particularly on gentle to flat areas has been identified as a preferred method to keep grass short and maintaining a clear detection zone. In this regard, it is recommended					

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
		that tall grass be mowed biannually. The first cut can be made prior to the start of the wet season (August - September) and the second cut towards the end of the wet season (February - March). - Veld burning: In areas where mowing is not feasible, veld burning may be a viable alternative used to maintain visibility within the detection zone. This requires a cool burn (downwind fire) that will proceed through the grassland as quickly as possible so as to cause the least damage to herbaceous plants. Ideally grass must be burnt only in winter (May - June) when temperatures are low. A firebreak system must be implemented to ensure effective management of controlled burns. ▪ Maintenance of border patrol road infrastructure - Unless absolutely necessary (under special circumstances), patrol vehicles of any type must remain on roads and must not to create unauthorised tracks or roads. These informal roads and tracks cause unnecessary disturbance, adversely affect surface hydrology by creating ruts that can act as paths of preferential flow (thus affecting diffuse flow settings) and induce erosion where the groundcover has been disturbed. This is particularly important in seepage and other unchannelled valley bottom wetland types where the wetland is characterised by moist grassland which is particularly susceptible to this type of impact. - Quad patrols must make use of the same tracks and not create a series of tracks. Similar impacts to those detailed in the point above are applicable. - Regular monitoring and clearing of sediment-laden roadside drains is recommended to avoid excessive accumulation of sediment in drains which will eventually render them useless. The period of monitoring will be specified in the Maintenance Contract. - Blocked or obstructed culverts must be inspected and cleared of sediment and debris. On-going monitoring of culvers and clearing as and when needed. - Erosion headcuts, eroding river banks and scouring at stormwater drainage points must be stabilised immediately to avoid damage to watercourses and road infrastructure. Eroding and / or unstable road batters must also be stabilised and rehabilitated for the same reasons. - Major structural maintenance of road crossings including culverts and fill embankments within watercourses must take into account the construction phase mitigation measures outlined in this report and the EMPr (***Appendix J***).					
		Without	**8**	**2**	**3**	**0.75**	**-9.75**	**Moderate**
		With	**4**	**2**	**3**	**0.50**	**-4.50**	**Low**

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
	Aspect: Operational use of border infrastructure and maintenance activities **Impact:** Flow modification, erosion / sedimentation impacts	**Key mitigation measures:** ▪ Regular (on-going and as and when required) maintenance of stormwater infrastructure including side drains, discharge outlets and culverts. Failures must be repaired as soon as practically possible and siltation and / or blockages must be cleared to ensure continued efficiency of the stormwater systems.						
	Aspect: Operational use of border infrastructure and maintenance activities **Impact:** Impact on water quality	**Without**	**8**	**1**	**1**	**0.5**	**-5.00**	**Moderately Low**
		With	**4**	**1**	**1**	**0.2**	**-1.20**	**Low**
		Key mitigation measures: ▪ An Operational Maintenance Management Plan must be developed for the servitude and infrastructure to guide maintenance of the developed infrastructure and to ensure that budget provision for environmental operational management of the servitude is implemented. ▪ All SANDF and other vehicles utilising the patrol road must be properly maintained to prevent leaks of fuel and other pollutants into the environment.						
Cumulative	Cumulative impacts of the planned infrastructure development are expected to have a highly significant impact on wetland habitat	▪ A wetland offset must be considered to address residual impacts on wetland habitat that is largely attributed to road construction, which will result in the clearing and transformation of wetland habitat within the development footprint. Once the residual impacts have been quantified for the project, an Offset Framework will need to be compiled for the project once the detail design is completed, prior to construction. This framework will amongst other things include: - A detailed screening of the preliminary offset options; - Selection of preferred offset option/s; - Preparation of an indicative budget for implementing the selected offsets and for the long-term management of the offset areas (approximately 30 years) – if applicable. - Review of legal requirements associated with undertaking the proposed offsets, particularly under the NEMA and the National Water Act (NWA). - Clarification of offset commitments; and						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P
		- Compilation of a detailed Offset Implementation Plan that encompasses securing the offset sites and the compilation of detailed offset rehabilitation and conservation management plans.					

9.3.6 Heritage

Table 56: Heritage impacts

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
Construction	**Aspect:** Construction activities **Impact:** Potential impact on archaeological (Early Stone Age, Middle Stone Age, Later Stone Age, Rock Art, historical sites) and cultural resources	**Without**	**16**	**1**	**5**	**0.75**	**-16.50**	**Moderately High**
		With	**4**	**1**	**1**	**0.20**	**-1.20**	**Low**
		Key mitigation measures: ▪ Border Cave may not be changed or altered under any circumstances and a buffer zone of 50m must be maintained around this important site. ▪ A buffer zone of 50m must also be maintained around the one identified rock art site (S 26°52' 27.72"; E 32° 11' 34.43"). ▪ All the other sites must have a buffer zone of at least 10m – 30m as specified in the Phase 1 Heritage Impact Assessment (***Appendix C4***). Should it not be possible to maintain these buffer zones then the Applicant / Developer may motivate for a Phase Two Heritage Impact Assessment of the relevant sites. This second phase heritage impact assessment may involve a rescue excavation or the collection of the surface artefacts under the auspices of the relevant provincial heritage agency. ▪ If any heritage / archaeological features are exposed by construction work then all work should stop immediately and relevant provincial heritage agency (AMAFA or Mpumalanga Provincial Heritage Resources Agency), should be contacted for further evaluation. Attention is drawn to the South African Heritage Resources Act, 1999 (Act No. 25 of 1999) and the KwaZulu-Natal Heritage Act (Act No. 4 of 2008) which, requires that operations that expose archaeological or historical remains must cease immediately, pending evaluation by the provincial heritage agent.						
		Without	**16**	**1**	**5**	**0.50**	**-11.00**	**Moderate**

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
	Aspect: Construction activities. **Impact:** Potential impact on graves	**With**	**4**	**1**	**1**	**0.20**	**-1.20**	**Low**
		Key mitigation measures: ▪ All the grave sites must have a buffer zone of at least 10m – 30m as specified in the Phase 1 Heritage Impact Assessment (***Appendix C4***). ▪ A Phase Two Heritage Impact Assessment will be necessary in order to initiate a grave exhumation and reburial process – where necessary. This process will also include the application of a permit from the relevant Provincial Heritage Agency and extensive community consultations.						

9.3.7 Palaeontology

Table 57: Palaeontology impacts

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
Construction	**Aspect:** The excavations and clearing of vegetation during the construction	**Without**	**8**	**1**	**2**	**0.50**	**-5.50**	**Moderately Low**
		With	**2**	**1**	**2**	**0.2**	**-1.00**	**Low**

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P
	phase will consist of digging into the superficial sediment cover as well as underlying deeper bedrock. These excavations will change the existing topography and may possibly disturb, destroy or permanently close-in fossils at or below the ground surface. These fossils will then be lost for research **Impact:** Damaging impacts on palaeontological heritage occur during the construction phase which will modify the existing topography	**Key mitigation measures:** ▪ In the event that fossil remains are discovered during any phase of construction, either on the surface or unearthed by fresh excavations, the ECO in charge of these developments must be alerted immediately. These discoveries must be protected (preferably in situ) and the ECO must report to SAHRA so that appropriate mitigation (e.g. recording, collection) can be carried out by a professional palaeontologist. ▪ Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an approved collection which comprises a museum or university collection, while all fieldwork and reports must meet the minimum standards for palaeontological impact studies proposed by SAHRA.					

