8 IMPACT IDENTIFICATION

8.1 Introduction

As required in section 31(2) of the NEMA Regulations, 2010, this section includes a description of the manner in which the biophysical, social, economic and cultural aspects of the environment may be affected by the proposed activity as well as a description of the environmental issues that were identified during the impact assessment process.

8.2 Topography

8.2.1 Potential Impacts

Disruption or modification of physical landforms to some degree is the most readily noticeable impact associated with the construction of any infrastructure. The direct impact on landforms with the establishment of a powerline is mainly one of disruption of surface soils and vegetation which can result in a change in surface water drainage and therefore can result in erosion.

The study area can be described as slightly undulating to strong undulating plains with high mountains. The construction of the power lines along the route corridors would not result in a major change in the topography of the area. Impacts of the project on the topography are anticipated to be localised and restricted to the foundation areas and are expected to be more dominant during the construction phase of the powerline particularly with respect to the construction of tower foundations and access roads. The anticipated impacts would be of low to medium significance

8.2.2 Recommended Mitigation and Management Measures

The following mitigation and management measures are considered applicable:

- The contractor must ensure that adequate measures are put into place to control surface water flows across and around the site during foundation preparation.
- Areas susceptible to erosion must be protected by installing the necessary temporary and/or permanent drainage works as soon as possible. Areas susceptible to erosion must also be rehabilitated (re-vegetated) as quickly as possible.
- Any erosion channels developed during the construction period or during the vegetation establishment period shall be backfilled and compacted, and the areas restored/rehabilitated to a proper condition.
- All cleared areas will be promptly rehabilitated and in accordance with specific instructions from the Construction Manager.

- Soil must be exposed for the minimum time possible once cleared of invasive vegetation. The timing of clearing and grubbing must be co-ordinated as much as possible to avoid prolonged exposure of soils to wind and water erosion.

More detailed mitigation and management measures can be found in the Environmental Management Programme included in **Appendix E**.

8.3 Soil and Agricultural Potential

The Agricultural Report has been included in **Appendix K.**

8.3.1 Potential Impacts

The impacts involved in the construction of a power line, substation and associated infrastructure (especially the power line access road) can be severe. The two main aspects are:

- **Loss of agricultural land due to the construction activities**

This is especially important in areas where high potential land, either for dryland or irrigated cultivation, exists. The prevailing climatic restrictions in the study area make such potential impacts unlikely on a widespread scale, although small areas of irrigation are visible on the Google Earth image at several places along one or other of the routes.

- **Increased soil erosion, due to removal of surface vegetation**

The main area where this may be applicable would be the construction of an access road along the power line route. Due to the fact that there are significant areas with steep topography (mainly in the Soutpansberg mountain belt), there is a definite potential for serious soil erosion to occur.

8.3.2 Recommended Mitigation and Management Measures

The following mitigations measures are recommended with regards to the above mentioned impacts:

- Avoid intensively cultivated areas (especially those under irrigation) wherever possible.
- Minimize the removal of vegetation wherever possible. In areas where steep topography is unavoidable, road construction measures, such as culverts, berms, cut-off drains etc should be taken to minimize surface run-off. If possible, the steepest sloping areas should be surfaced (concrete or tar) and stabilized to avoid deterioration over time

The following additional mitigation measures are recommended for topsoil management:

- Topsoil[6] will be sourced from areas which are cleared for construction and spoil dumps, conserved and used judiciously in the rehabilitation of disturbed land.
- The Contractor is required to strip topsoil together with grass from all areas where permanent or temporary structures are located, construction related activities occur, and access roads are to be constructed. Topsoil must be stockpiled for later use.
- Topsoil is to be handled twice only - once to strip and stockpile, and secondly to replace, level, shape and scarify.
- Topsoil must not be compacted in any way, nor should any object be placed or stockpiled upon it. No vehicles may be allowed access onto the stockpiles after they have been placed
- Land to which topsoil has been applied will be vegetated as soon as possible after application.

The following recommendations are made in terms of preferred tower alternatives:

- Guyed "V" or guyed suspension towers can be utilised in areas where grazing or game farming are the main activities, due to the fact that the footprint of the tower is smaller.
- Self supporting towers are recommended in areas where cultivated lands and orchards are found due to the fact that there are no guy ropes.

More detailed mitigations measures with regards to soil management in general are included in the EMPR (**Appendix E**).

8.4 Geology

8.4.1 Potential Impacts

Geological issues that should to be taken into consideration are as follows:

- Due to inaccessibility by road some construction will have to be carried out across the mountains with the assistance of helicopters;
- The positioning and construction of pylons and anchors placed in areas with steep mountain slopes must be carefully considered in order to avoid long term erosion problems;
- Impacts related to the pollution of geological features in case of spillage/leakage of hydrocarbon and other hazardous material from storage facilities have been identified as having a medium significance.

[6] Topsoil is defined as the top layer of soil that can be mechanically removed to a depth of about 100mm without ripping or blasting.

For the erection of most structures it is generally possible to overcome a geological barrier it is only a matter of design and associated costs. Base line geology will however only be sufficient to plan the route and mitigate the construction cost of a power line where it is founded on un-weathered material, such as is generally found in the mountainous section of route.

Special emphasis should be placed on accessibility of inter alia agricultural lands and mountains. Due to the specialised type of work the real impact of the geotechnical conditions will have to be assessed after the decision has been taken regarding the different alternatives and the route has been finalised.

8.4.2 Recommended Mitigation and Management Measures

- Relevant geotechnical studies should be undertaken where necessary;
- Areas susceptible to erosion must be protected by installing the necessary drainage works as soon as possible.
- Any erosion channels developed during the construction period or during the vegetation establishment period shall be backfilled and compacted, and the areas restored to a proper condition.
- Any spills will be rendered harmless and arrangements made for appropriate collection and disposal including cleaning materials, absorbents and contaminated soils.

More detailed mitigation and management measures can be found in the Environmental Management Programme included in **Appendix E**.

8.5 Flora

The Flora Report has been included in **Appendix L**.

8.5.1 Potential Impacts

- ***Tab-Nzh 1***
    - Low impact on vegetation as the corridor follows and existing power line and there is an existing servitude which might need to widened by a few metres;
    - There are existing access roads with Eskom installed gates;
    - The number of pylons might have to be increased as the route gets narrow between the mountains. The stepper the route with more turning points will necessitate more pylons and strain towers;
    - Only approximately 5% of the route needs new access roads.

- ***Tab-Nzh 1a***
    - Low impact on vegetation
    - Follows existing power line and servitude which will need to be widened;
    - Existing access roads.

- ***Tab-Nzh 1b***
  - Low impact on vegetation;
  - Follows existing power line and servitude which will need to be widened;
  - Existing access roads;

- ***Tab-Nzh 2***
  - Corridor will have low impact on vegetation as most of the area is highly impacted;
  - There is an existing power line and servitude which will need to be widened;
  - Follows an existing railway line;
  - Bush encroachment was also observed on this route and thus the biodiversity has decreased over this area.

- ***Tab-Nzh 3***
  - Corridor will have a high impact on vegetation, the area is pristine with Nature Reserve;
  - There are no access roads, creating new roads requires vegetation clearance;
  - High in biodiversity;
  - Crosses the Ben Lavin nature reserve.

- ***Tab-Nzh 4***
  - Impact will be high along the ridge ;
  - The narrow ridge through the Waterpoort is high in biodiversity;
  - The Waterpoort ridge is highly inaccessible and new roads of extreme length will have to be constructed;
  - There is an access road on the south and the north of the Waterpoort ridge along the railway line;
  - More pylons will have to be erected due to the undulate terrain that will necessitate turns and bends that will mean heavier construction methods and stronger towers. Tower sites will have to stabilised which in turn mean bigger sites;

- ***Tab-Nzh 5***

  - The corridor will have a high impact due to no access for most part of the route;
  - The area is virtually undisturbed and houses a lot of protected plant species;
  - There are no access roads
  - No linear infrastructure in this area;
  - The area is flat to undulate and fewer pylons will have to be constructed.

8.5.2 Recommended Mitigation and Management Measures

- ***Vegetation clearance***
  - Prior to construction and vegetation clearance a walk through of the preferred alignment should be undertaken by a suitable qualified botanist to provide site specific mitigatory measures as well as closely examine the proposed tower/pylon footprint areas for any red data species or species of special concern etc.
  - After vegetation clearing, re –growth must be allowed to occur and shall be cut within 50 mm of the ground and the vegetation is not to be disturbed after initial clearing. Indigenous vegetation which does not interfere with the safe construction and operation of the power line should be left undisturbed.
  - Existing access roads along the existing servitude should be used as far as possible, for access during construction and operations. Clearing for pylon positions must be the minimum required for the specific tower, not more than a 5m radius around the structure position (Eskom- TRMAGAAZ7)

- ***Control of invasive/alien vegetation***
  - Alien vegetation in servitudes shall be managed in terms of the Regulation GNR.1048 of 25 May 1984 (as amended) issued in terms of the Conservation of Agricultural Resources Act, Act 43 of 1983. Weeds and invasive vegetation should be removed prior to construction activities preventing spreading into newly disturbed areas or areas cleared of vegetation. Alien plant species that invade disturbed soils around the newly erected pylons must be controlled. This should be done in such a way as to allow the natural grasses to colonise the disturbed area, thereby keeping the aliens at bay. No chemical control to be used in the control of alien plants or indigenous plants (Eskom-TRMAGAAZ7))

- ***Soil erosion***
  - Access roads and site surfaces must be monitored for deterioration and possible erosion during construction and operations and eroded area must be rehabilitated. All areas susceptible to erosion must be installed with temporary and permanent diversion channels and berms to prevent concentration of surface water and scouring of slopes and banks, thereby countering soil erosion.
  - All vehicle movement must be along the existing access roads. Surface area under power lines to be mowed and not ploughed. Disturbed surface areas in the construction phase to be restored. No mounds of soils created during construction to be left. After completion of the project all disturbed sites and surfaces to be restored.
  - The use of permitted access roads only at all times during construction and operations will play a big role in ensuring that the vegetation re growth can be successful and the area outside the servitude can be rehabilitated. All the above mentioned mitigation measures needs to be implemented to the core to ensure

that there is no further unnecessary damage or disturbances to the flora/vegetation.

More detailed mitigation and management measures can be found in the Environmental Management Programme included in **Appendix E**.

8.6 Fauna

The Fauna Report has been included in **Appendix J**.

8.6.1 Potential Impacts

- ***Tabor – Nzhelele 400kV Powerline***

The proposed 400kV Tabor to Nzhelele transmission alignments bisect several sensitive environments including the Manavhela Ben Lavin Nature Reserve, the Soutpansberg Conservation area, rivers (Sand, Doring and Mutmaba) as well as several non-perennial drainage lines, seasonally inundated pans as well as large open bushveld areas especially to the north of the Soutpansberg in several private game and hunting farms.

The preferred alignments from a faunal perspective include the Alternative 2 alignment from the Tabor Substation as it follows an exiting railway line reserve as well as the N1. Alternative 1b is the preferred alignment towards Makhado and the Soutpansberg as it is mainly situated within transformed habitats as well as not bisecting the Manavhela Ben Lavin provincial nature reserve. There are only two alternative alignments over the Soutpansberg Conservation area. Alternative 4 to the west of Makhado follows an existing railway line as well as the Sand River through the Sand River Gorge. This is not the preferred alignments due to the sensitivity of the adjacent environment. The preferred alignment is Alternative 1 immediately to the east of the N1 and Makhado as sections of the alignment are situated within transformed and degraded vegetation units. Ideally the alternative 1 alignment should be realigned to avoid the small patch of Northern Mistbelt Forest as this provides suitable habitat for several threatened faunal species including the "Endangered" Northern Forest Rain Frog (*Breviceps sylvestris*). The alternative 1 alignment follows an existing Powerline servitude through the Soutpansberg Conservation area. The preferred alignment to the north of the Soutpansberg towards the Nzhelele substation is the Alternative 1 alignment. Alternative 1a is not preferred as Alternative 1 is situated in close proximity to the N1 and the cleared servitude could potentially be utilised for a fire-break.

The construction of the proposed Tabor-Nzhelele 400kV Transmission line will most-likely result in limited (55m) opening-up of the vegetal cover during the construction phase. The opening up of existing vegetated areas, thereby creating corridors along which animals can move, may result in increased predation levels on small mammals, reptiles, amphibians, arachnids and scorpions along these corridors. The limitation of the disturbance of vegetation cover as well as rocky outcrops, logs, stumps, termite mounds within sensitive areas will ameliorate this impact. Impact will be short-long term depending on the amount of vegetation to be cleared. Excessive habitat destruction during construction could reduce the amount of habitat available. This impact is anticipated to be localised, of a long-term nature and of medium significance, provided that appropriate mitigation measures are implemented (e.g. the limitation of vegetation clearance within sensitive areas).

Prior to construction and vegetation clearance a suitably qualified zoologist (herpetologist) should conduct a walk down of the preferred alignment and closely examine the proposed tower/pylon construction areas (concrete supports) for the presence of any animal burrows (including spiders and scorpions), rocky outcrops, logs, stumps and other debris and relocate any affected animals to appropriate habitat away from the servitude or tower.

The alteration of vegetation and habitats in the proposed 55m servitude will impact on the fauna directly within the proposed route and potentially in the immediate surrounding area. It is imperative that minimal vegetation clearance and disturbances should occur along the proposed alignment. Vegetation clearance should be restricted to the actual transmission line servitude (55m) and not into adjacent bushveld areas. As certain sections of the proposed transmission line is situated on a sloping gradient; erosion/siltation preventative measures must be implemented throughout all phases of the project. In addition, the increased human density, heavy construction machinery and vehicles will most likely directly and indirectly result in the short-long term alteration of the faunal composition on the site and surrounding areas. Loss of habitat for foraging, reproduction and shelter will most severely impact on the smaller sedentary species (insects, arachnids, reptiles, amphibians and mammals).