9.3.8 Socio-economic

Table 58: Socio-economic impacts

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
Construction		**Without**	**4**	**2**	**1**	**0.5**	**+3.50**	**Low**
		With	**8**	**2**	**1**	**0.5**	**+5.50**	**Moderately Low**

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
	Aspect: Construction activities **Impact:** The project will contribute to job creation jobs during the construction phase	**Key mitigation measures:** ▪ All labour (skilled and unskilled) and contractors must be sourced locally where possible. ▪ A labour and recruitment policy must be developed, displayed and implemented by the contractor. ▪ Recruitment at the construction site must not be allowed. ▪ A Community Liaison Officer must be appointed to deal with the employment of local labour and to interface between the contractor and the local community. ▪ Where possible, labour intensive practices (as opposed to mechanised) should be implemented. ▪ The principles of equality, BEE, gender equality and non-discrimination must be implemented.						
	Aspect: Construction activities **Impact:** Contractors, the influx of people and potential job creation will result in the proliferation of social ills and issues such as crime, prostitution, the spread of HIV / AIDs, prevalence of diseases such as malaria, informal settlements etc. Lack of provision of ablutions that may lead to the creation of 'informal ablutions' within or close to surface water resources, interaction with wild animals	**Without**	**4**	**1**	**1**	**0.75**	**-4.50**	**Low**
		With	**4**	**1**	**1**	**0.50**	**-3.00**	**Low**

		Key mitigation measures:
		▪ The Applicant / Developer needs to be actively involved in the prevention of social ills associated with contractors.
		▪ No informal settlements must be allowed.
		▪ A Safety Plan (accompanied by a risk assessment) and site-specific method statements for working in sensitive areas must be compiled that deals with worker safety inside and adjacent to Protected Area especially with regards to interaction with wild animals.
		▪ Due to the concentration of a workforce in the area over the construction period, the Contractor must implement an HIV / AIDS Awareness Programme, annually on-site.
		▪ A Malaria Awareness Programme must be implemented in malaria-risk areas annually on-site. Activities for malaria awareness and prevention will be broad-based, targeting both individuals and groups. They may consist of:
		  ▪ Information posters in public places both on and off site (eating places, bars, guest houses, etc.) indicating symptoms, when to seek medical assistance etc.
		  ▪ Providing screen on doors and windows of site offices;
		  ▪ Administration of anti-malaria medication to workers (by qualified professionals) in high-risk areas; and
		  ▪ Discussion of malaria and its effects at site meetings.
		▪ Strict penalties will be built into tenders to deal with issues such as petty crime, stock theft, fence cutting, trespassing etc.
		▪ No poaching of wildlife or selling of firewood must be allowed.						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
Operations	**Aspect:** Provision of improved border control infrastructure **Impact:** Socio-economic benefits to the local area due to prevention of illegal cross border activities and the prevention of spread of livestock disease	Without	4	4	4	0.50	+6.00	Moderately Low
		With	8	4	4	0.75	+12.00	Moderate
		Key mitigation measures: ▪ The border control infrastructure must be maintained in a good condition and patrolled regularly. ▪ The livestock exclusion zone must be strictly maintained as such, and all damaged to inner fences be repaired so that livestock do not enter this zone.						

9.3.9 Waste

Table 59: Waste impacts

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
Construction	**Aspect:** Construction activities **Impact:** Waste generation during the construction phase will have a negative impact on the environment, if not controlled adequately. Waste includes general construction rubble, existing redundant infrastructure and hazardous waste (used oil, cement and concrete etc.)	Without	8	1	1	0.75	-7.50	Moderately Low
		With	2	1	1	0.5	-2.00	Low
		Key mitigation measures: ▪ Adequate rubbish bins and waste disposal facilities must be provided onsite and at the construction camp. ▪ All bins must be animal proof. ▪ The construction site must be kept clean and tidy and free from rubbish. ▪ Recycling / re-use of waste must be encouraged. ▪ No solid waste must be burned on site. ▪ Eating areas must not be located within 50m of the watercourse habitats. ▪ Waste bins must be provided at the eating areas. ▪ Bins and / or skips must be supplied at convenient intervals on site for disposal of waste within the construction camp. The bins must have liner bags for easy control and safe disposal of waste.						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P
		▪ Bins must be provided to all areas that generate waste e.g. worker eating and resting areas and the camp site. General refuse and construction material refuse must not be mixed. ▪ Regular clearing of bins is required. ▪ Rubble generated from demolishing of existing infrastructure must be loaded onto a dump truck as soon as it is generated. A dump truck must be on standby while all existing infrastructure is being demolished. ▪ Once loaded onto a truck, the rubble must be taken to a landfill site and a waybill must be retained as proof of safe disposal. ▪ Should rubble be required as a raw material for the construction, it must be taken to a designated stockpile area - which must be approved by the ECO. ▪ Should rubble be required as a raw material for the construction, it must be taken to a designated stockpile area - which must be approved by the ECO. ▪ Spoil material must be hauled to a designated spoil site. No spoil material must be pushed down slope or discarded on site. ▪ All general waste, constructional plant, equipment, surplus rock and other foreign materials must be cleared and completely removed from site once construction has been completed.					

9.3.10 Air Quality

Figure 96: Air quality impacts

Phase	Potential Aspect and/or Impact	Mitigation	Extent (E)	Duration (D)	Intensity (I)	Probability (P)	Significance (E+D+I+P)	
Construction		Without	8	1	1	0.75	-7.50	Moderately Low
		With	4	1	1	0.50	-3.00	Low

Phase	Potential Aspect and/or Impact	Mitigation	Extent (E)	Duration (D)	Intensity (I)	Probability (P)	Significance (E+D+I+P)
	Aspect: Construction activities (site clearing; operation of vehicles, equipment etc.). **Impact:** Fugitive dust emissions from debris handling and debris piles; mobile plant/machinery and general construction activities Other air quality impacts including vehicle emissions and odours from chemical toilets	**Key mitigation measures:** ▪ Dust management - Dust must be suppressed on the construction site during dry periods by the regular application of water. - Water used for this purpose must be used in quantities that will not result in the generation of runoff. - Stockpiles must be positioned such that they are not vulnerable to wind erosion. - Skips and trucks which are loaded with construction materials must be covered. - All piles should be maintained for as short a time as possible and must be enclosed by wind-breaking enclosures of similar height to the pile. - Stockpiles must be situated 50m away from wetlands and nearby receptors and should take into account the predominant wind direction. - A speed limit of 40 km/hr should be set for all vehicles travelling over exposed areas or near stockpiles. - Dust and mud should be controlled at vehicle exit and entry points to prevent the dispersion of dust and mud beyond the site boundary. ▪ Emissions from equipment and vehicles - All mobile plant and equipment must be in good working order. - A register must be maintained for vehicle maintenance. - All mobile plants that are unable to be repaired immediately must be removed from service until such time as they are in good working condition. ▪ Odour prevention - Chemical toilets must be provided and cleaned on a regular (weekly) basis. - Servicing receipts must be maintained and kept on site within the site environmental file. - Waste must be cleaned daily from site.					

9.3.11 Noise

Table 60: Noise impacts

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
Construction	**Aspect:** Constructions staff, vehicles, equipment, blasting and piling activities **Impact:** Increase in noise pollution	Without	8	2	1	1	-11.00	Moderate
		With	8	2	1	0.5	-5.50	Moderately Low
		Key mitigation measures: ▪ All construction activities must be undertaken according to daylight working hours. ▪ Surrounding communities and adjacent landowners are to be notified upfront (48 hours) of noisy construction activities (blasting, excavations and piling activities). ▪ The Contractor must consider providing all equipment with standard silencers. Maintain silencer units in vehicles and equipment in good working order. ▪ All mobile plant and equipment must be regularly maintained to ensure their integrity and reliability. ▪ Construction staff working in an area where the 8-hour ambient noise levels exceed 75 dBA must have the appropriate Personal Protective Equipment (PPE) (earmuffs). ▪ All operations must meet the noise standard requirements of the Occupational Health and Safety Act (Act No. 85 of 1993). ▪ A Complaints Register is to be kept at the Site Office at all times.					

9.3.12 Safety (including Construction Traffic)

Table 61: Safety impacts

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P	
Construction	**Aspect:** Construction traffic **Impact:** Impact on pedestrians (scholars and community members), border patrol	With	8	2	1	0.75	-8.25	Moderate
		Without	4	2	1	0.5	-3.50	Low
		Key mitigation measures: ▪ Members of the public adjacent to the construction site must be notified of construction activities in order to limit unnecessary disturbance or interference. ▪ Construction activities must be undertaken during daylight hours. ▪ A Safety Officer must be appointed to continuously monitor safety conditions during construction.						

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P
	staff, construction workers, livestock (cattle)	▪ A policy on Contractor Health and Safety for the duration of their work on site, must be applied and be monitored. ▪ A recommended speed limit of 25km/hr must be obeyed with when travelling on gravel roads. ▪ Adequate road warning signs and road markings must be introduced especially near areas of high pedestrian activity (V-gates and border posts). ▪ The road signage must be carried out in accordance with the latest edition of the South African Road Traffic Signs Manual (SARTSM) and comply with the latest editions of the Southern African Development Community (SADC) Road Traffic Signs Manual. ▪ When encountering any livestock on the road, drivers must slow down and stop and sound the hooter. ▪ Drivers are not permitted to use their vehicles to push the livestock off the road. ▪ No crossing of the railway line around Golela by construction vehicles or workers must be allowed at any point except at the existing level crossings. ▪ When approaching any pedestrians / scholars appropriate action must be implemented which will include the following: - If roads are dry, slow down when travelling past any pedestrians to mitigate the dust exposure. - If roads are wet, drive slowly past any pedestrians to prevent the splashing of water / mud. - If any pedestrian is walking on the road allow them to move to a safe section of the road as there are no sidewalks before passing them. - If pedestrians are identified on the road from a distance, sound the hooter to warn them. ▪ The Contractor and Safety Officer must maintain daily communication with the SANDF units responsible for patrolling the international border. The SANDF must be informed daily of construction numbers and progress, especially with respect to the demolishing and replacing of the border fence. ▪ All construction camps must be fenced and patrolled 24 hours a day by security personnel. ▪ It is recommended that construction workers be accompanied by members of the SANDF or SAPS in order to prevent any incidents of conflict with the Mozambican authorities related to construction activities close to, or on the border line that could lead to South African construction workers being detained. In this context it is recommended that the Safety Officer set up a communication protocol with the relevant Mozambican authorities to inform them of construction areas and progress to facilitate safe working conditions and to minimise the possibility of any international incidents. ▪ All construction staff must have the appropriate PPE. ▪ Any environmental, health and safety incidents must be reported to the responsible person. ▪ In this context it is recommended that the Safety officer set up a communication protocol with the relevant Mozambican authorities to inform them of construction areas and progress to facilitate safe working conditions and to minimise the possibility of any international incidents.					

Phase	Potential Aspect and / or Impact	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D) x P
		▪ All construction staff must have the appropriate PPE.					

10 ENVIRONMENTAL IMPACT STATEMENT

10.1 Key Issues and Impacts Identified

The following key issues have been raised as part of the engagement process with end users, partners and stakeholders on the project:

- 50m application corridor and servitude including the minimum amount of vegetation to be cleared in highly sensitive areas including Protected Areas and expansion areas, Centres of Endemism, sensitive faunal and floral habitats as well as aquatic habitats.
- Solutions to deal with actual challenges / treats.
- Potential impact of the securing of the border on the future development of the Lubombo Transfrontier Conservation Resources Area comprising the Usuthu-Tembe-Futi Corridor; Nsubane-Pongola and Songimvelo-Malolotja TFCAs and South Africa's International Obligations in terms of Protocols signed establishing the TFCAs. The erection of fences and decommissioning of fences in the long-term may have further residual impacts as well as financial implications.
- Impact of the project on the legal mandates of certain organs of state (e.g. conservation authorities in terms of conservation and protection of biodiversity) that are contradictory to the mandates of the end users on the project.
- The impact of increased veterinary control and isolation on conservation and wildlife (faunal) movement i.e. access to rivers and drinking points and reduction in carrying capacity.
- The creation of potential residual impacts relating to the phasing of construction activities (i.e. different infrastructure components being developed at different times).
- Potential impact of construction on the environment in the context of the encroachment of alien invasive plant species into the construction servitude and wider area.
- Location of construction camps and lay-down areas in relation to sensitive habitats within the study area.
- Hydrological and other impacts on wetlands and watercourses crossed.
- Biodiversity offsets related to natural habitat loss.
- Potential conservation gains of the project i.e. upgrading fencing in Protected Areas e.g. Ndumo Game Reserve and reducing poaching.
- Social issues relating to people being prevented from being able to move informally across the border once the infrastructure is developed, closure of public roads and accesses.
- Potential impact on archaeological, cultural and palaeontological resources.
- Maintenance of the infrastructure (and provision of budget for maintenance) during the operational phase of the project to avoid environmental impacts.

10.1.1 Biophysical Impacts and Associated Mitigation

Arguably the most significant of these biophysical impacts / issues relates to the loss of natural habitat and fragmentation through clearing to develop infrastructure within a linear alignment, as well as the physical destruction and / or modification of terrestrial and aquatic habitat, as well as flow modifications and erosion / sedimentation impacts and water quality impacts within the wetlands and watercourses crossed by the alignment. Based on the concerns raised by stakeholders in the context of habitat loss efforts have been made to limit the actual footprint of the developed infrastructure and the resultant area of loss of natural habitat. This has been done in a number of ways; firstly the 50m application corridor has been narrowed in the following areas of high environmental sensitivity:

- Protected Areas (Ndumo Game Reserve, Pongola Nature Reserve, Songimvelo Nature Reserve) – narrowed to 15m.
- Wetlands in the Witkoppies-Berbice area: between km 241 and km 242 the corridor has been narrowed on the eastern side of the road centreline to avoid impacting the riparian zone of the Mozana River

(W42K-R05). Between km 242.5 and km 243 where the patrol road crosses, and runs close to the wetland W42K-W13, the corridor has been narrowed to 15m to avoid affecting this wetland unnecessarily. Around km 242, the corridor has similarly been narrowed, except in the vicinity of the outlets of wetlands W42K-W11 and W42K-W12, in order to allow for the recommendation that the patrol road cross these wetlands at the point at which they narrow to minimise the area of wetland habitat that is transformed.

- Detour roads located in Protected Areas e.g. Songimvelo Nature Reserve, the corridor width has been narrowed to 15m i.e. 7.5m either side of the centreline

The narrowing of the application corridor in these areas of high sensitivity will ensure that no development is permitted beyond the narrowed width.

Secondly, certain infrastructure components have been removed from the infrastructural configurations in certain sensitive areas, in particular fencing which will be responsible for further fragmentation away from the core 'patrol zone' located in direct proximity to the international border:

- The initial proposal of an elephant fence has been changed to a veterinary fence on the eastern and southern boundary of the Ndumo Game Reserve.
- No new infrastructure will be developed on the southern boundary of the Ndumo Game Reserve, except for the upgrading of the existing boundary fence. Pending a formal agreement between the EKZNW, DAFF and SANDF, the internal perimeter roads will be used to patrol the reserve boundary. A footpath will still be required on the outer side of the fence as the DAFF will need to inspect the fences whilst the SANDF would patrol using the internal roads within the reserve.
- Ndumo to Abercorn Drift along the Usuthu River - As an alternative to fencing this section of the Usuthu River, barriers (similar to those proposed along other sections of the Mozambique / KZN border) will be used to block any potential access to vehicles (in areas where the topography is conducive to illegal vehicle movement). The barriers must not impede wildlife access to the river. The fencing emphasis will shift from the Usuthu River to the maintenance of the Usuthu Gorge CCA fence, with all future fence patrol infrastructure to be internal to the CCA (forming part of the future proclaimed conservation area's infrastructure).
- Where the international border is defined by the middle of a river, border beacons / markers will as a minimum still be needed on the bank of the river (South African side).
- Upgrading of the D1841 may increase the risk of trafficking along this route. As a solution, an alternative access alignment to Nkonjane will be along the internal perimeter roads along the western boundary fence of the Ndumo Game Reserve.
- Access to the western boundary of the Pongola Nature Reserve via the P720 will be fenced and access controlled.
- Witkoppies-Berbice area:
  - A deviation of the patrol road around a highly sensitive floodplain wetland (W42K-W14) (associated with the Mozana River) and associated seepage wetland (W42K-W15_500m) has been included in the alignment between km 243-244. Accordingly, no road or footpath infrastructure must be aligned across these wetlands. Only the international border fence is aligned along the section of the international border that traverses the floodplain wetland W42K-W14, to avoid impacts on this wetland; no further fencing must be developed within these wetlands.
  - For the design of the international border fence that traverses the floodplain wetland W42K-W14, the following measures are specified:
    - The footprint of the fence must be limited to the fence footings within the wetland. These must be designed to accommodate flood flows and inundation for large parts of the year.
    - Due to the inundated nature of this wetland, it is recommended that a running track made from coarse stone material be constructed along the fence line to allow the movement of construction workers and equipment into this wetland, and to minimise damage to wetland substrate and

vegetation. This running track must be fully removed from the wetland once construction of the fence is complete.