- ***Proposed New Access and Maintenance Roads***

The proposed new access road situated adjacent to Alternative alignment 1 follows an existing track adjacent to agricultural and forestry activities for the majority of the alignment. As a precautionary measure prior to the construction of the new access road a walk through of the entire road footprint should be undertaken by a suitably qualified zoologist in order to inspect the area for any animal burrows, rocky outcrops etc. Site specific mitigatory measures can be implemented for the new access road. It is however highly unlikely that the proposed new access road provides critical habitat for any threatened faunal species due to the adjacent habitat transformation.

The proposed new access and maintenance road to the Nzhelele substation follows an existing informal access road. The new Nzhelele distribution substation (awaiting approval) yard footprint will have to be expanded from the 2 ha to 6 ha for the proposed new Tabor-Nzhelele 400kV transmission line. Two small non-perennial drainage lines as well as a seasonally inundated pan are situated within the proposed expanded substation site. No surveys were undertaken for the expanded sections of the Nzhelele substation due to restricted access. More intensive surveys are required in order to ascertain the presence of any threatened faunal species namely Giant Bullfrogs (*Pyxicephalus adspersus*) at the seasonal pan as well as Mullers' Velvet Gecko (*Homopholis mulleri*) on any Marula (*Sclerocarya birrea*) and Knob Thorns (*Acacia nigrescens*). It is however highly unlikely that the proposed 6ha development footprint provides critical habitat for both species within the immediate area. As a precautionary measure a suitably qualified herpetologist should examine the proposed expanded 6ha footprint for any Marula (*Sclerocarya birrea*) and Knob Thorns (*Acacia nigrescens*) as well as the seasonal wetland habitats.

- ***Generic Impacts***

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in Southern Africa are electrocution of birds (and other animals) and disturbance and habitat destruction during construction and maintenance activities.

- *<u>Habitat destruction and disturbance</u>*
  During the construction phase and maintenance of powerlines, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, and the clearing of servitudes.

- *<u>Vegetation/Flora</u>*
  Protected or endangered species may occur along the line route.

- *<u>Revegetation</u>*
  Where necessary a suitable mixture of grass seed shall be used to re-seed damaged areas. Badly damaged areas shall be fenced in to enhance rehabilitation.

- *<u>Surrounding Farming Activities (Domestic Livestock)</u>*
  Construction activities must be planned carefully so as not to interfere with the calving and lambing season for most animal species. The Contractor's workforce will have to be very careful not to disturb the animals as this may lead to fatalities which will give rise to claims from the Landowners.

- *<u>Access Roads</u>*
  Planning of access routes must be done in conjunction between the Contractor, Eskom and the Landowner. All access to private farmland must be negotiated in advance with land-owners. All agreements reached shall be documented in writing and no verbal

agreements should be made. The condition of existing access / private roads to be used shall be documented with photographs.

- *Dangerous Animals*

  Numerous dangerous wild animals (Lions. Buffalo, Rhino), venomous snakes and arachnids and scorpions occur around the proposed expanded Nzhelele substation site and along the proposed 400kV transmission line and thus safety measures must be implemented to ensure the safety of the contractors and sub-contractors.

  - Arachnids

    During the construction phase care must be taken not to destroy any trap-door or baboon spider burrows. Prior to excavations a thorough inspection of the cleared areas must be undertaken to determine the presences of any baboon spider burrows, loosely embedded rocks or stumps in the proposed cleared areas. Several species of Baboon and Trapdoor species have been recorded in the area. Of the mygalomorphs, it is mainly the larger Baboon Spiders that are in great demand as pets and are consequently regarded as commercially threatened by the International Union for Conservation of International Trade in Endangered Species (CITES) (De Wet & Schoonbee 1991). The genera *Ceratogyrus, Harpactira* and *Pterinochilus* were added to schedule V11 of the Transvaal Provincial Nature Conservation Ordinance of 1983 as Protected Invertebrate Animals.

  - Scorpions

    Several species of scorpions are recorded from the area. These scorpions construct burrows or scrapes under rocks as well as found under loose bark, wood piles and other surface debris. The majority of these scorpions possess a painful sting they are not of medical importance except *Parabuthus* spp. which are amongst South Africa's most venomous scorpion species. Suitable habitat occurs along the alignments for *Parabuthus transvaalicus* and *Parabuthus mossambicensis*.

  - Snakes

    Several venomous snake species occur along the proposed route including Black Mamba (*Dendroaspis polylepis*), Boomslang (*Dispholidus typus*), Southern or Bibron's Burrowing Asp (*Actractaspis bibronii*), Mozambique Spitting Cobra (*Naja mossambica*), Snouted Cobra (*Naja annulifera*), Puff Adder (*Bitis arietans*), Rinkhals (*Haemachatus haemachatus*), Common or Rhombic Night Adder (*Causus rhombeatus*).

- *Fire Prevention*

  The frequent burning of the vegetation will have a high impact on remaining reptile species. Fires during the winter months will severely impact on the hibernating species, which are extremely sluggish. Fires during the early summer months destroy the emerging reptiles as well as refuge areas increasing predation risks.

- *Threatened animals*

At a local scale the study site and surrounding areas comprises suitable habitat for certain threatened animal species.

8.6.2 Recommended Mitigation and Management Measures

- ***Mammals:***

  - Prior to construction and vegetation clearance a walk through of the preferred alignment should be undertaken by a suitable qualified zoologist to provide site specific mitigatory measures as well as closely examine the proposed tower/pylon footprint areas for any animal burrows, logs, stumps etc. Smaller mammal species recorded in the vicinity of the tower positions can be relocated away from the construction area in suitable habitat.
  - Trees including stumps; bark and holes in trees are vital habitats for numerous arboreal mammal species (Galagos, Woodland Doormouse and Tree Rat).
  - The removal of indigenous tree species as well as vegetation clearance must be kept to the minimum area required (55m) and remain as close to existing powerline, road and railways servitudes wherever possible. This is especially pertinent for the crossing of the Soutpansberg Conservation area.
  - All rules and regulations applying to the provincial and private game farms must be adhered to especially within the farms where dangerous mammal species occur.
  - No hunting or poaching activities must be allowed along the servitude during the construction and operational phases of the Tabor-Nzhelele project. Severe fines should be implemented for any illegal poaching activities.
  - Major rocky outcrops, large termitaria and animal burrow systems should be avoided.
  - All mammals encountered during the vegetation clearance should be allowed to free movement away from the area without being trapped or harassed.

- ***Reptiles***

  - Prior to construction activities a walk through of the preferred alignment; with special emphasis on any rocky outcrops in close proximity to the servitude as well as around the proposed tower positions; should be undertaken by a suitably qualified herpetologist in order to provide specific mitigatory measures for the construction phase of the project.
  - Ideally the construction activities should take place during the dry winter months when the majority of reptile species are dormant.
  - No rocky outcrops or termite mounds should be intentionally destroyed.
  - Any reptiles rescued or recovered around the proposed tower positions should be relocated in suitable habitat away from the servitude
  - Trees including stumps; bark and holes in trees are vital habitats for numerous arboreal reptiles (chameleons, snakes, agamas, geckos and monitors).

- The removal of indigenous tree species as well as vegetation clearance must be kept to the minimum area required (55m servitude).
- Cleared vegetation should form wood piles and logs and stumps. Dead or decaying wood piles should be created as these will provide valuable refuge areas especially due to the clearance of vegetation cover. Logs and stumps also provide important habitats for several reptile species as well as smaller mammals, amphibians, arachnids and scorpions. With time they will eventually be reduced to valuable compost by several animal species. Dead trees and stumps will also be used for nesting purposes by barbets, hoopoes, owls, hornbills as well as perching or hunting platforms for birds like the kingfisher.
- Any lizards, gecko's, agamids, monitors or snakes encountered should be allowed to escape to suitable habitat away from the disturbance. No reptile should be intentionally killed, caught or collected during any phase of the project.
- Several venomous snake species occur along the proposed alignments including Black Mamba, Horned Adder, Boomslang, Mozambique Spitting Cobra, Snouted Cobra, Snouted Night Adder, Common or Rhombic Night Adder and Puff Adder (*Bitis arietans*).
- General avoidance of snakes if the best policy if encountered. Snakes should not be intentionally harmed or killed and allowed free movement away from the area.
- Appropriate foot wear (sturdy leather boots) should be worn in the field.

- ***Amphibians***

- Prior to construction and vegetation clearance a walk through of the preferred alignment should be undertaken by a suitable qualified herpetologist to provide site specific mitigatory measures as well as closely examine the proposed tower/pylon footprint areas for any burrows, logs, stumps etc. Frog species recorded in the vicinity of the tower positions can be relocated away from the construction area in suitable habitat.
- Ideally the construction activities should be undertaken during the dry winter months (May-September) when the majority of amphibian species are dormant.
- Construction activities of the pipeline should be restricted to daylight hours reducing the potential impact on the nocturnal breeding activities of the majority of amphibian species.
- No Giant Bullfrogs must be collected for food or illegal pet trade.
- As a precautionary mitigation measure it is recommended that the construction contractor as well as an independent environmental control officer (ECO) should be made aware of the possible presence of certain threatened amphibian species (Giant Bullfrog, Northern Forest Rain Frog) prior to the commencement of the construction activities. Any Giant Bullfrogs or Northern Rain Frogs unearthed should ideally be relocated away from the construction activities. The frog should be re-buried approximately 20cm in soft moist sand.

- ***Habitat destruction and disturbance***

The following general recommendations are made to minimise the impacts of powerline construction on threatened fauna:

- As a precautionary measure a walk through of the selected alignment as well as tower positions should be conducted during the EMPR phase of the project by a suitable qualified botanist as well as zoologist; in order to ascertain for the presence of any threatened plant or animal species within or in close proximity to the construction areas (tower supports) for the presence of any animal burrows (including spiders and scorpions), rocky outcrops, logs, stumps and other debris and relocate any affected animals to appropriate habitat away from the servitude or tower.
- Close site supervision must be maintained during construction.
- During the construction phase workers must be limited to areas under construction and access to the undeveloped areas, especially the surrounding open areas must be strictly regulated ("no-go" areas during construction activities).
- Provision of adequate toilet facilities must be implemented to prevent the possible contamination of ground (borehole) water in the area. Mobile toilets must be provided in order to minimise unauthorised traffic of construction workers outside of the designated areas.
- All temporary stockpile areas including litter and dumped material and rubble must be removed on completion of construction. All alien invasive plant should be removed from the site to prevent further invasion.
- Access to the powerline servitude must be restricted. Access to the powerline servitude should ideally be fenced off and gated along the main access roads. No quad-bikes, motorcycles or off road vehicles and illegal hunting should be permitted in the adjacent properties.
- Firearms or any other hunting weapons must be prohibited on site.
- Contract employees must be educated about the value of wild animals and the importance of their conservation.
- Educational programmes for the contractor's staff must be implemented to ensure that project workers are alerted to the possibility of snakes being found during vegetation clearance. The construction team must be briefed about the management of snakes in such instances. In particular, construction workers are to go through ongoing refresher courses to ensure that threatened snakes, such as pythons, are not killed or persecuted when found.
- Severe contractual fines must be imposed and immediate dismissal on any contract employee who is found attempting to snare or otherwise harm wild animals.
- No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the site.
- No specific recommendations are made for the protection of burrowing red data mammals. Consideration could be given to rescuing the animals where there burrows are found in advance of construction. This is not recommended as a general

prescription since the chances of digging out live Aardwolf or Antbear are small. Aardwolf are likely to vacate their burrows in the face of the advancing construction. There is also a risk associated with capturing animals dug out of burrows, and holding them in captivity. If a section of many active burrows is found then mitigation could be considered (minor deviation to the powerline alignment or rescue operation for the animals).

- ***Vegetation/Flora***

- *Management objective*
  - Minimal disturbance to vegetation where such vegetation does not interfere with construction and operation of the line
  - No unnecessary destruction to surrounding vegetation
  - Protection of any protected or endangered plant species
  - Prevention of litigation concerning removal of vegetation

- *Measurable targets*
  - Adequate protection of any endangered or threatened plant or tree species
  - No litigation due to removal of vegetation without the necessary permits

- *Mitigation and recommendation*
  - Special care should be taken not to damage or remove any such species unless absolutely necessary.
  - Permits for removal must be obtained from Provincial Nature Conservation should such species be affected.
  - All plants not interfering with the operation of the line shall be left undisturbed.
  - Collection of firewood and traditional medicinal plants is strictly prohibited.
  - No area should be cleared of trees, bushes and other vegetation for the purpose of a camping site.
  - Remaining indigenous bulbous geophytes and Aloes should be retained or replanted wherever possible.
  - Where herbicides are used to clear vegetation, specimen-specific chemicals should be applied to individual plants only. General spraying should be prohibited.

All alien vegetation should be eradicated over a five-year period. Invasive species (*Acacia mearnsii, Melia azedarach, Opuntia ficus-indcia, Lantana camara, Solanuma mauritianum, Caesalpinia decapetala, Eucalyptus* sp) should be given the highest priority. No dumping of any materials in undeveloped open areas and neighbouring properties. Activities in the surrounding open undeveloped areas (especially open grasslands) must be strictly regulated and managed.

The construction of the proposed Tabor-Nzhelele 400kV transmission line will definitely result in limited opening-up of the vegetal cover during the construction and operational (maintenance) phase. The opening up of existing vegetated areas, thereby creating corridors along which animals can move, may result in increased predation levels on small mammals, reptiles, amphibians, arachnids and scorpions along these corridors.

The limitation of the disturbance of vegetation cover as well as any rocky outcrops, logs, stumps, termite mounds within sensitive areas will ameliorate this impact. Impact will be short-long term depending on the amount of vegetation to be cleared. Excessive habitat destruction during construction could reduce the amount of habitat available. This impact is anticipated to be localised, of a long-term nature and of medium significance, provided that appropriate mitigation measures are implemented (e.g. the limitation of vegetation clearance within sensitive areas).