- For the patrol road crossings of wetlands W42K-W11 and W42K-W12, it is strongly recommended that the patrol road be aligned to cross these wetlands at the point at which they narrow (becoming channelised) to enter the Mozana River, thus minimising loss of functional wetland habitat (-27.181909°; 31.129403° for W42K-W11, -27.180944°; 31.128726° for W42K-W12). At these crossing points it is recommended that stone gabion basket structures be utilised to stabilise the headcuts (related to the drop in levels and exacerbated by cattle movement) that are present in the wetlands at these locations.

- A veterinary fence will be designed on the South African side of the border specifically the pan handle section of the nature reserve (km 420 – km 447) and an elephant fence will be incorporated into the detail design from the Josefsdal Border Post (Bulembu) km 390 to km 418.

Thirdly the clearing of (woody) vegetation has been limited to the patrol zone which is generally 10m – 15m in width. Other parts of the declared servitude will not be cleared of vegetation for the purposes of border control.

Fourthly, the following is proposed in terms of border fence design and the associated impact on wildlife movement:

- High visibility helps wildlife negotiate fences. Visibility is especially important in grasslands and near rivers, streams and wetlands to protect low-flying birds, such as owls and waterfowl. It is recommended that increased fence visibility be considered in areas with high bird traffic / activity and across watercourses (rivers and wetlands) or fences with previous known bird / mammal mortalities. Fence design could incorporate the following to increase fence visibility:
  - Enclosing the wire in a light weight length of white high-density polyethylene (HDPE) pipe;
  - Attaching reflective or colourful weather-resistant and ‘audible’ flagging materials such as plastic strips / flappers, plastic flags, metal tags, aluminium cans, etc.); and
  - The barbs on existing barbed fences can be covered with tubing, particularly in entanglement hot spots.
  - Fence design should include a suitable mesh size that will be large enough for small mammals, reptiles and amphibians to pass through. Alternatively, underpasses can be considered in fence design (further engineering input required).
  - For smaller vertebrates, reptiles and amphibians, low-level mesh fences can be added to guide the individuals towards passages. Fine-meshed fencing buried at the bottom has been successfully used in association with pipe culverts for small animal connectivity under roads / fences. Rope bridges across roads have proven successful for a number of arboreal species across the world. These overpasses / bridges may be particularly effective for the Samango Monkey and are cost-effective to install.

Lastly in line with the mitigation hierarchy, a number of steps to avoid sensitive areas through specialist sensitivity analysis, realignment recommendations and site-specific watercourse crossing design considerations were provided to the Engineering team. These planning phase recommendations were incorporated (where practically) possible and agreed to as part of the final preliminary layout and design specifications. In this regard, the impact descriptions that follow take into account these recommendations, chief amongst which were the realignment recommendations.

Further to these design measures a comprehensive series of mitigation measures have been identified in the biodiversity and freshwater reports in order to reduce the biophysical impacts of the project to acceptable levels. These mitigation measures are directed at preventing the different types of biophysical impacts from materialising, including direct impacts such as physical transformation of habitat discussed above, but also

indirect / secondary impacts, including downstream (hydrological) and adverse impacts on ecological processes such as loss of ecological connectivity and fragmentation. Site-specific impacts mitigation measures have been specified in certain freshwater and terrestrial habitats that are highly sensitive, including the Witkoppies-Berbice area and Protected Areas.

It should also be noted that according to the mitigation hierarchy, where it is not possible to avoid, minimise or rehabilitate, an offset maybe required to compensate for the residual negative effects that the project has on biodiversity including wetlands. A preliminary assessment of potential offset requirements suggests that biodiversity offsets may be warranted for this development project, given the potentially large extent of permanent transformation of threatened vegetation types involved. The extent of the area to target, together with the mechanisms and cost implications for doing so, will need to be investigated once confirmation for the need for an offset has been obtained from the Competent Authority (i.e. DEA).

Any offset recommendations specified as such by DEA must be adhered to in the development of the project. The DPW's commitment to funding infrastructural upgrades associated with the development of further conservation initiatives (see below) could potentially constitute a form of financial offset for loss of biodiversity associated with the project.

10.1.2 Conservation Planning Impacts and Association Mitigation

The other significant impact that was raised by stakeholders in the initial engagement process related to the potential of the project to significantly adversely affect the development of the Lubombo Transfrontier Conservation and Resource Area (TFCA). The strengthening of the border control infrastructure, in particular the upgrading of much of the border to an elephant fence could be considered to be contrary to the wider objectives of the TFCA, which was established to restore the natural movement of fauna, in particular elephant populations between Protected Areas in South Africa and Mozambique as well as South Africa and Swaziland and could thus be considered to be a negative development in the context of cross-border conservation planning.

Re-establishing of free movement of fauna between the TFCAs (Usuthu-Tembe-Futi Corridor; Nsubane-Pongola and Songimvelo-Malolotja) remains a key objective of the TFCA development and is being actively pursued by the governments of South Africa, Mozambique and Swaziland (as per the *General Transfrontier and Resource Area Protocol, 22 June 2000*), with the intention of removing all fencing between the reserve components once the outer boundaries of the reserve components have been adequately secured. The required strengthening of the border fencing to fulfil the mandates of both the SANDF (security) and DAFF (livestock disease prevention) is arguably contrary to the key development outcome for the TFCA and blocks the fulfilling of EKZNW, MTPA and Peace Parks Foundation and the wider South African Government's mandate as specified by legislation (protocols) set up for the development of the TFCAs.

It was in this context of these apparently conflicting mandates that the Applicant hosted a meeting in early July 2018 between the two end users (SANDF and DAFF), EKZNW and representatives from the DEA's Transfrontier Conservation Division in order to find compromises and resolutions for the implementing of the Phase 1 and 2 projects. As an outcome of this meeting a number of resolutions were made that represented a compromise between the organs of state; importantly a resolution was made to replace the elephant fence along the eastern boundary of the Ndumo Game Reserve with a veterinary fence. In the section of the route around the Pongola Nature Reserve the design makes provision for the upgrade of a veterinary fence rather than an elephant fence as this is a TFCA (Nsubane-Pongola) as well.

The DPW has offered to provide assistance with the infrastructural upgrades associated with the amalgamation of the Ndumo Game Reserve with the Usuthu Community Conservation Area (CCA) in order to effectively increase the area under conservation management.

This offer occurred in the context of the Applicant – the DPW's adoption of an 'Integrated Border Management Approach' to the development of the Phase 1 and Phase 2 projects. As part of this integrated approach, the development of the upgraded border infrastructure will not only negate negative impacts on the development of the Usuthu CCA, but rather assist its development.

It is noted that a fundamental understanding is required for the removal of constructed fences especially associated with TFCA and CCAs. There are many ways to plan and deal with areas where fencing may change or be removed in future, however due to uncertainty regarding Protected Area expansion plans and timeframes for implementation, these impacts cannot be adequately quantified and mitigated during this assessment. The DPW should undertake (outside of this EIA process) to support the EKZNW (wherever possible) in conservation initiatives as expansion of conservation areas along the border is a gain for conservation and security and could potentially provide an appropriate contribution to offsets.

10.1.3 Socio-Economic Impacts and Associated Mitigation

Social impacts related to the potential cessation of currently permitted 'informal' movement of people across the border at a number of locations would be able to be prevented by the retention of formal gates to allow cross-border informal movement to continue at these locations.

Other socio-cultural and socio-economic impacts that are anticipated to arise from the project development are largely positive in nature. The project is a large-scale infrastructure development project and will thus generate employment opportunities during the construction phase which will assist inhabitants of the project area to maintain their livelihoods, should local inhabitants be employed by the project. The infrastructure upgrades will also secure vulnerable sections of the border which is currently subject to a high degree of illegal movement of people and stolen goods, in particular stolen and hijacked vehicles. The infrastructure upgrades will enable a number of government departments, in particular the SANDF to more effectively perform their mandate which will assist in the securing of the border area which is subject to high levels of crime, much of which is related to the illegal cross-border activities.

The upgrading of the border fence will also enable South Africa to retain its FMD-free zone status as recognised by the World Organisation for Animal Health (Office International des Epizooties).

10.1.4 Heritage and Paleontological Impacts and Associated Mitigation

The proposed project would have limited negative impacts on archaeological and palaeontological resources in the area provided that the mitigation measures that have been specified to ensure that archaeological or palaeontological resources be documented or protected should these be uncovered in the process of constructing the border patrol infrastructure are adhered to.

10.1.5 Operational Impacts

While construction-related impacts are to be addressed through best management practices and drafting of an Environmental Management Programme (EMPr) for the development project, there are a range of longer-term aspects that need to be addressed to ensure that operational-phase impacts are managed in such a way as to limit impacts on terrestrial and aquatic habitats. Operational-phase environmental impact / risk management and mitigation guidelines include:

- Maintenance of border patrol infrastructure i.e. road, stormwater infrastructure and fence;
- IAP control (must also be built in the Fence Maintenance Plan);
- Maintenance of the border detection zone;
- Erosion control; and
- Wildlife monitoring during patrols.

10.2 Sensitivity Map

The sensitivity maps presented in ***Appendix K*** must be considered when determining if the proposed project should be authorised.

10.3 Summary of Impacts

A summary of the impacts is provided in **Table 62**.

Table 62: Summary of negative and positive impacts

Impacts	Without Mitigation	With Mitigation
Planning Phase		
Impact on fauna and flora, watercourses, Protected Areas	High (-23)	Moderately Low (-5)
Impact on protected fauna and flora	Moderately High (-17)	Moderately Low (-6.5)
Impact on fauna and vegetation in and adjacent to the construction servitude	Moderate (-15)	Low (-3.5)
Impact on watercourses due to improper design of infrastructure	High (-24)	Moderately Low (-6.5)
Construction Phase		
Physical degradation of soils due to removal and compaction	Moderately Low (-5.25)	Low (-2)
Physical degradation due to soil: erosion as a result of exposed soil and topsoil	Moderately Low (-7.5)	Low (-2)
Soil pollution	Moderately Low (-7.5)	Low (-2)
Impacts associated with earthworks i.e. slope stability, cut and filling, construction in problem soils, hard rock etc.	Moderate (-11.5)	Moderately Low (-5)
Groundwater contamination (spillage of fuels, chemicals and lubricants; lack of ablution facilities; wash bay areas)	Moderate (-8.25)	Low (-2.5)
Physical destruction and / or modification of terrestrial habitats	High (-22)	Moderately Low (-7)
Indirect erosion, sedimentation impacts on terrestrial habitats	Moderately High (-15)	Low (-3.5)
Impact on biodiversity connectivity - alteration of ecological processes that are important for the maintenance of terrestrial biodiversity (flora and faunal species)	High (-23)	Moderate (-11.25)
Physical destruction and / or modification of aquatic habitats	High (-21)	Moderately High (-13)
Flow modification and erosion / sedimentation impacts	High (-20)	Moderately Low (-5.5)
Impact on water quality	Moderate (-8.25)	Low (-1.4)
Impact on archaeological (Early Stone Age, Middle Stone Age, Later Stone Age, Rock Art, historical sites) and cultural resources	Moderately High (-16.5)	Low (-1.2)
Impact on graves	Moderate (-11)	Low (-1.2)
Damaging impacts on palaeontological heritage occur during the construction phase which will modify the existing topography	Moderately Low (-5.5)	Low (-1)
Job creation and opportunities	Low (+3.5)	Moderately Low (+5.5)
Proliferation of social ills and issues such as crime, prostitution, the spread of HIV / AIDS, informal settlements etc. Lack of provision of	Low (-4.5)	Low (-3)

Impacts	Without Mitigation	With Mitigation
ablutions that may lead to the creation of 'informal ablutions' within or close to surface water resources		
Socio-economic benefits to the local area due to prevention of illegal cross border activities and the prevention of spread of livestock disease	Moderately Low (+6)	Moderate (+12)
Waste generation (demolished culverts, general construction rubble and hazardous waste (used oil, cement and concrete etc.).	Moderately Low (-7.5)	Low (-2)
Air quality (dust, emissions, odours)	Moderately Low (-7.5)	Low (-3)
Noise pollution from construction vehicles, construction staff and construction activities e.g. excavations, blasting and piling	Moderate (-8.25)	Low (-3.5)
Operational Phase Impacts		
Impacts relating to maintenance activities in terrestrial habitats i.e. proliferation of IAPs, clearance of vegetation to maintain the detection zone	High (-22)	Low (-3.5)
Indirect erosion, sedimentation and pollution impacts on terrestrial habitats	Moderately High (-15.75)	Low (-4)
Fauna trapped in fences, fragmentation of habitats, impeded mobility of wildlife, e.g. from accessing drinking water	Moderately High (-16.5)	Moderately Low (-7)
Positive impact on biodiversity features (especially within Protected Areas) by ensuring reduced occurrences of illegal activities such as poaching etc. removal of fences (e.g. TFCAs and merging of the Ndumo Game Reserve and the Usuthu CCA)	Moderately Low (+16)	Moderate (+8)
Impacts relating to maintenance activities in aquatic habitat i.e. proliferation of IAPs, clearance of vegetation to maintain the detection zone	Moderately High (-15)	Low (-4)
Flow modification, erosion / sedimentation impacts	Moderate (-9.75)	Low (-4.5)
Water quality	Moderately Low (-5)	Low (-1.2)

10.4 Conclusion and Recommendations

The BA Study has been undertaken in accordance with the EIA Regulations 2014 (as amended in 2017) in terms of Section 24(5) of the National Environmental Management Act (Act No. 107 of 1998) (as amended).

In order to protect the environment and ensure that the proposed project is constructed and operated in an environmentally responsible manner, there are a number of significant environmental legislation that have been taken into account during this study. These included:

LEGISLATION
The Constitution of South Africa (No. 108 of 1996)
National Environmental Management Act (Act No. 107 of 1998) (as amended) and EIA Regulations 2014 (as amended in 2017)
National Environmental Management: Waste Act (Act No. 59 of 2008) (as amended)
National Environmental Management Biodiversity Act (Act No. 10 of 2004)

LEGISLATION
National Environmental Management: Protected Areas Act (Act No. 57 of 2003) and Regulations GN R1061 of 28 October 2005: Regulations for the proper administration of Special Nature Reserves, National Parks and World Heritage Sites
National Environmental Management: Air Quality Act (Act No. 39 of 2004)
National Water Act (Act No. 36 of 1998) (as amended)
National Forests Act (Act No. 84 of 1998)
National Heritage Resources Act (Act No. 25 of 1999)
Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)(as amended)
KZN Nature Conservation Ordinance (Ordinance No.15 of 1974)
Mpumalanga Nature Conservation Act (Act No. 10 of 1998)
Hazardous Substance Act (Act No. 15 of 1973) and Regulations
Occupational Health and Safety Act (Act No. 85 of 1993)
Construction Regulations (2014)
World Heritage Convention Act, 1999 (Act No. 49 of 1999) and regulations
Spatial Planning and Land Use Management Act, 2013 (Act 16 of 2013)
General Trans-Frontier Conservation and Resource Area Protocol (22 June 2000)
Lubombo Ndumu-Tembe-Futi Transfrontier Conservation and Resource Area Protocol (22 June 2000)
Lubombo Pongola-Nsubane Transfrontier Conservation and Resource Area Protocol (22 June 2006)

This relevant legislation has informed the identification and development of appropriate management and mitigation measures that must be implemented in order to minimise potentially significant impacts associated with the project.