- ***Vegetation Clearance***

- *Management objective*
  - Minimise damage to surrounding vegetation
  - Minimise damage to topsoil
  - Successful rehabilitation of barren areas

- *Measurable targets*
  - No damage to vegetation outside the 55m powerline servitude
  - No loss of topsoil
  - No visible erosion three months after completion of the contract
  - All disturbed areas successfully rehabilitated three months after completion of the contract

The object of vegetation clearing is to trim, cut or clear the minimum number of trees and vegetation necessary for the safe mechanical construction and electrical operation of the distribution line. Only an 8m strip may be cleared flush with the ground to allow vehicular passage during construction. No scalping shall be allowed on any part of the servitude road unless absolutely necessary. The removal of all economically valuable trees or vegetation shall be negotiated with the Landowner before such vegetation is removed.

Vegetation clearing on tower sites must be kept to a minimum. Big trees with large root systems shall be cut manually and removed, as the use of a bulldozer will cause major damage to the soil when the root systems are removed. Stumps shall be treated with herbicide. Smaller vegetation can be flattened with a machine, but the blade should be kept above ground level to prevent scalping. Any vegetation cleared on a tower site shall be removed or flattened and not be pushed to form an embankment around the tower.

No vegetation clearing in the form of de-stumping, scalping or uprooting shall be allowed on river- and stream banks (riparian zone). Vegetation shall only be cut to allow for the passage of the pilot-cables and headboard. Trees and vegetation not interfering with the statutory clearance to the conductors can be left under the line. Dense vegetation under the line which could cause a fire hazard, particularly in the middle third of the span in the vicinity of the lowest point of the conductors, will be considered as a separate case. With permission of the landowner, the total servitude under the line and up to 5m outside the outer phases can be cleared.

Protected or endangered species of plants shall not be removed unless they are interfering with a structure. Where such species have to be removed due to interference with a structure, the necessary permission and permits shall be obtained from Provincial Nature Conservation. All protected species not to be removed must be clearly marked and such areas fenced off if required.

Disturbed areas of natural vegetation as well as cut and fills must be rehabilitated immediately to prevent soil erosion.

The use of herbicides shall only be allowed after a proper investigation into the necessity, the type to be used, the long-term effects and the effectiveness of the agent. Eskom's approval for the use of herbicides is mandatory. Application shall be under the direct supervision of a qualified technician. All surplus herbicide shall be disposed of in accordance with the supplier's specifications.

Upon completion of the stringing operations and before handover, the servitude must be inspected and all vegetation interfering with the safe operation of the line shall be removed / cut down. All alien vegetation in the total servitude and densifiers creating a fire hazard shall be cleared and treated with herbicides. Ideally the mowing or cutting of grasses should be restricted to the transformed grassland areas and not within the valley bottom wetlands and hillslope seepage areas. The removal of rank grassland vegetation could have a potentially negative impact on secretive species such as the African Grass Owl which prefers rank grassland for nesting and roosting activities.

It is recommended that a contractor for vegetation clearing should comply with the following parameters:

- The contractor must have the necessary knowledge to be able to identify protected species as well as species not interfering with the operation of the line due to their height and growth rate.
- The contractor must also be able to identify declared weeds and alien species that can be totally eradicated.
- The contractor must be in possession of a valid herbicide applicators license.

- ***Revegetation***

Where necessary a suitable mixture of grass seed shall be used to re-seed damaged areas. Badly damaged areas shall be fenced in to enhance rehabilitation. Areas to be rehabilitated must be planted with a mixture of endemic pioneer grass species endemic to the area, as soon as the new growing season starts. To get the best results in a specific area, it is a good idea to consult with a vegetation specialist or the local extension officer of the Dept of Agriculture. Seed distributors can also give valuable advice as to the mixtures and amount of seed necessary to seed a certain area. Re-seeding, as well as fencing in of badly damaged areas, will always be at the discretion of the Environmental Control Officer, unless specifically requested by a Landowner.

- *Management objective*
  - Minimise damage to topsoil and environment at tower positions
  - Successful rehabilitation of all damaged areas
  - Prevention of erosion

- *Measurable targets*
  - No loss of topsoil due to construction activities
  - All disturbed areas successfully rehabilitated within three months of completion of the contract
  - No visible erosion scars three months after completion of the contract

A mixture of seed can be used provided the mixture is carefully selected to ensure the following:

a) Annual and perennial plants are chosen.
b) Pioneer species are included.
c) All the plants shall not be edible.
d) Species chosen will grow in the area without many problems.
e) Root systems must have a binding effect on the soil.
f) The final product should not cause an ecological imbalance in the area.

- *Construction Phase*
  - Disturbed areas of natural vegetation as well as cut and fills must be rehabilitated immediately to prevent soil erosion.
  - Re-seeding shall be done on disturbed areas as directed by the Environmental Control Officer.

- ***Surrounding Farming Activities***

- *Management objective*
  - Minimise disruption of surrounding farming activities

  - Minimise disturbance of fauna
  - Minimise interruption of breeding patterns of fauna

- *Measurable targets*
  - No hunting and poaching or intentional killing of animals (including snakes, scorpions, spiders)
  - No stock losses where construction is underway
  - No complaints from Landowners or Nature Conservation
  - No litigation concerning stock losses and animal deaths

- *Mitigation and recommendation*
  - Interference with any wildlife without the applicable permits shall not be allowed.
  - The Contractor shall under no circumstances interfere with livestock without the Landowner being present. This includes the moving of livestock where they interfere with construction activities.
  - Should the Contractors workforce obtain any livestock for eating purposes, they must be in possession of a written note from the Landowner.
  - Speed limits must be restricted especially on farm roads (30km/hr) preventing unnecessary road fatalities of surrounding livestock.

- ***Access Roads***

- Planning of access routes must be done in conjunction between the Contractor, Eskom and the Landowner.
- All access to private farmland must be negotiated in advance with land-owners.
- All agreements reached shall be documented in writing and no verbal agreements should be made.
- The condition of existing access / private roads to be used shall be documented with photographs.
- The Contractor shall properly mark all access roads. Markers shall show the direction of travel as well as tower numbers to which the road leads.
- Roads not to be used shall be marked with a "NO ENTRY" sign.
- Unnecessary traversing of agricultural and natural open land is discouraged.
- Where required, speed limits shall be indicated on the roads (30km). All speed limits shall be strictly adhered to at all time.
- Vehicle access to the powerline servitude must as far as possible be limited to existing roads.
- If a new access roads need to be constructed it should follow cleared areas such as cattle pathways.

- ***Dangerous Animals***

  - *Arachnids*
    - During the construction phase care must be taken not to destroy any trap-door or baboon spider burrows.
    - Prior to excavations a thorough inspection of the cleared areas must be undertaken to determine the presences of any baboon spider burrows, loosely embedded rocks or stumps in the proposed cleared areas.
    - Eskom must ensure that no baboon spiders are illegally collected or intentionally destroyed throughout all stages of the project.

  - *Scorpions*
    - Care should be taken when removing stumps, logs or rock material.
    - Any scorpions encountered on the site should be left alone and allowed free access away from the activity or safely removed from the area.
    - No scorpions should be intentionally killed.
    - Standard precautions or safety measures includes wearing sturdy leather boots and gloves in the field and close inspection of sleeping areas and bedding, clothes, shoes etc. for any scorpions.
    - Stings from mildly venomous scorpions cause localised pain and swelling, with little systematic reaction. The affected limb should be immobilized and an ice pack should be applied, if possible, to the site of the sting. The site of the sting should be cleaned and never cut open. Venom sprayed in the eyes (certain Parabuthus species are able to spray venom) produces an intense burning sensation and may result in temporary blindness if the eyes are not washed out thoroughly with clean water or some other neutral liquid such as milk

  - *Snakes*
    - General avoidance of snakes if the best policy if encountered.
    - Snakes should not be harmed or killed and allowed free movement away from the area.
    - Safety precaution measure must be implemented especially during the vegetation clearance phase which could result in encounters with several venomous snake species.
    - Appropriate foot wear (sturdy leather boots) should be worn in the field.

- ***Fire Prevention***

  - *Management objective*
    - Minimise risk of veld fires
    - Minimise damage to grazing
    - Prevent runaway fires

- *Measurable targets*
  - No veld fires started by the Contractor's work force
  - No claims from Landowners for damages due to veld fires
  - No litigation

- *Mitigation and recommendations*
  - No open fires shall be allowed on site under any circumstance.
  - The Contractor shall have fire-fighting equipment available on all vehicles working on site, especially during the winter months.

- ***Threatened animals***

- As a precautionary mitigation measure it is recommended that the construction contractor as well as an independent environmental control officer (ECO) should be made aware of the possible presence of certain threatened animal species namely Giant Bullfrog, Northern Forest Rain Frog, Southern African Python, Soutpansberg Flat Lizard, Muller's Velvet Gecko, Ground Pangolin, Brown Hyaena, Lion, Wild Dog, Cheetah and White Rhinoceros.
- Prior to the commencement of construction activities a walk through of the preferred alignment as well as proposed tower positions must be undertaken by a suitably qualified zoologist/herpetologist in order to provide site specific mitigatory measures as well as make recommendations in order to ameliorate potentially negative impacts to any threatened faunal species.
- In the event that any of the above-mentioned species are discovered relevant conservation authorities should be informed and activities surrounding the site suspended until further investigations have been conducted.

More detailed mitigation and management measures can be found in the Environmental Management Programme included in **Appendix E**.

8.7 Avifauna

The Avifauna Report has been included in **Appendix M.**

8.7.1 Potential Impacts

- ***General description of impacts of power lines on birds***

Because of its' size and prominence, electrical infrastructure constitutes an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds (and other animals) and birds colliding with power lines (Ledger

1983; Verdoorn 1996; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000). Other problems are electrical faults caused by bird excreta when roosting or breeding on electricity infrastructure, (Van Rooyen & Taylor 1999) and disturbance and habitat destruction during construction and maintenance activities.

- ***Electrocutions***

Electrocution of birds on overhead lines is an important cause of unnatural mortality of raptors and storks. It has attracted plenty of attention in Europe, USA and South Africa (APLIC 1994; van Rooyen & Ledger 1999). Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). Electrocution is highly unlikely on 400kV power lines as the clearances are usually large; this however is dependent on the exact pole structure used**. For this study, it is assumed that a bird friendly structure will be used, and the detailed impact assessment and ratings below, is based on this assumption.** Therefore, the impact of electrocution is likely to be of low significance for the proposed power line.

- ***Collisions***

Collisions are the biggest single threat posed by over-head transmission power lines to birds in southern Africa (van Rooyen 2004). In general, large transmission lines with earth wires that are not always visible to birds can have the largest impact in terms of collisions. Most heavily impacted upon are korhaans, bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). **Historical data (discussed above) shows that this study area may contain numerous species sensitive to collision**. Unfortunately, many of the collision sensitive species are considered threatened in southern Africa. The Red Data species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. These species have not evolved to cope with high adult mortality, with the results that consistent high adult mortality over an extensive period could have a serious effect on a population’s ability to sustain itself in the long or even medium term. Many of the anthropogenic threats to these species are non-discriminatory as far as age is concerned (e.g. habitat destruction, disturbance and power lines) and therefore contribute to adult mortality, and it is not known what the cumulative effect of these impacts could be over the long term. Collision of certain large flying bird species such as Bustards, Korhaans, Ibises and Storks with the proposed lines that will be constructed in this project, is a real possibility.

- ***Habitat destruction***

During the construction phase and maintenance of substations and power lines some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, and the clearing of servitudes, as well as clearing vegetation at the substation site. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through modification of habitat. Habitat destruction is anticipated to be of moderate to high significance in this study area.

- ***Disturbance***

Similarly, the above mentioned construction and maintenance activities impact on bird through disturbance, particularly during bird breeding activities. Disturbance of birds is anticipated to be of moderate significance.

- ***Sensitivity Analysis***

In general the site has areas of low, moderate and high sensitivity in terms of avifauna, based on the occurrence of a number of listed species in the study area, as well as the various micro-habitats available to avifauna. There broader area appears more sensitive, in that more red-listed species have been recorded in the larger SABAP1 QDGS's, when compared to the pentads close to the site, and the line routes themselves tend to be near to human disturbances. The sensitive zones are mapped and described below. These were determined through the examination of sensitive micro-habitats available.

The sensitivity maps below (**Figures 8.1 – 8.4**) show only areas where the proposed power line routes pass through an area/s of medium to high sensitivity. The maps are in order from north to south, and each show two features that have been buffered. These are the Rivers which have been buffered using GIS by 200m, and Wetlands (including dams), which have been buffered by 100m. The importance of these micro-habitats to avifauna has been discussed in earlier sections of this report. All of these Rivers and Wetlands, as well as the buffered zones around them, are regarded as Medium -High Sensitivity areas, and collision mitigation, is recommended for any new power lines that will run through these areas. The remaining areas outside of these buffer zones are designated as Low – Medium sensitivity, and it is unlikely that any collision mitigation will be required in these areas (although this is subject to change following the avifaunal "walkthrough" in the EMPR phase of the project). Following the EIA phase site visit an additional sensitivity map (**Figure 8.5**) was created for the Soutpansberg area, and to include the additional Alternative (Tab-Nzh 4). This map includes the same sensitivities as above as well as an additional feature, the Soutpansberg Vulture Colony, which has been buffered by 3km (high sensitivity zone) and 6km (medium sensitivity zone) respectively. Furthermore, general areas of concern, that will require additional examination in the EMPR/walkthrough phase to determine mitigation requirements, have been indicated by red dotted polygons.

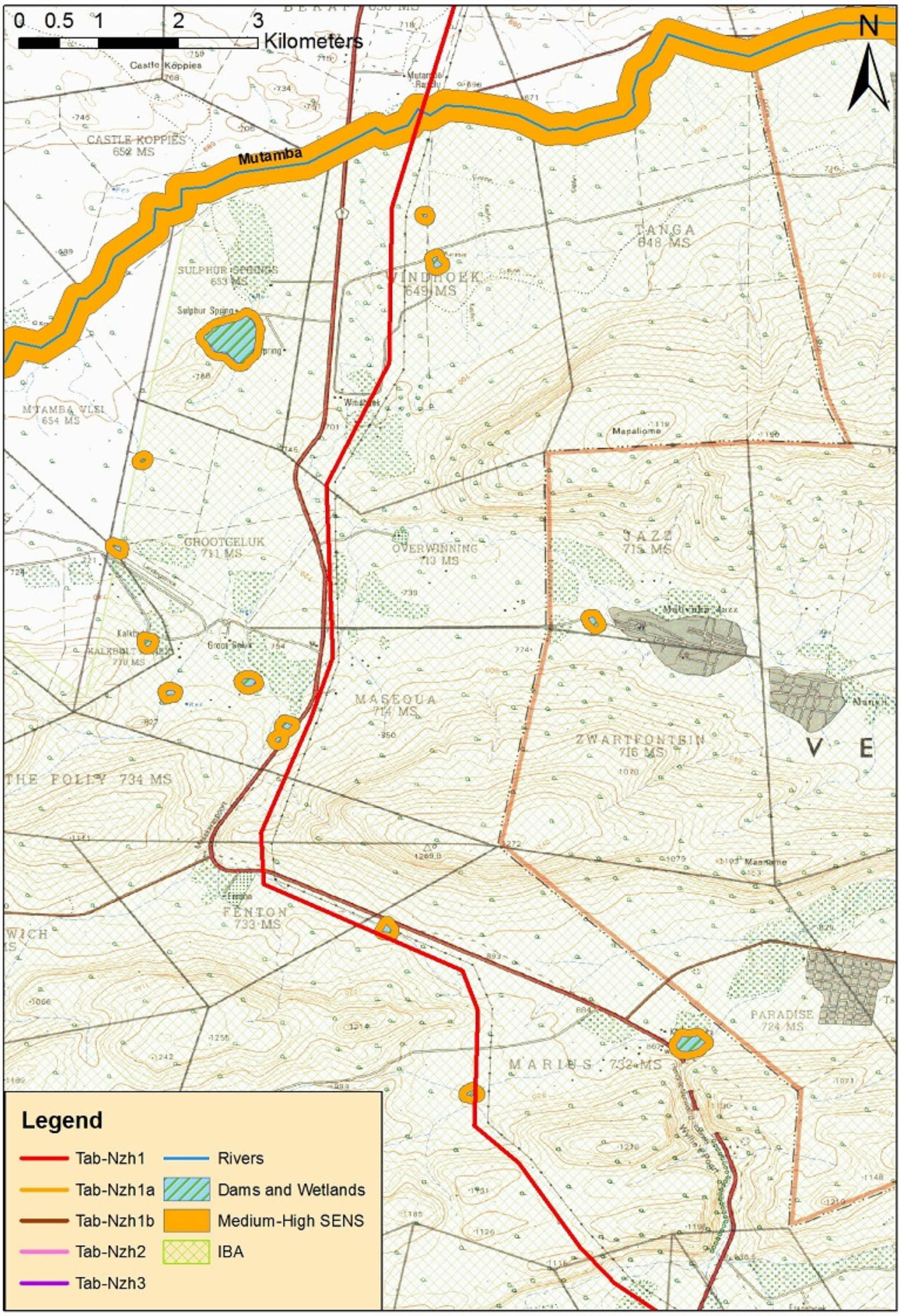


Figure 8.1: Sensitivity Map 1, showing areas of medium to high avifaunal sensitivity. The Mutamba River crossing is the main area of concern here.

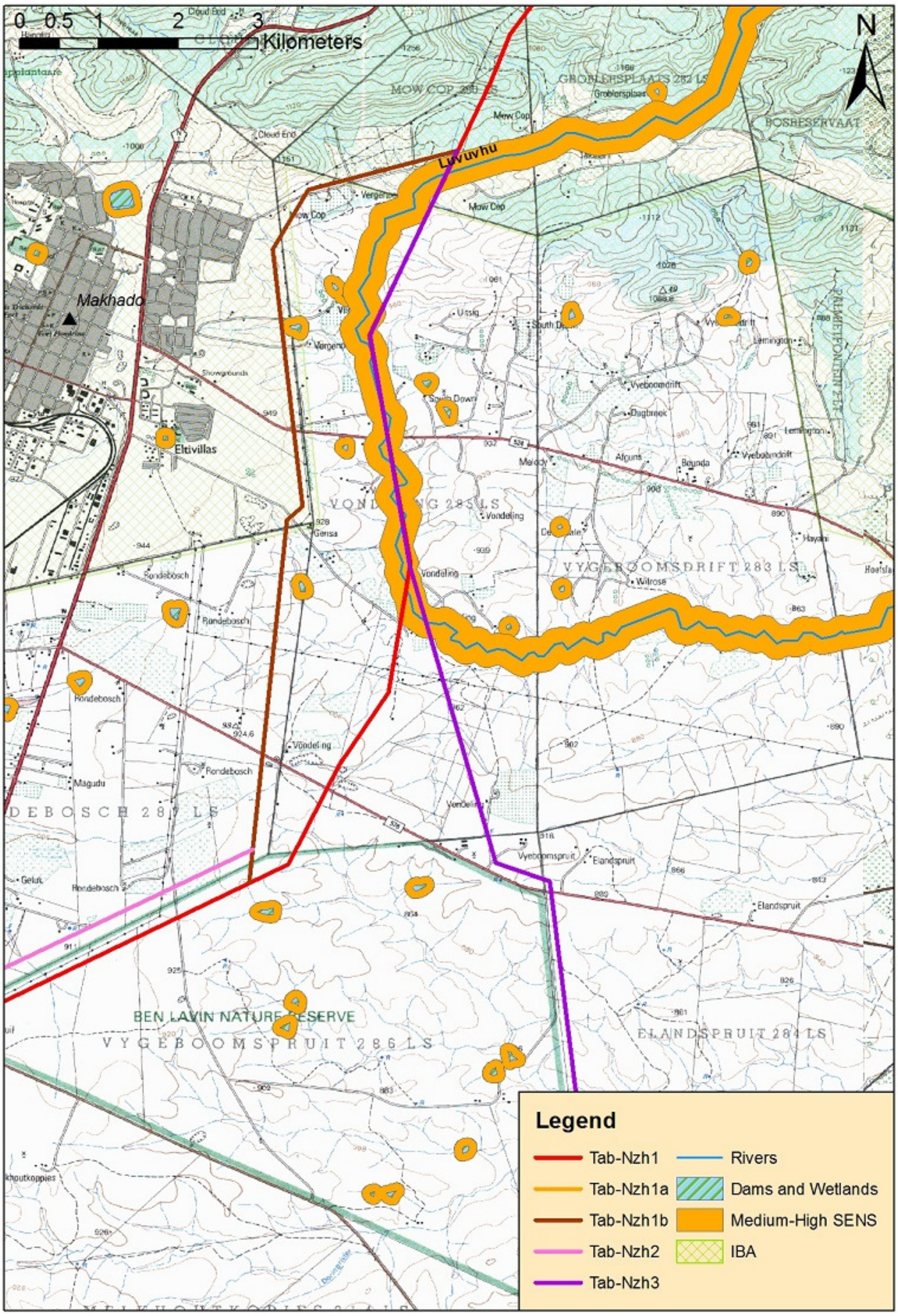


Figure 8.2: Sensitivity Map 2, showing areas of medium to high avifaunal sensitivity. The Luvuvhu River is the main area of concern here.

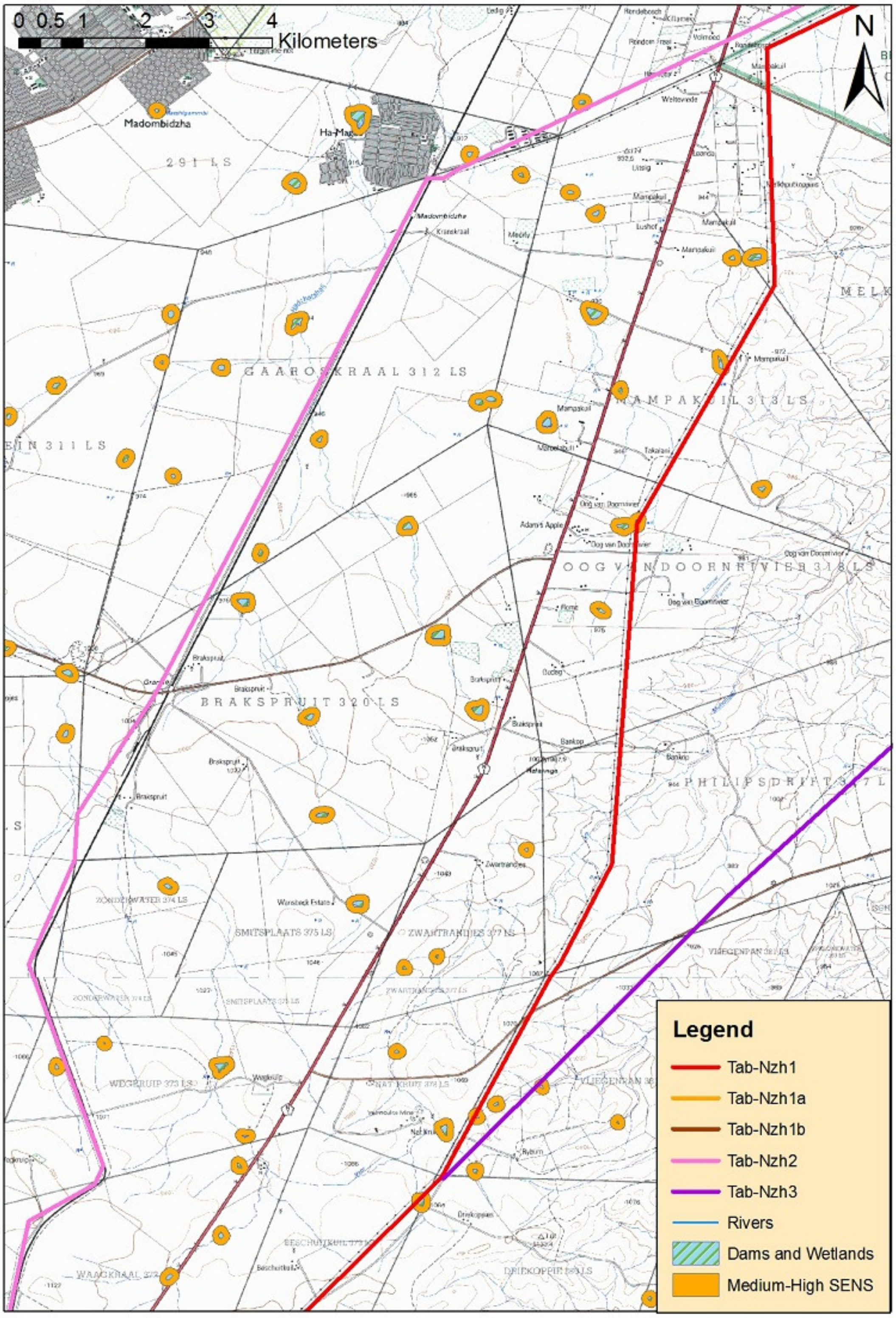


Figure 8.3: Sensitivity Map 3, showing areas of medium to high avifaunal sensitivity.

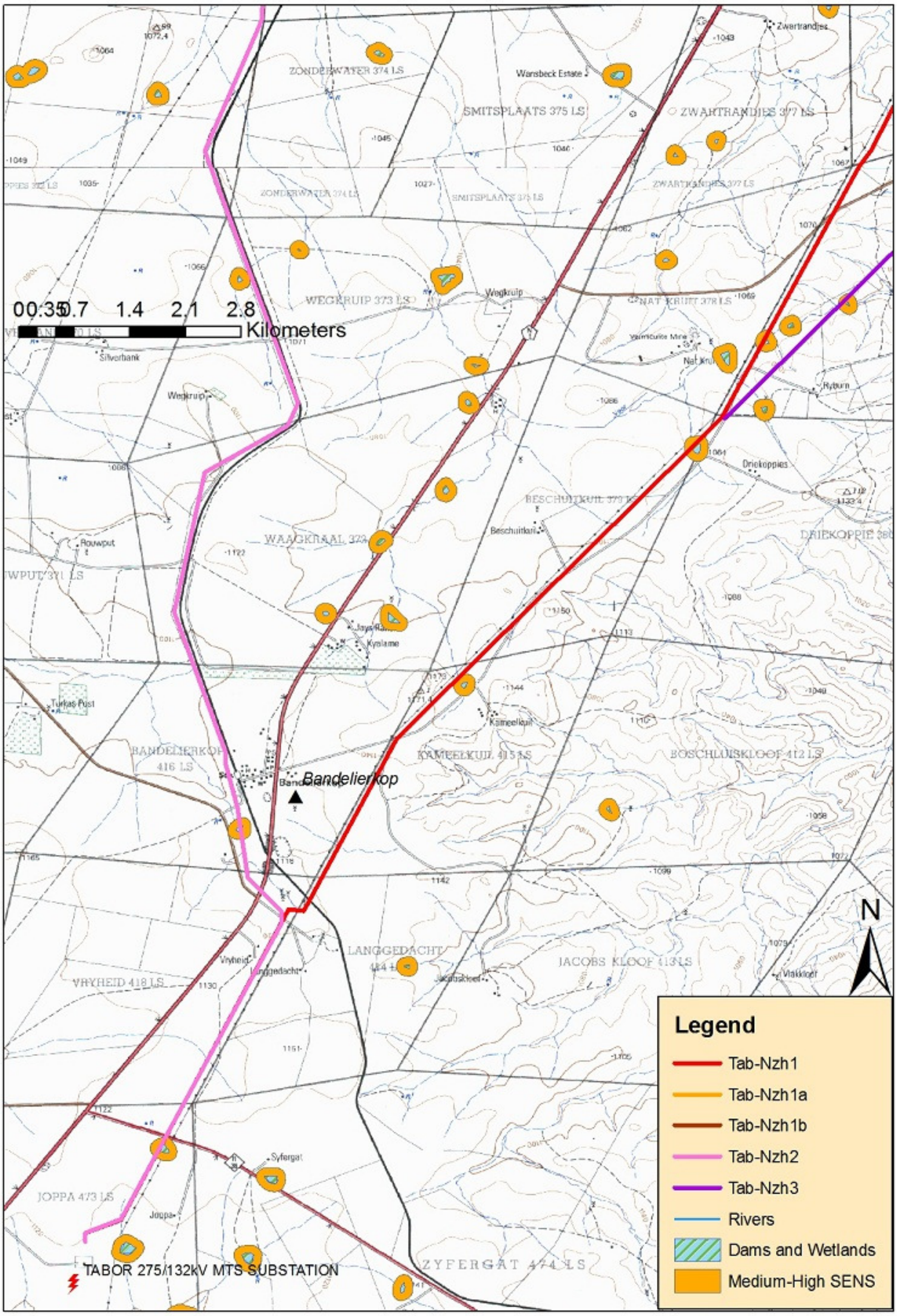


Figure 8.4: Sensitivity Map 4, showing areas of medium to high avifaunal sensitivity.