The conclusions of this cBAR including preliminary comments and concerns from I&APs and stakeholders are as a result of a comprehensive BA study undertaken over a period of ??? prior to lodging this draft CBAR for comments.

10.5 Assumptions, Uncertainties or Gaps in Knowledge

10.5.1 Basic Assessment Study

The BA process followed the legislated process required and as governed and specified by the EIA Regulations 2014 (as amended in 2017). Inevitably, when undertaking scientific studies, challenges and limitations are encountered. For this specific BA, the following challenges were encountered:

- All information provided by the Engineering team to the EAP was correct and valid at the time it was provided.
- The environmental assessment has been conducted on preliminary route design.
- The EAP does not accept any responsibility in the event that additional information comes to light at a later stage of the process.
- All data from unpublished research is valid and accurate.

- The scope of this investigation is limited to assessing the potential environmental impacts associated with the upgrading or development of border control infrastructure (border patrol road, fencing, as well as certain sections where quad bike tracks and footpaths will be developed) and detour roads **along the Phase 2 section (km 54 – km 524) only**.

In addition to the assumptions above, the following assumptions and limitations were noted by the specialist team.

10.5.2 Freshwater Habitat Assessment

- The freshwater report deals exclusively with a defined area and the extent and nature of freshwater / aquatic ecosystems in that area.
- The field assessments focused on prioritised wetlands as per the prioritisation methodology outlined in the freshwater report for the wider (Phase 2) project.
- Sampling by its nature, means that generally not all aspects of ecosystems can be assessed and identified.
- Soil samples and vegetation indicators were often inconclusive in determining the outer boundary of the wetlands onsite in some of the field assessment locations due to extensive historic and on-going disturbance of soils caused by agricultural practices.
- With ecology being dynamic and complex, there is the likelihood that some aspects (some of which may be important) may have been overlooked.
- While disturbance and transformation of habitats can lead to shifts in the type and extent of freshwater ecosystems, it is important to note that the current extent and classification is reported.
- Infield soil sampling and vegetation observations were only undertaken at strategic sampling points within the habitats likely to be negatively affected. Between sampling points the outer boundary had to be extrapolated using aerial photography and as such the accuracy of such extrapolated sections has limitations and is open to the interpretation of the assessor / delineation practitioner.
- The accuracy of the delineation is based solely on the recording of the onsite wetland indicators using a GPS. GPS accuracy will therefore influence the accuracy of the mapped sampling points and therefore water resource boundaries and an error of 3 – 5m can be expected.
- All vegetation information recorded was based on the onsite observations of the author and no formal vegetation sampling was undertaken. Furthermore, the vegetation information provided only gives an indication of the dominant and / or indicator riparian species and only provides a general indication of the composition of the vegetation communities. Thus, the vegetation information provided has limitations for true botanical applications i.e. accurate and detailed species lists and rare / Red Data species identification.
- Infield soil and vegetation sampling was only undertaken within a specific focal area in the vicinity of the proposed development, while the remaining water resource / HGM units were delineated at a desktop level with limited accuracy.
- The nature and physical properties of certain soil types in the study area presents difficulties for wetland boundary delineation utilising the standard delineation methodology for wetlands in South Africa (DWAF, 2005).
- Inferences made about the ecological integrity / health of the wetlands / rivers assessed were based on selected variables, sampled on selected occasions at selected geographic locations. This limits the degree to which this information can be extrapolated spatially and temporally (i.e. over seasons). Wetlands by nature can be highly variable ecosystems and can display fine and large scales changes in the structure, composition and quality of the habitat over periods of time.
- No wetland fauna sampling or faunal searches were conducted. The assessment was primarily habitat-based.
- The site was surveyed in late summer and early autumn (February to April 2017). The field surveys therefore do not cover the full seasonal variation in conditions for the entire site. However, seasonality

is not such an issue for the target study area as the field surveys were conducted during the growing season. In addition the need for comprehensive seasonal surveys is not warranted.

- The PES and EIS assessments undertaken are largely qualitative assessment tools and thus the results are open to professional opinion and interpretation. Effort has been made to substantiate all claims where applicable and necessary.
- It should be noted that while WET-Health (Macfarlane et al., 2008) is the most appropriate technique currently available to undertake assessments of wetland condition / integrity, it is nonetheless a rapid assessment tool that relies on qualitative information and expert judgment. While the tool has been subjected to an initial peer review process, the methodology is still being tested and will be refined in subsequent versions. The health assessment was undertaken based on field assessment for all of the wetlands assessed, and is based on observations of the wetland within a 500m radius of the border line and not the entire wetland.
- The setting of the hypothetical reference state for wetland and riverine nits assessed was extremely difficult in certain cases due to the transformed and modified nature of certain of these systems and a lack of information regarding reference state. Therefore, the reference states presented should be considered speculative with a low level of confidence in certain situations.
- The Ecological Importance and Sensitivity assessment did not specifically address all the finer-scale biological aspects, including detailed faunal biodiversity assessments.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the field survey and based on the assessor's working knowledge and experience with similar projects.
- Evaluation of the significance of impacts with mitigation takes into account mitigation measures provided in this report.

10.5.3 Terrestrial Ecological Assessment

- This report deals exclusively with a defined area and the extent and nature of the vegetation and habitat / ecosystems in that area. This included a 50m wide corridor of the proposed border patrol road and proposed fence control boundary. In most instances, this corridor is measured from the fence control boundary moving into South Africa. Only a width of about 2m within Swaziland and Mozambique was included in the assessment corridor.
- Sampling by its nature means that generally not all aspects of ecosystems can be assessed and identified.
- With ecology being dynamic and complex, there is the likelihood that some aspects (some of which may be important) may have been overlooked.
- Given limited time in the field and access problems, not all vegetation communities were visited in the field, and for those that were visited only limited information was documented such as dominant species, conservation important plants and fauna, level of IAP infestation and the condition of the vegetation community.
- Rapid sampling and vegetation / habitat assessment methods were used due to time and budget constraints. Thus formal vegetation plots and detailed vegetation/habitat sampling and analyses were not undertaken, limiting the resolution of the information captured and produced in this study.
- Areas that were not ground-truthed / verified in the field were assessed at a low level of confidence.
- Field assessments of the border infrastructure were undertaken late in the summer / growing season (March to April 2017) and winter flowering cryptic forbs may have therefore been over-looked. The assessment therefore does not cover the full seasonal variation in conditions in the area of study.
- The locations of individual specimens of protected species were not recorded. Instead a general location of the site was recorded to which protected plants can be referenced to. GPS accuracy was limited to 3 – 5m and recording points beneath tree cover is likely to have further reduced GPS accuracy.

- Information on the threat status of plants species was informed largely by the SANBI Threatened Species Online database, which was assumed to be up to date and accurate at the time of compiling this report. Any changes made after the compilation of the report are therefore not covered.
- While an assessment of the potential occurrence of flora species of conservation concern has been undertaken, and is informed by readily available information, this provides only a surrogate indicator of the likelihood of such species occurring.
- No detailed survey of fauna was conducted during this assessment. Any fauna documented in this report are based on site observations during a limited time spent in the field and do not reflect the overall faunal composition of the site. It is assumed that based on the nature of the project, that faunal impacts are likely to be limited.
- Habitat condition and structure was used as a surrogate to assess habitat sensitivity from the perspective of harbouring conservation important species of flora and fauna, in the absence of detailed floral surveys and faunal surveys, with intact habitat / vegetation considered to be more ecologically important and sensitive in this regard in comparison to degraded/transformed habitat.
- Due to the complexities of ecological systems and the sensitive dependence on initial conditions, any predictions of the effects of perturbation are made with low confidence.
- All calculations of areas to be transformed are based on agreed construction footprints for different components of the proposed development.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the vegetation field surveys and based on the assessor's working knowledge and experience with similar development projects.
- Additional information used to inform the assessment was limited to data and GIS coverage's available nationally and for the province of KZN at the time of the assessment.