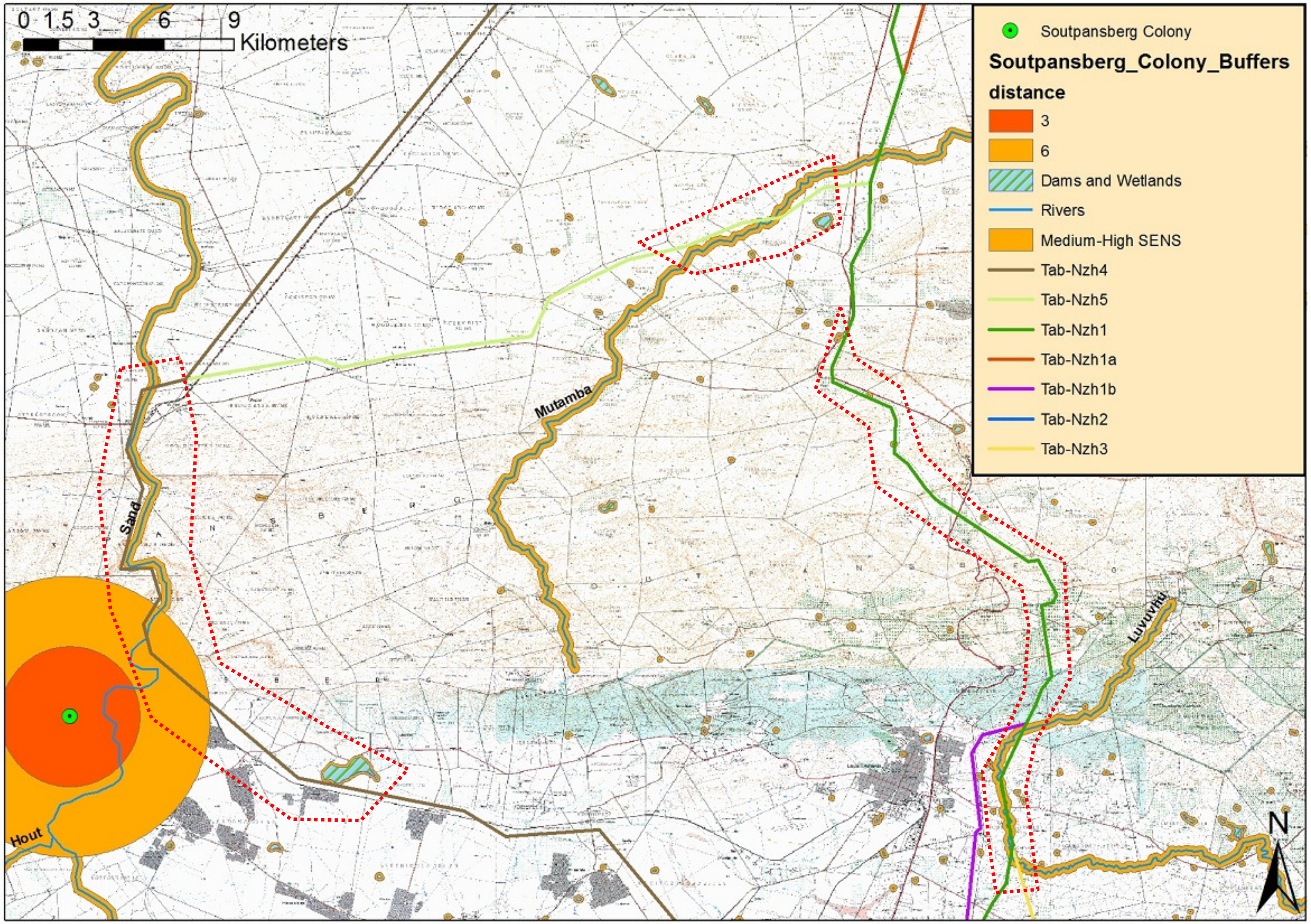


Figure 8.5: Sensitivity map for the Soutpansberg region, showing the Vulture Colony, buffered wetlands and rivers, as well as areas of general concern (red polygons)..

8.7.2 Recommended Mitigation and Management Measures

Construction Phase

Impact	***Mitigation***
Habitat destruction	Strict control should be maintained over all activities during construction, in particular heavy machinery and vehicle movements, and staff. It is difficult to mitigate properly for this as some habitat destruction is inevitable. It is important to ensure that the construction Environmental Management Programme incorporates guidelines as to how best to minimize this impact.
Disturbance	Strict control should be maintained over all activities during construction. It is difficult to mitigate properly for this as some disturbance is inevitable. **During Construction, if any of the "Focal Species" identified in this report are observed to be roosting and/or breeding in the vicinity, the EWT is to be contacted** for further instruction.

Operational Phase

Impact	***Mitigation***
Collision	Mark the relevant sections of line, within the sensitivity zones, with appropriate marking devices. These sections of line, and the exact spans, will be finalised as part of the Environmental Management Programme (EMPR) phase, once power-line routes are finalised and pylon positions are pegged.
Electrocution	**Structure dependent. TBC in EIA phase.**
Nesting of birds on Tower structures and disturbance during routine maintenance.	No nests may be removed, without first consulting the EWT's Wildlife and Energy Program (WEP). During maintenance, **if any of the "Focal Species" identified in this report are observed to be roosting and/or breeding in the vicinity, the EWT is to be contacted** for further instruction.

More detailed mitigation and management measures can be found in the Environmental Management Programme included in **Appendix E**.

8.8 Sites of Archaeological, Historical and Cultural Interest

The Heritage Report has been included in **Appendix N**.

8.8.1 Potential Impacts

Impact analysis on cultural heritage resources under threat of the proposed development is based on the present understanding of the development.

It is further complicated by the fact that large sections of all the proposed routes are still very much under researched and what might now, based on available information, be seen as a preferred alternative, might change if in-depth surveys of a particular route has been conducted

The possible impact of the proposed development on the different categories of heritage sites is assessed as follows:

Environmental Parameter	**Pre-colonial: Stone Age sites**
Issue/Impact/Environmental Effect/Nature	Many sites are still unknown. Their potential and significance therefore unknown. The impact will be the physical disturbance of the material and its context. Impact will be focused on a particular node, i.e. tower positions or access/ inspection roads
Significance Rating	Sites have a medium significance on a region level – viewed as NHRA Grade III sites. Distinguish from find spots, which have low significance. Rock art sites are viewed to have high significance on a regional level – viewed as NHRA Grade II sites.

Environmental Parameter	**Pre-colonial: Iron Age sites**
Issue/Impact/Environmental Effect/Nature	Many sites are still unknown. Their potential and significance therefore unknown. The impact will be the physical disturbance of the material and its context. Impact will be focused on a particular node, i.e. tower positions or access/ inspection roads
Significance Rating	Sites have a high significance on a region level – viewed as NHRA Grade III sites.

Environmental Parameter	**Colonial Period - farmsteads**
Issue/Impact/Environmental Effect/Nature	The various features are subject to damage. Easier to identify and therefore easier to avoid. Variety of interconnected elements makes up the whole. Impact on part therefore implies an impact on the whole
Significance Rating	Sites have a medium significance on a region level – viewed as NHRA Grade III sites.

Environmental Parameter	**Colonial Period - cemeteries**
Issue/Impact/Environmental Effect/Nature	The various features are subject to damage. Easier to identify and therefore easier to avoid. Variety of interconnected elements makes up the whole. Impact on part therefore implies an impact on the whole
Significance Rating	Sites have a medium significance on a region level – viewed as NHRA Grade III sites.

Environmental Parameter	**Colonial Period – industrial heritage**
Issue/Impact/Environmental Effect/Nature	Different features are subject to damage. Some might be unique – no alternatives or second examples. Easy to identify and therefore easy to avoid
Significance Rating	Sites have a medium significance on a region level – viewed as NHRA Grade III sites.

8.8.2 Recommended Mitigation and Management Measures

As the exact coordinates for the power line and the individual tower structures are not yet available, it is difficult to determine what the final impact of the proposed development would be. Therefore, for the project to continue, we propose the following:

- Mitigation should be based on avoiding of sites rather than anything else. In order to achieve this, a full "walk down" of the selected corridor must be done prior to construction taking place, to document all sites, features and objects, in order to propose adjustments to the routes and thereby to avoid as many impacts as possible.
- No impact on heritage sites, features or objects can be allowed without a valid permit from SAHRA.

Environmental Parameter	**Pre-colonial: Stone Age sites**
Mitigation measures	All of these sites should be avoided as far as possible. Mitigation should take the form of isolating known sites and declare them as no-go zones with sufficient large buffer zones around them for protection. Sites that cannot be avoided should be excavated in full by an archaeologist qualified in Stone Age archaeology.

Environmental Parameter	**Pre-colonial: Iron Age sites**
Mitigation measures	All of these sites should be avoided as far as possible. Mitigation should take the form of isolating known sites and declare them as no-go zones with sufficient large buffer zones around them for protection. Sites that cannot be avoided should be excavated in full by an archaeologist qualified in Iron Age archaeology.

Environmental Parameter	**Colonial Period - farmsteads**
Mitigation measures	All of these sites should be avoided as far as possible. Mitigation should take the form of isolating known sites and declare them as no-go zones with sufficient large buffer zones around them for protection. In exceptional cases mitigation can be implemented after required procedures have been followed.

Environmental Parameter	**Colonial Period - cemeteries**
Mitigation measures	All of these sites should be avoided as far as possible. Mitigation should take the form of isolating known sites and declare them as no-go zones with sufficient large buffer zones around them for protection. In exceptional cases mitigation can be

	implemented after required procedures have been followed.

Environmental Parameter	**Colonial Period – industrial heritage**
Mitigation measures	All of these sites should be avoided as far as possible. Mitigation should take the form of isolating known sites and declare them as no-go zones with sufficient large buffer zones around them for protection. In exceptional cases mitigation can be implemented after required procedures have been followed, but only as last case scenario.

More detailed mitigation and management measures can be found in the Environmental Management Programme included in **Appendix E**.

8.9 Visual Aspects

The Visual Impact Assessment has been included in **Appendix O.**

8.9.1 Potential Impacts

- ***Issues Related to Possible Visual Impact.***

The corridors for the proposed alternative routes transect a combination of transformed and wilderness landscapes. The visual quality of panoramas differs from low to very high. The following issues with regard to possible visual impact have been identified:

- The clearing of vegetation to create a 55m wide servitude for the proposed 400 kV powerline, thereby creating a scar effect in the landscape;
- Cumulative impacts with regard to expanding the corridors of existing powerlines to accommodate the additional 400 kV powerline;
- Possible effect of the construction of the powerline on sensitive viewers, particularly:
  - Places of residence, especially farmsteads;
  - Travellers on the N1, especially tourists;
  - Tourist areas, such as resorts and hunting lodges;
  - Scenic spots and vantage points.
- The effect of night time lighting at the proposed Nzhelele Substation and the impact of glare and sky glow on residents, visitors and tourists in the area.

Issues with regard to visual impact primarily concern vistas of the Soutpansberg and wilderness areas where the sense of place is sensitive to any form of transformation.

- ***Visual Impact Analysis***

The visual impact assessment is an iterative process, where different criteria are analysed independent of each other, including the following:

- Visibility and exposure analysis;
- Proximity analysis;
- Visual Absorption Capacity analysis;
- Night Lighting assessment

The results are finally integrated and interpreted in a visual impact index to arrive at a conclusive assessment.

The visual impact assessment process is described as follows:

- *Visibility and Exposure*

Visibility refers to the line of site between the observer and objects in the landscape, being it natural features or man-made structures. **Exposure** refers to the degree of visibility of these features, e.g. can the observer see the complete structure or only part thereof. This is determined by various factors, such as the topography and the appearance of objects around the viewer, such as trees, buildings, etc. In this context, the definition of foreground, middle ground and background plays an important role.

The visibility analysis is conceptual, based on the modelling of the landscape in terms of elevation and land cover in terms of a classification of primary land cover types. The input data include a digital terrain model derived from 20 m contours.

Visibility is analysed by means of a **viewshed analysis**, which is a GIS operation based on a digital elevation model (DEM), and the height of the powerline towers. The viewshed operation calculates which locations in a DEM can be connected by means of an uninterrupted straight line to a viewpoint location within any specified distance. For the purpose of this project, the distance was set at 5km on either side of the route. Effectively, it calculates which predefined points along the route are not obstructed by topography and therefore may be visible from any location in the surrounding area.

Exposure is determined by two factors, i.e. the size and extent of the development and the view thereof, partly or in full. The viewshed analysis is based on a number of points outlining the proposed development. The visibility of each of these points is calculated and included as numeric values in the output dataset. The number of points along the route that can be seen from a specific location can therefore be calculated, thereby determining the exposure of the object (powerline or substation).

The towers of a 400kV powerline stand 38m tall and are highly visible, due to the vertical intrusion of the skyline (**Figure 8.6**). Topography is a determining factor in that flat landscapes will promote a higher degree of visibility and exposure than mountainous terrain. This is evident from the maps, showing varying degrees of visibility and exposure between the Soutpansberg and the adjoining flat land.

Figure 8.6: Photo showing the highly visible nature of a powerline

In order to assess the visibility and visual exposure of the proposed 400kV powerline, all seven alternative routes have been analysed individually. The results are represented on maps (**Figures 8.7 – 8.13**).

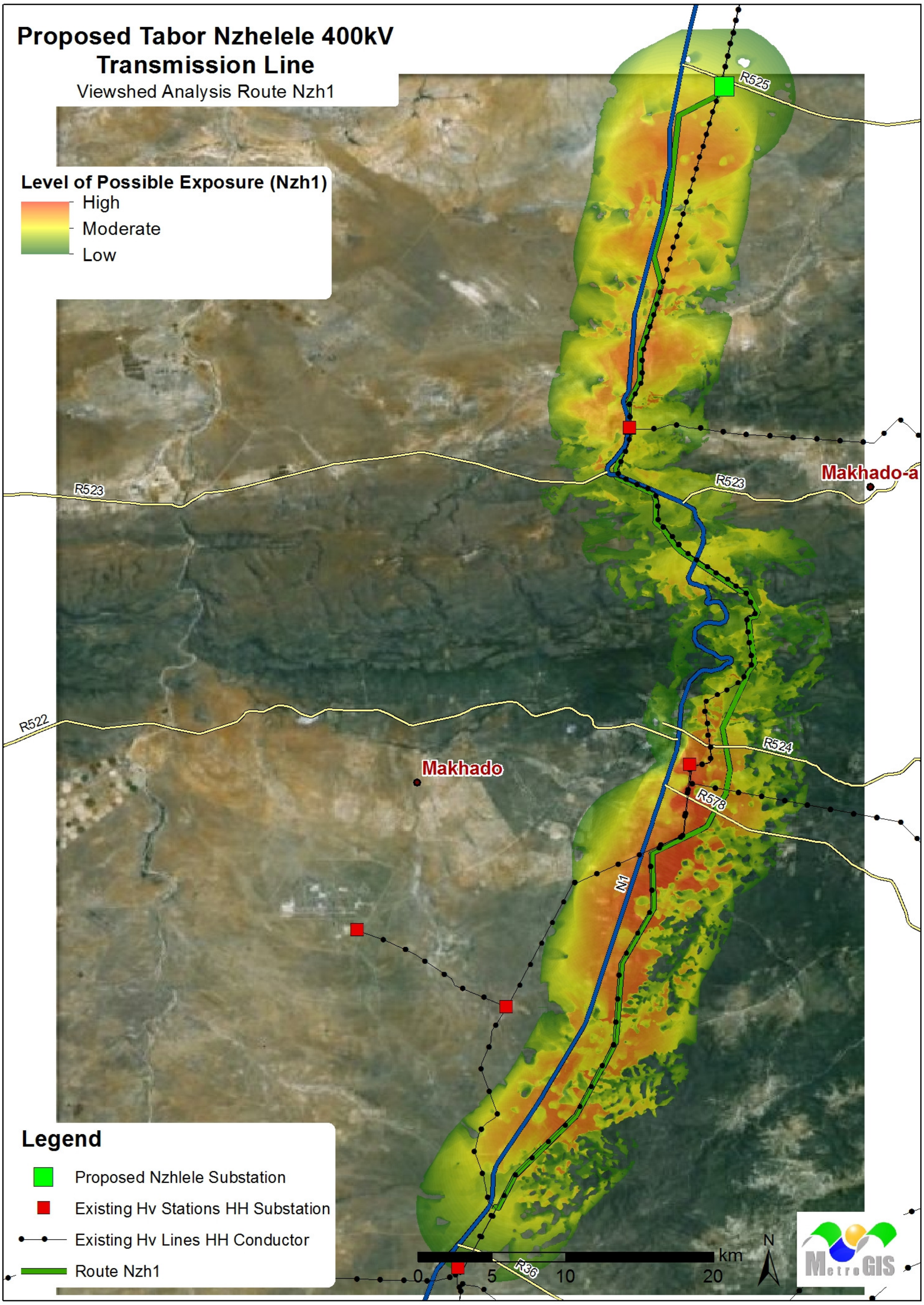


Figure 8.7: Viewshed analysis for Alternative 1

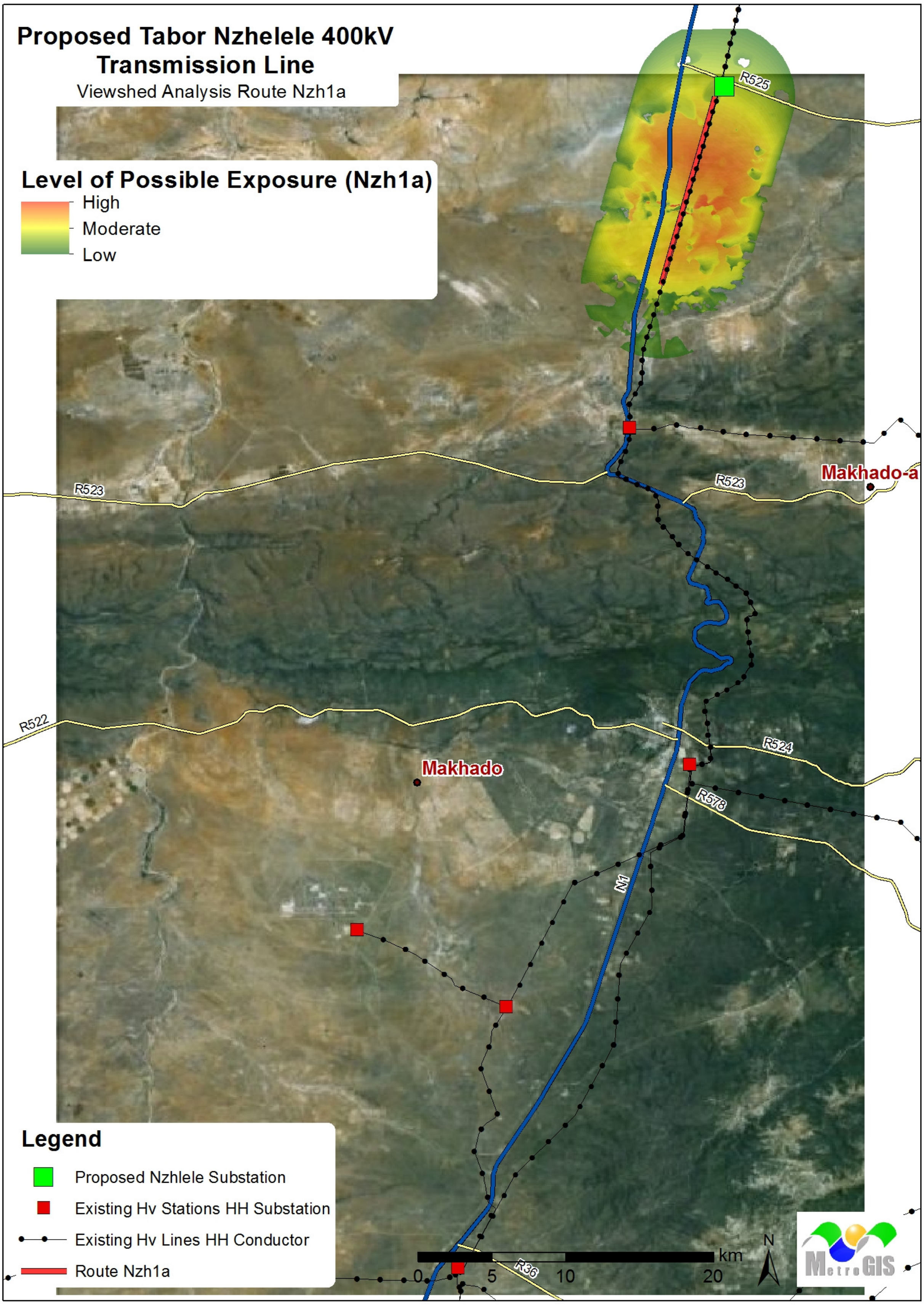


Figure 8.8: Viewshed analysis for Alternative 1a

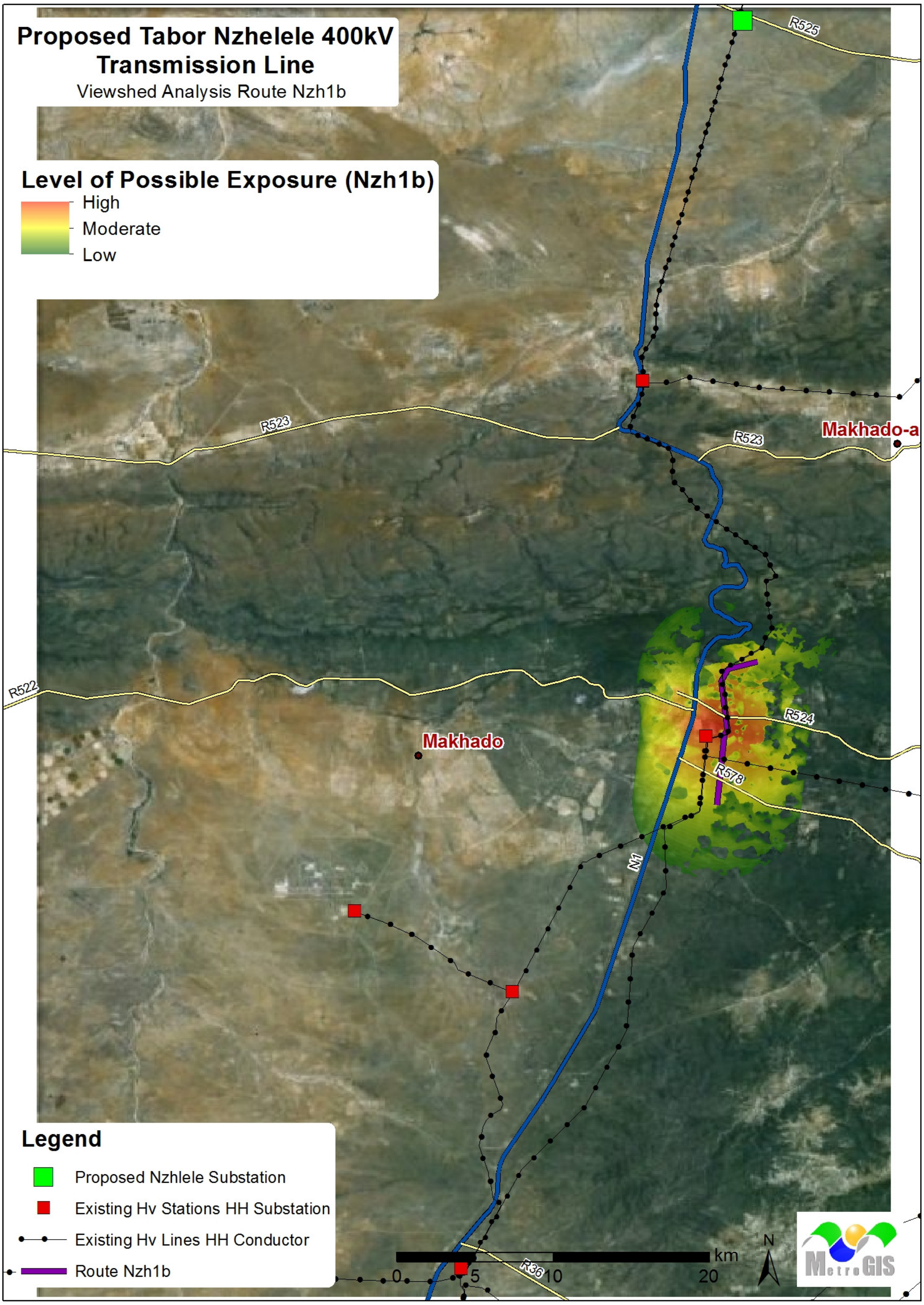


Figure 8.9: Viewshed analysis for Alternative 1b

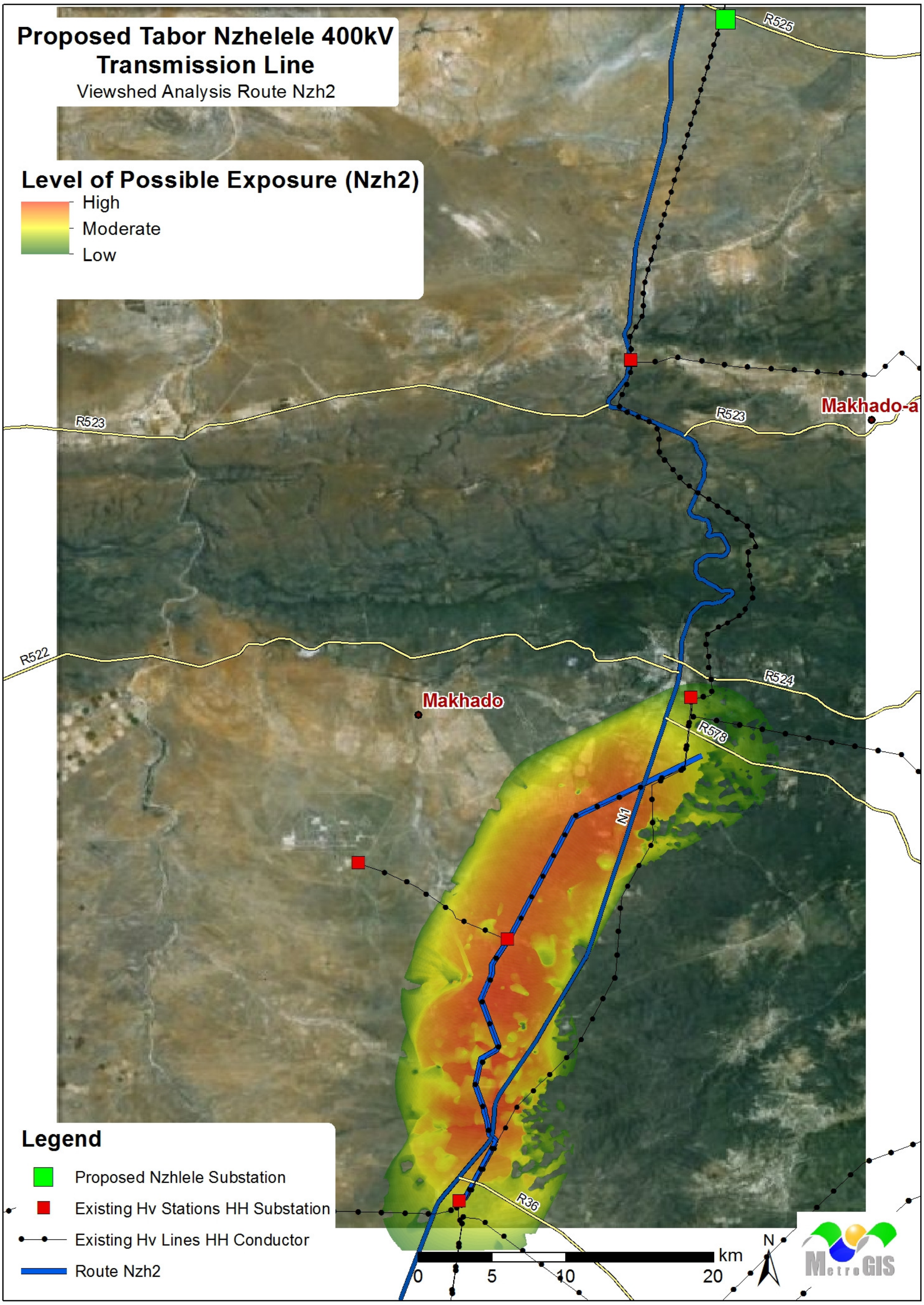


Figure 8.10: Viewshed analysis for Alternative 2

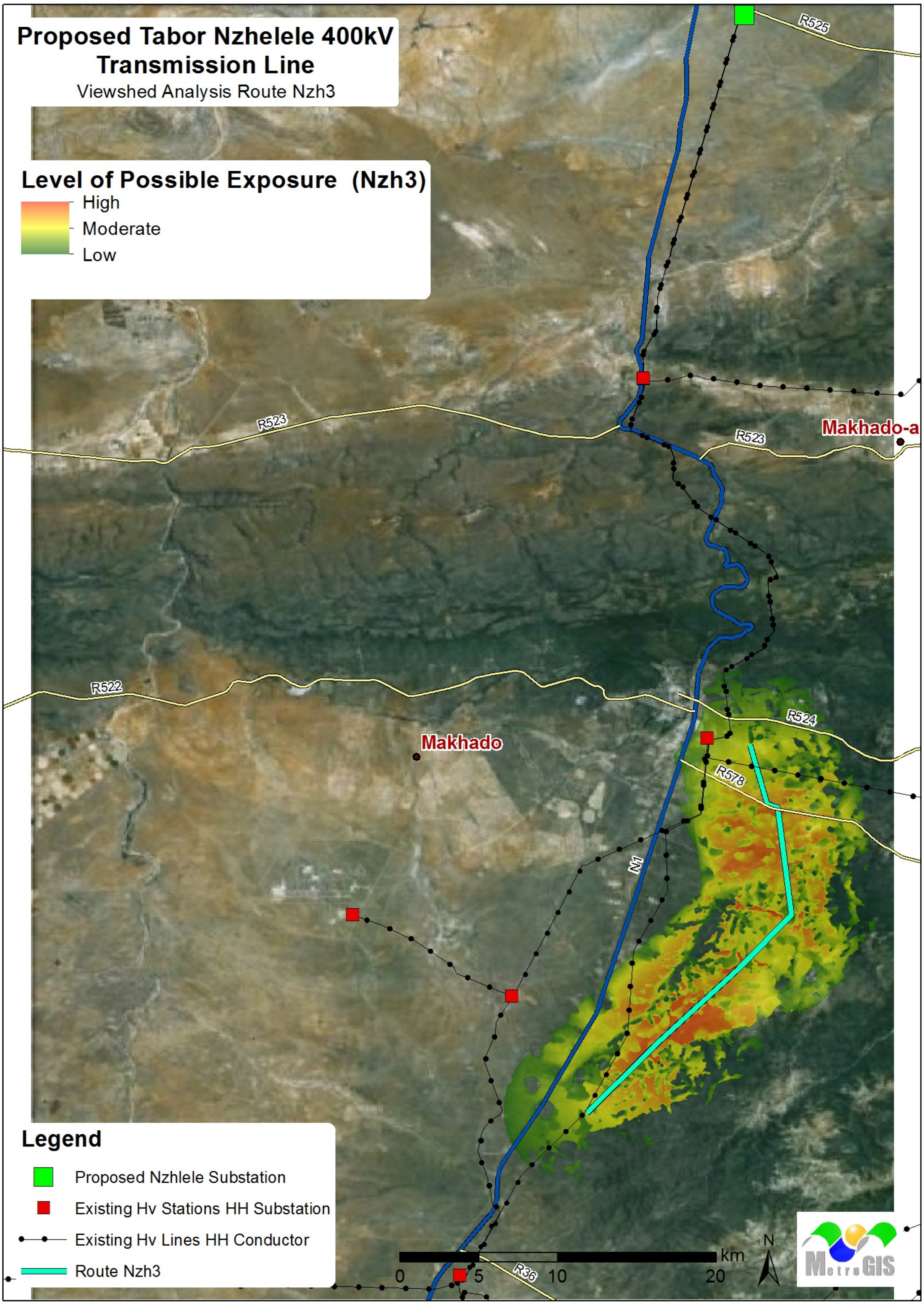


Figure 8.11: Viewshed analysis for Alternative 3

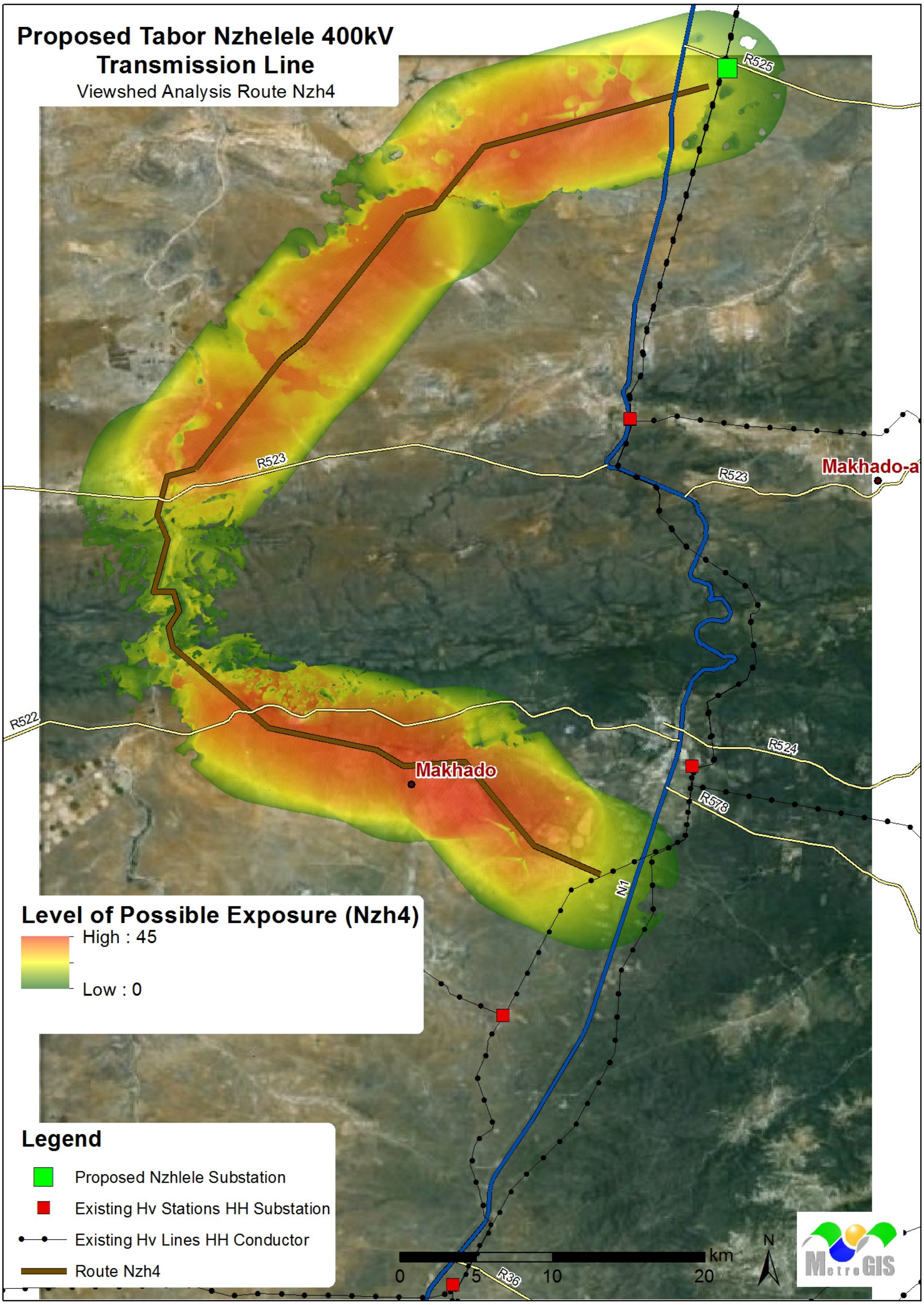


Figure 8.12: Viewshed analysis for Alternative 4

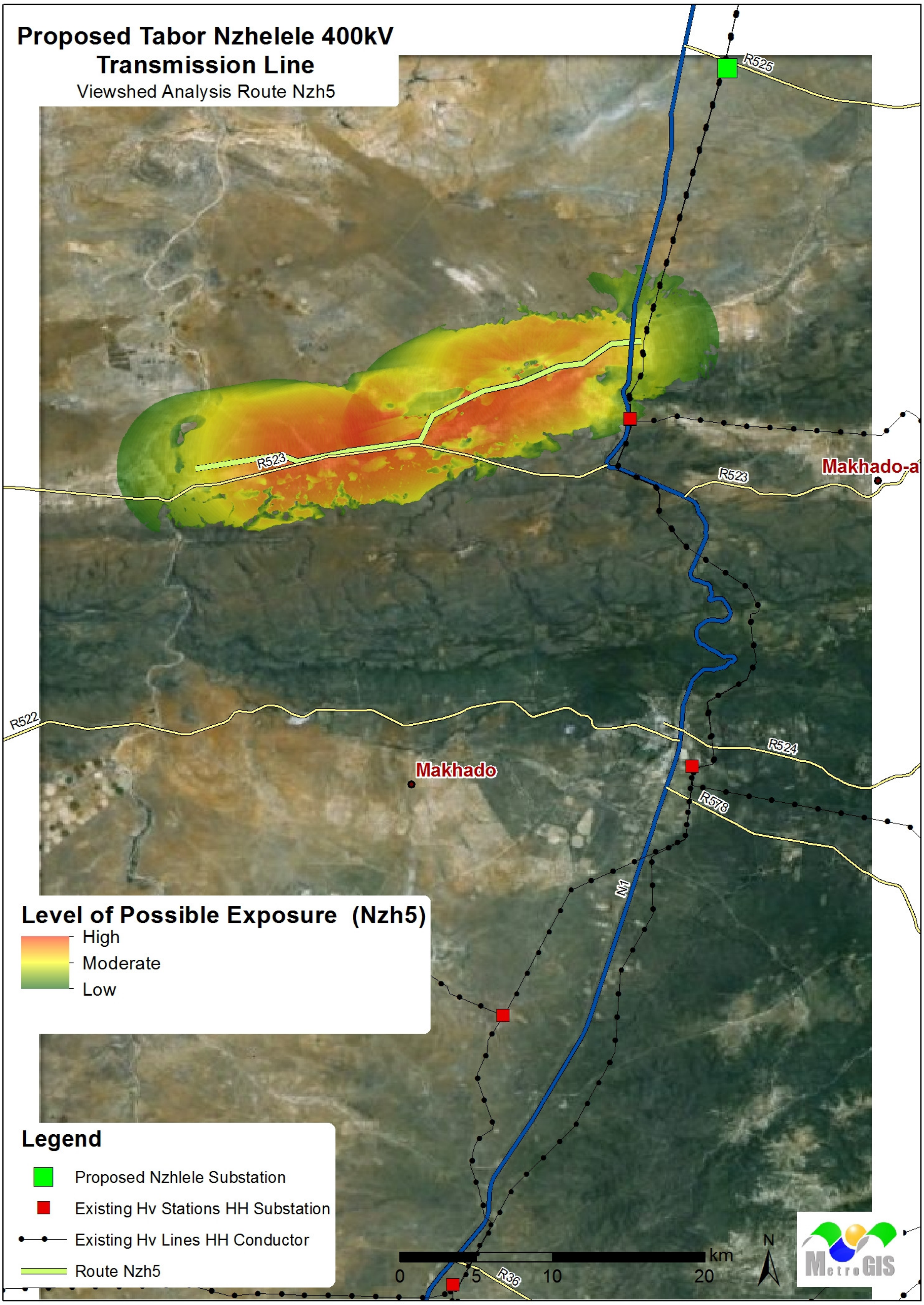


Figure 8.13: Viewshed analysis for Alternative 5

- *Proximity*

The appearance of an object in a person's central field of vision, and the way it dominates the field of view, determines the visual impact it might cause. This effect changes with distance from the object. Therefore, a proximity analysis is required to incorporate the effect of reduced visibility over distance.