10.5.4 Heritage

- Available heritage databases are incomplete. Large parts of study area have never been surveyed from a heritage perspective.
- Given the abundance of archaeological sites within 10km from the northern and western sections of the study area, it can be expected that such will also occur within the near vicinity of the proposed border road.
-
- The existing data bases are biased in terms of prehistoric archaeological sites. Historical period sites and cemeteries have not been recorded and do not appear on any existing database. Sites belonging to African-on-African conflict as well as 'living heritage sites' need to be researched and added to available databases.
- The project area has never been systematically surveyed for other categories of cultural heritage. It is expected that such systematic surveys will produce more sites especially in the categories of struggle-era and 'living heritage' sites.
- Large sections of the project are flanked by mountains and hilly terrain that may yield shelters with Rock Art and Stone Age deposits. However, the survey was limited to distances of no more than 50m beyond existing roads. Given this survey methodology promising areas that may have contained Rock Art and later Stone Age sites were not covered.

10.5.5 Palaeontology

- The accuracy of Palaeontological Desktop Impact Assessments is reduced by old fossil databases that do not always include relevant locality or geological formations. The geology in various remote areas of South Africa may be less accurate because it is based entirely on aerial photographs. The accuracy of the sheet explanations for geological maps is inadequate as the focus was never intended to be on palaeontological material.

- The entire extent of South Africa has not been studied palaeontologically. Similar Assemblage Zones but in different areas might provide information on the presence of fossil heritage in an unmapped area.
- Desktop studies of similar geological formations generally assume that unexposed fossil heritage is present within the development area.

10.6 Recommendations

10.6.1 Recommendations to the Competent Authority

This cBAR provides an assessment of both the potential negative impacts and benefits and anticipated as a result of the proposed project. The approach to impact mitigation was in line with the principles of the mitigation hierarchy and a number of steps were taken to ensure that impacts could be avoided or minimised as far as possible through pre-construction planning and design, sensitivity assessments, realignment recommendations and conceptual design recommendations.

Table 63: Key impact mitigation measures provided at various stages of the assessment process in line with the mitigation hierarchy

Tier of mitigation hierarchy	Impact mitigation recommendation provided as part of this assessment	Relevant report / document / report chapter
Avoid or prevent Pre-construction planning and design phase mitigation	Provision of best practice conceptual watercourse crossing design recommendations.	*Pre-Construction Planning and Design Phase Recommendations for River Crossings (**Appendix B1**)*
	Desktop Ecological Sensitivity Screening to inform route alignments and the avoidance of sensitive aquatic and terrestrial environments.	*Proposed Swaziland Border Patrol Road: Desktop Aquatic and Terrestrial Ecological Sensitivity Assessment (**Appendix B2**)*
	Provision of desktop realignment options to avoid sensitive aquatic and terrestrial environments.	*Swaziland Border Patrol Road: Review of Road Realignment Options (**Appendix B3**)*
	Following field visits site specific realignments and infrastructure design recommendation were made, including: • Provision of site specific realignment options to avoid sensitive aquatic and terrestrial environments informed by site investigations. • Provision of a borrow pit screening assessment to inform the environmentally sensitive selection of borrow pits. • Provision of conceptual site-specific watercourse crossing design recommendations based on field investigations.	*Proposed Upgrading of The Border Patrol Road Between South Africa, Swaziland And Mozambique & Associated Quarrying Activities: Preliminary Freshwater and Terrestrial Habitat Assessment Report to Inform Re-alignments and No-Go Alternatives (**Appendix B3**)*
	• Road embankment design recommendations. • Stormwater management recommendations. • Wetland crossing design considerations. • Site-specific specialist Input into Final Crossing Design and Implementation.	*Table 51 of this report.*

Tier of mitigation hierarchy	Impact mitigation recommendation provided as part of this assessment	Relevant report / document / report chapter
Minimise Best practise construction and operation phase mitigation	Best practice construction phase mitigation measures including construction method statement for key activities with watercourses.	*Table 55 and EMPr (**Appendix J**)*
	Best practice operation phase mitigation measures.	*Table 55 and EMPr (**Appendix J**)*
	Provision of monitoring guidelines.	*EMPr (**Appendix J**)*
Rehabilitate	Provision of rehabilitation method statements.	*Proposed Border Patrol Road, Fence & Obstacle Barrier between South Africa, Swaziland and Mozambique within the KwaZulu-Natal & Mpumalanga Provinces: Conceptual Post-Construction Rehabilitation Plan for Aquatic Habitats (EMPr – **Appendix J**)*
Offset	Provision of preliminary offset calculations and recommendations.	*Section 9.5 of the Aquatic Habitat Assessment (**Appendix C3**) and Section 8 of the Terrestrial Habitat Assessment (**Appendix C2**)*

The project is a critical strategic importance on a national level and forms part of the National Government's obligations to secure the borders of South Africa and to protect its citizens from illegal activities as well as disease control. Therefore, the EAP recommends that the development / upgrading of the proposed infrastructure be authorised.

The findings conclude that there are potential negative impacts as highlighted in ***Section 9*** that can be mitigated provided that the recommended mitigation and management measures contained within the EMPr (***Appendix J***) are implemented.

The project, in the EAP's opinion, does not (for the majority of the project) pose a detrimental impact on the receiving environment and it inhabitants and can be mitigated significantly and where impacts cannot be mitigation a recommendation for offsets have been made. **Therefore, the EAP recommends the development / upgrading of proposed infrastructure associated with the Planning and Design for the Maintenance of the Patrol Roads and Fencing on the borders between South Africa, Swaziland and Mozambique be authorised.**

Construction is expected to take place in phases, based on current security risk and associated prioritisation. Construction will likely commence in May 2019 and, depending on the phasing and budgetary cycles, could continue for a number of years. An EA with a validity of 10 years is recommended.

The Applicant must be bound to stringent conditions to maintain compliance and a responsible execution of the project.

In order to achieve appropriate environmental management standards and ensure that the findings of the environmental studies are implemented through practical measures, the recommendations from this BA study are included within an EMPr (refer to ***Appendix J***).

The EMPr must be used to ensure compliance with environmental specifications and management measures.

The implementation of this EMPr for the construction and post-construction (rehabilitation) phase of the project is considered to be vital in achieving the appropriate environmental management standards as detailed for this project.

In addition, the following key conditions must be included as part of the authorisation:

a) The Applicant / Developer is not negated from complying with any other statutory requirements that is applicable to the undertaking of the activity. Relevant key legislation that must be complied with by the proponent includes *inter alia*:

- Provisions of the National Environmental Management Waste Act (Act No. 59 of 2008) (as amended);
- Provisions of the National Water Act, 1998 (Act No. 36 of 1998) (as amended);
- Provisions of the National Forests Act (Act No. 84 of 1998);
- Provisions of the National Environmental Management: Protected Areas Act (Act No. 57 of 2003) – NEM: PAA;
- Provisions KwaZulu-Natal Nature Conservation Ordinance (Ordinance No. 15 of 1974); and
- Mpumalanga Nature Conservation Act (Act No. 10 of 1998).

b) The Applicant / Developer must appoint a suitably experienced Environmental Control Officer (ECO) for the construction phase of the development that will have the responsibility to ensure that the mitigation / rehabilitation measures and recommendations are implemented and to ensure compliance with the provisions of the EMPr.

c) All supporting plans e.g. Spill Contingency Plan, Conceptual Stormwater Management Plan, Rehabilitation Plans (Terrestrial and Aquatic Habitat), Invasive Alien Plant Eradication and Control Method Statement) and Conceptual Construction Method Statements included in the EMPr must be complied with.

d) Plant search and rescue exercise: This entails:

iv. An ecologist undertaking site visits to target vegetation communities to record and count the number of protected plants and vegetation communities requiring a plant permit from EKZNW and MTPA or a licence from the provincial DAFF;
v. Compilation of a threatened and protected plant relocation and replacement protocol and
vi. Supervising the plant relocation or replacement exercise.

e) Conservation-important fauna search and recovery exercise: Due to the sheer extent of the project and the uncertainty in implementation, a search and recovery / walkthrough process before construction is strongly recommended for biodiversity "hotspots" based on the outcomes of the desktop fauna POC assessment. Most of the grassland, forest and wetland habitats with more intact vegetation could potentially harbour Red Data listed fauna and these areas will need to be the focus of search and recovery exercises. A programme to undertake such an exercise should be developed and implemented prior to construction commencing on sections of new road / fence. This can be structured and undertaken in a phased-manner and aligned with the construction programme.

f) Pre-construction selection of site camps: the ecologist and ECO must be consulted to authorise the placement of construction camps and lay-down areas within the assessed 50m assessment corridor / study area.

g) Detailed Post-construction Rehabilitation Plan: A detailed Post-construction Terrestrial Vegetation / Habitat and Freshwater Resources Rehabilitation must be developed based on the guidelines provided in the conceptual rehabilitation plans. The plan must address the following issues in order to be implementable at the site level:
   vi. Identification and estimation of the location and extent of areas requiring revegetation;
   vii. Development of a detailed planting strategy and planting method (with spacing and densities) that is specific to different vegetation communities and sub-communities;
   viii. Review and finalisation of methods and equipment for IAP clearing;
   ix. Review and finalisation of slope / soil stabilisation measures and resources based on slope and soil types; and
   x. Bill of quantities and costs for all interventions (including re-vegetation).

h) Decision on biodiversity offset requirements: A preliminary assessment of potential offset requirements suggests that biodiversity offsets may be warranted for this development project, given the potentially large extent of permanent transformation of threatened vegetation types involved. An Offset Framework will need to be drafted during the detail design phase. Careful consideration needs to be given to ensure that that nett gains also be taken into account, such as improving the existing infrastructure with suitable stormwater management, introducing crossing where structures are inadequate etc. Given that the significance of impacts is likely to be higher in KZN, there could be a motivation to focus such an intervention in KZN although this would need to be discussed with the relevant conservation bodies. The extent of the area to target, together with the mechanisms and cost implications for doing so, will need to be investigated once confirmation for the need for an offset has been obtained from the regulating authorities.

i) All necessary permits, licences and approvals must be obtained prior to the commencement of construction.

j) A Phase Two Heritage Impact Assessment will be necessary in order to initiate a grave exhumation and reburial process – where necessary. This process will also include the application of a permit from the relevant Provincial Heritage Agency and extensive community consultations.

k) The specifications of the EMPr with respect to the following must be strictly adhered to:
   i. The procedure and environmental mitigation measures in the event of phasing (different timing) of infrastructural components;
   ii. The pre-construction assessment and ECO approval of the construction camp layouts, in consultation with the EKZNW and MTPA;
   iii. The pre-construction compilation of a species-specific alien plant management plan that covers both the construction and operational phases of the development; and
   iv. The compilation of an Operational Maintenance Management Plan and adherence to this plan.

l) All infrastructure configurations as detailed in this report must be strictly adhered to, in particular the infrastructure in the highly environmentally sensitive parts of the route. In such areas where the application corridor and servitude have been narrowed, no development beyond the narrowed application corridor must be permitted.

10.6.2 Recommendations to the Applicant / Developer

The Applicant / Developer must adhere to the recommendations provided by the specialists and the EAP. The EMPr summarises these recommendations. The Applicant / Developer must take full responsibility for

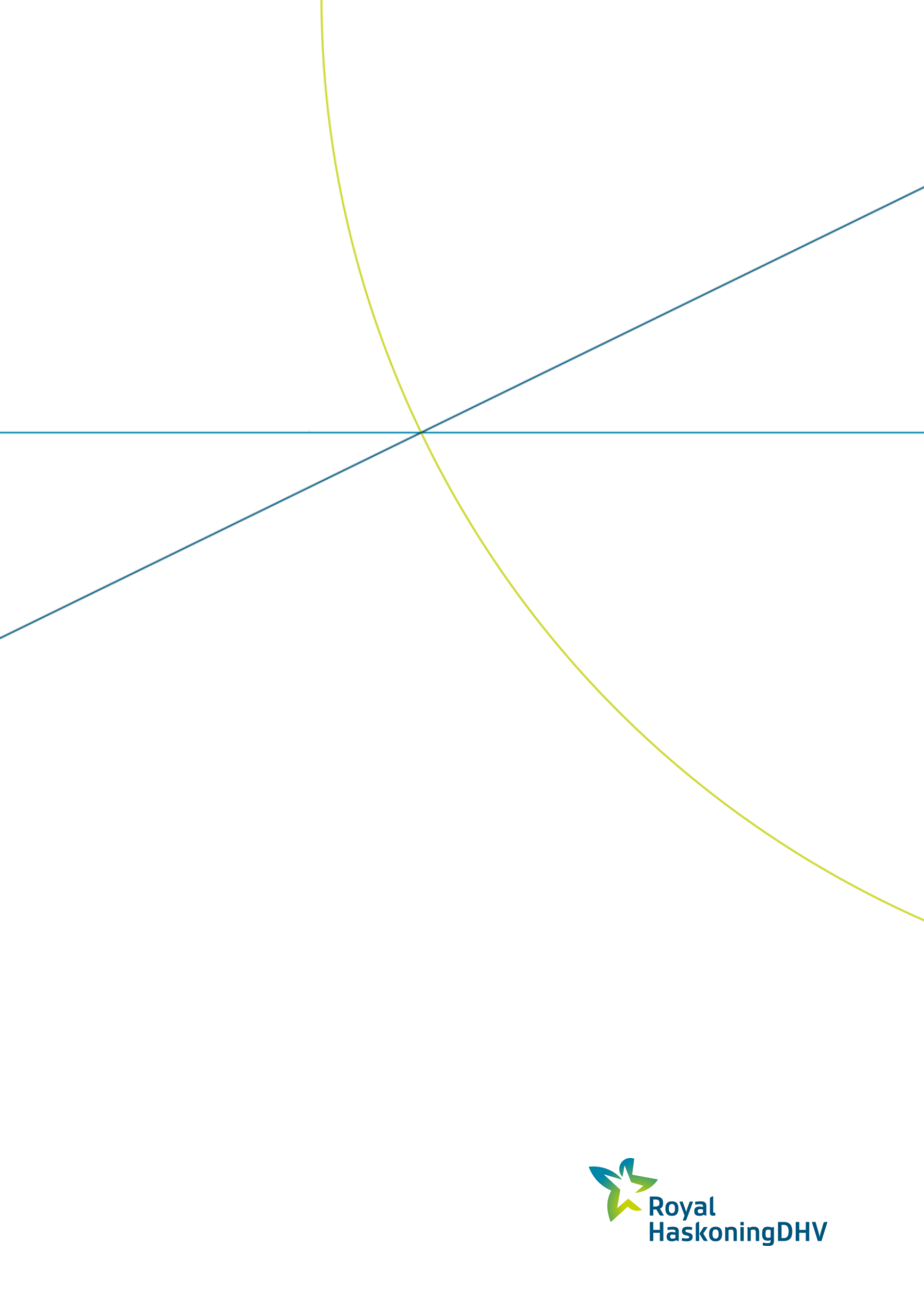
the execution of the project in a manner which does not negatively impact on the environment by ensuring that responsible decisions are made.

10.7 Declaration by the EAP

The following is hereby affirmed by the EAP to be included in this report:

- the correctness of the information provided in the reports;
- the inclusion of all comments and inputs from stakeholders and I&APs;
- the inclusion of all inputs and recommendations from the specialist reports where relevant; and
- any information provided by the EAP to I&APs and any responses by the EAP to comments or inputs made by interested and affected parties.

Signed: Prashika Reddy *Pr.Sci.Nat.*



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