With a powerline being a linear feature stretching over a distance beyond the range of human visibility, proximity becomes an important factor. Given the narrow footprint of the powerline, and the transparent characteristics of conductor cables and towers, powerlines are particularly inclined to become less visible over distance, as is illustrated in the photograph in **Figure 8.14**. The appearance of the tower and cables dominate the scene for a relative short distance, primarily in the foreground. Towards the background the feature becomes hardly visible (look at the second and third tower in the background on the photograph), with mainly the clearance of vegetation indicating the presence of a powerline servitude in the background.

Figure 8.14: Reduced visibility intensity over increased distance from the powerline (powerline complex).

Given the above characteristics, the following proximity buffers have been identified for the powerline:

- 0 – 0.5km High visibility
- 0.5 – 1.5km Moderate visibility
- 1.5 – 3km Low visibility
- > 3km Insignificant

The buffers are used to determine the significance of visual impact. By integrating these with data representing possible sensitive viewer locations, the significance of proximity can be visualised, as indicated on the map in **Figure 8.15**.

- *Viewer Incidence & Perception*

The sensitivity of visual receptors and views will be dependent on the location and context of the viewpoint, the expectations and activity of the receptor, and the importance of the landscape in terms of its reference in various information publications such as tourist brochures, maps and websites. In terms of the latter, the author was able to source substantial information from the internet, supplementing the information gathered from site visits and geographical data interpretation. This is indicative of the importance of the Soutpansberg, game farms and private nature reserves as tourist destinations, and as a visual resource in particular.

The most sensitive receptors may include the following:

- Users of outdoor recreational facilities, including public roads, whose interest may be focussed on the landscape;
- Communities where development results in changes in the landscape setting or valued views enjoyed by the community;
- Owners and occupants of property with views on a visual resource which may be affected by the development (being it rural or urban).

The location of possible sensitive receptors within the visual catchment of the powerline is shown on the map in **Figure 8.15**. Viewer incidence has been determined to be the highest along the N1 National Road. Commuters and tourists using the N1, as well as local roads, could be negatively impacted upon by visual exposure to the powerline. The perception of this group has not been assessed, and it is assumed that tourists would be more sensitive to continuous views of the powerline, than other commuters.

Other than along the above roads, viewer incidence is concentrated in towns and villages (Makhado and nearby villages), in nature reserves and on farmsteads. Of these, visitors / tourists staying in lodges and on game farms are particularly sensitive to the visual intrusion of powerlines.

The sensitivity of visual receptors is considered to be lower within urban areas than within rural homesteads and farmsteads beyond the urban zone. This is due to the state of the visual environment within urban areas due to buildings, structures and visual clutter. For this reason, the urban areas have not been highlighted as sensitive receptors.

The severity of the visual impact on visual receptors decreases with increased distance from the proposed powerline. For this reason the building points on the map in **Figure 8.15** have been colour coded (refer to the legend on the map).

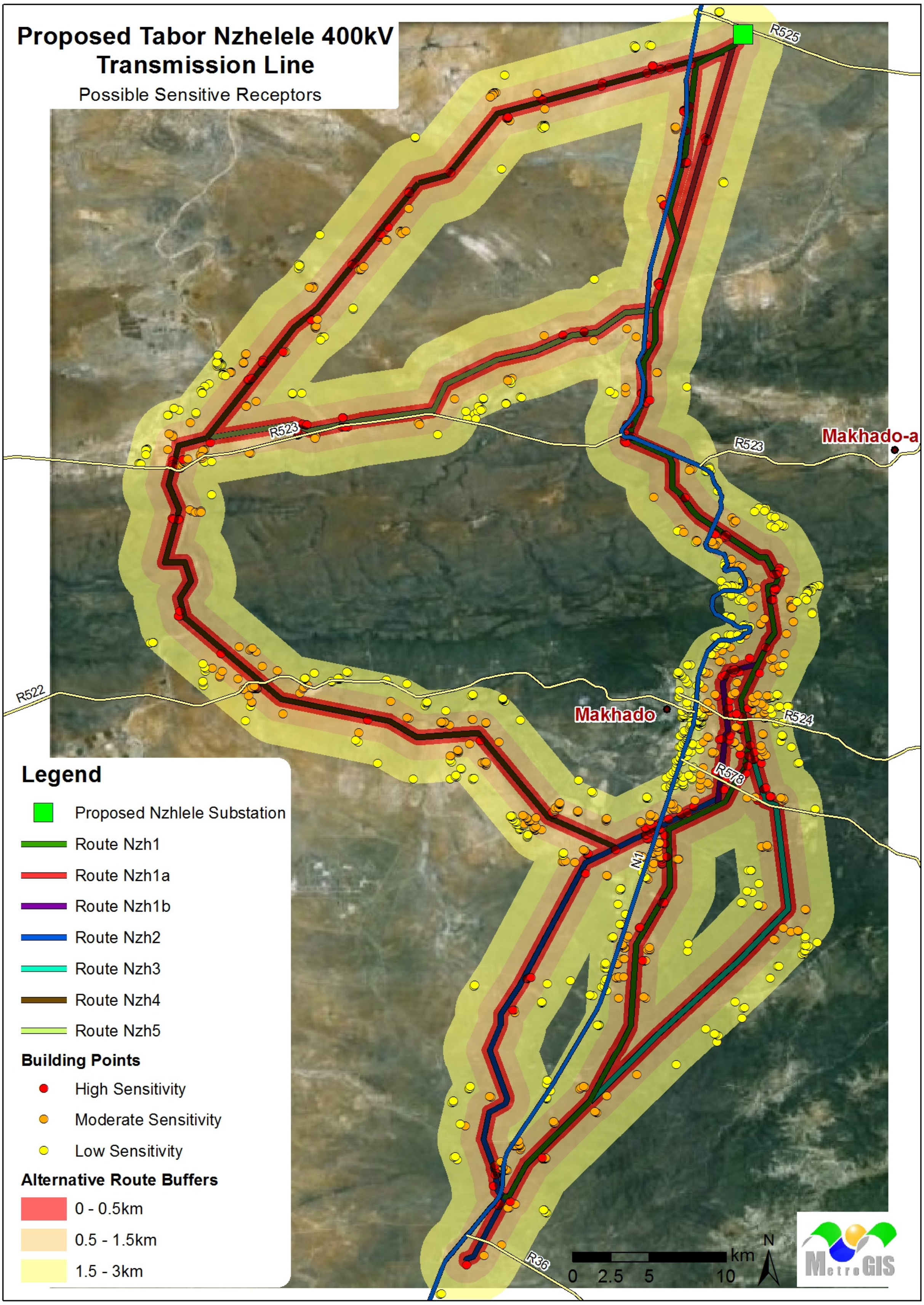


Figure 8.15: Map of possible sensitive receptor locations, with symbols differentiated by virtue of proximity to the powerline.

- *Visual Absorption Capacity*

Visual quality relates directly to the intrinsic qualities of a landscape that make it distinct and memorable. Visual absorption capacity (VAC) is an indication of the relative ability of the landscape to assimilate the changes brought about by the new development, thereby getting absorbed into or contrasted with the visual quality of the landscape. It also indicates the ability of natural features, such as trees or high ground, to screen or hide an object where it would have been visible otherwise.

The visual absorption capacity (VAC) of the landscape varies across the study area. This will be high in locations with dense vegetation where trees and bushes in the foreground will obstruct views of the powerline (refer to the photograph in **Figure 8.16**). The mountainous terrain of the Soutpansberg serves both the purpose of high and low VAC. In the situation where the powerline is visible as a vertical intrusion above the horizon, the VAC will be low (refer to the photograph in **Figure 8.17**). On the other hand, the presence of steep slopes in the background, especially with abundant vegetation cover, provides assimilation opportunities. This is possible, given the visually penetrable characteristics of conductor cables and suspension towers (often the reason why pilots fly into powerlines) – refer to the photograph in **Figure 8.18** where an existing powerline is virtually invisible.

Figure 8.16: View of the Soutpansberg and a farmstead, illustrating a scene with a visually coherent and harmonious pattern.

Figure 8.17: View of a powerline in the distance, illustrating the VAC of the Soutpansberg landscape in terms of visual screening and background assimilation**.**

Figure 8.18: View of powerline cables in the foreground, partially screened by vegetation close to the observer.

- ***Cumulative Impacts***

Cumulative visual effects can arise in three reasonably distinct ways.

First there is the effect of the extension of an existing development, or the positioning of a new development such that it would give rise to an **extended** and/or **intensified** impression of a pre-existing powerline in the landscape, as seen from fixed or transitory locations. This type of cumulative effect is categorised as *'static combined/simultaneous'*, and is relevant in the case where the proposed 400kV powerline will run parallel to existing powerlines.

Secondly, cumulative impacts can arise through an **increase in the perceptions** of sensitive receptors where powerlines are observed from locations from which more than one powerline would now be seen in different parts of the landscape. This distinction becomes relevant when the observer faces or visualises one powerline with another in the opposite direction behind her/his back.

Third, an increase in the incidence of sequential perceptions of different powerlines can occur through the **recurrence of images** and impressions arising from powerlines at various points in the landscape and which are continuously encountered when moving through it. This is particularly the case with the N1 National Road.

The significance of cumulative impacts is difficult to assess. On the one hand it can be reasoned that the *static combined/simultaneous* effect takes place where pre-existing powerlines have already established a visual impact and that the powerlines have become an integral part of the landscape. The argument is therefore that the significance of visual impact would be low.

On the other hand, there should be recognition of the limits of the environment to accept further development without notable harm (adverse visual impact). Cumulative impact assessment therefore seeks to ascertain if the introduction of new powerlines is likely to reach or exceed that limit. This is noteworthy in sensitive areas such as the Soutpansberg, which is highly appreciated as a visual resource.

Given the diverse character of the receiving environment between Tabor Substation and the proposed Nzhelele Substation, different effects of cumulative impact can be expected. The significance of cumulative impacts is of greater importance in the sensitive Soutpansberg region. Since the crossing of the Soutpansberg cannot be avoided, serious attention should be given to the design of the powerline (type of tower and site specific route alignment) in order to lessen the visual impact.

- ***Lighting & Light Pollution***

Night time light pollution is one of the aspects of visual impact that is becoming more relevant in as far as it disturbs the quality of night time outdoor experiences in a wilderness area. Sky glow and glare is anticipated to be the biggest effect of night time lighting at the proposed

Nzhelele Substation. Sky glow is the brightening of the sky directly above the source of concentrated lighting, and glare is the uncomfortable brightness of a light source when viewed against a dark background. Glare is only possible where a direct line of sight exist between the viewer and the light source. Sky glow is visible as a dome directly above the substation, and can be seen even if the powerline itself is not exposed to a particular location.

The design and layout of the proposed Nzhelele Substation indicates the provision of lighting dispersed over a large area. This will inevitably lead to sky glow and glare, experienced from roads and farms around the substation.

The measuring and analysis of light pollution, and the ensuing impacts, is a very challenging task. Many factors play a role in sky glow, which is the largest effect of light pollution. One must not only consider the lighting, but also the angular distribution of the light emitted from the luminaries, the light reflected from the ground and its angular distribution, as well as atmospheric effects of humidity and the interaction of light with dust particles in the atmosphere. These are factors which can change from moment to moment. The description of light pollution at the proposed Nzhelele Substation is therefore conceptual, based on existing information.

The information at hand shows the fact that lighting is required for 24 hour operations and security measures. All lighting, especially outdoor industrial lighting can have an impact on night time visual conditions. Structures and ground surfaces that are highly illuminated can be clearly visible for long distances. This will likely brighten the atmosphere between the ground and night sky, making the sky less visible. The amount of lighting sources is primarily cumulative, with each brightly-lit structure affecting night sky visibility. This impact is of particular concern for wilderness areas where clear and unpolluted night skies become part of the outdoor experience.

The following solutions to lessen the impact of light pollution on the environment are presented:

- *Shielded lighting:*
  Light that shines upward and away from the site is a direct waste and can be prevented. Redirecting light downwards, only to where it is needed, will reduce the unnecessary spill of light. This can be achieved by shielding individual light fittings, or complete structures and buildings.
- *Placement:*
  Optimised placement/layout of lights ensures that any light spill is directed away from the sensitive areas and that the minimum number of lights is installed to meet the required lighting levels. This can be achieved through modelling software used for lighting designs.
- *Fittings:*
  Cut-off street lamps shall be used instead of bulkheads for path and road lighting.
- *Lamps:*
  The use of low- or high-pressure sodium lamps is more suitable to environmentally sensitive areas. These produce an orange component (light spectrum) instead of the blue component of mercury lamps or metal halide discharge lamps. The enhanced blue part of

the spectrum is more visible by animal species and can be more disruptive.

- *Control:*
  Dividing the lights into zones and switching these zones only when necessary will minimise the light pollution. This can be achieved by placing PLC controlled contactors in the lighting DB's or by using manual light switches. Correct calibration of photocells will ensure that the lights turn on and off at suitable levels of ambient light.
- *Surfaces:*
  Less reflective surfaces will result in less reflection into the surrounding areas. Darker surfaces will be suitable for this.

8.9.2 Recommended Mitigation and Management Measures

The proposed Tabor - Nzhelele 400kV powerline is a linear structure covering a distance of more than 80km. The proposed Nzhelele Substations covers a large footprint area and consist of a variety of industrial components. Mitigation measures are few, and restricted to the following:

- Design;
- Route selection;
- Landscaping;
- Prevention;
- Rehabilitation.

- ***Design***

The most appropriate measures lie with the design of the facility. The sketches of typical 400kV towers in **Figure 8.19** suggest that the cross rope suspension tower contains less material and would be less visible than the supporting strain tower:

- Reduce the footprint and height of towers.

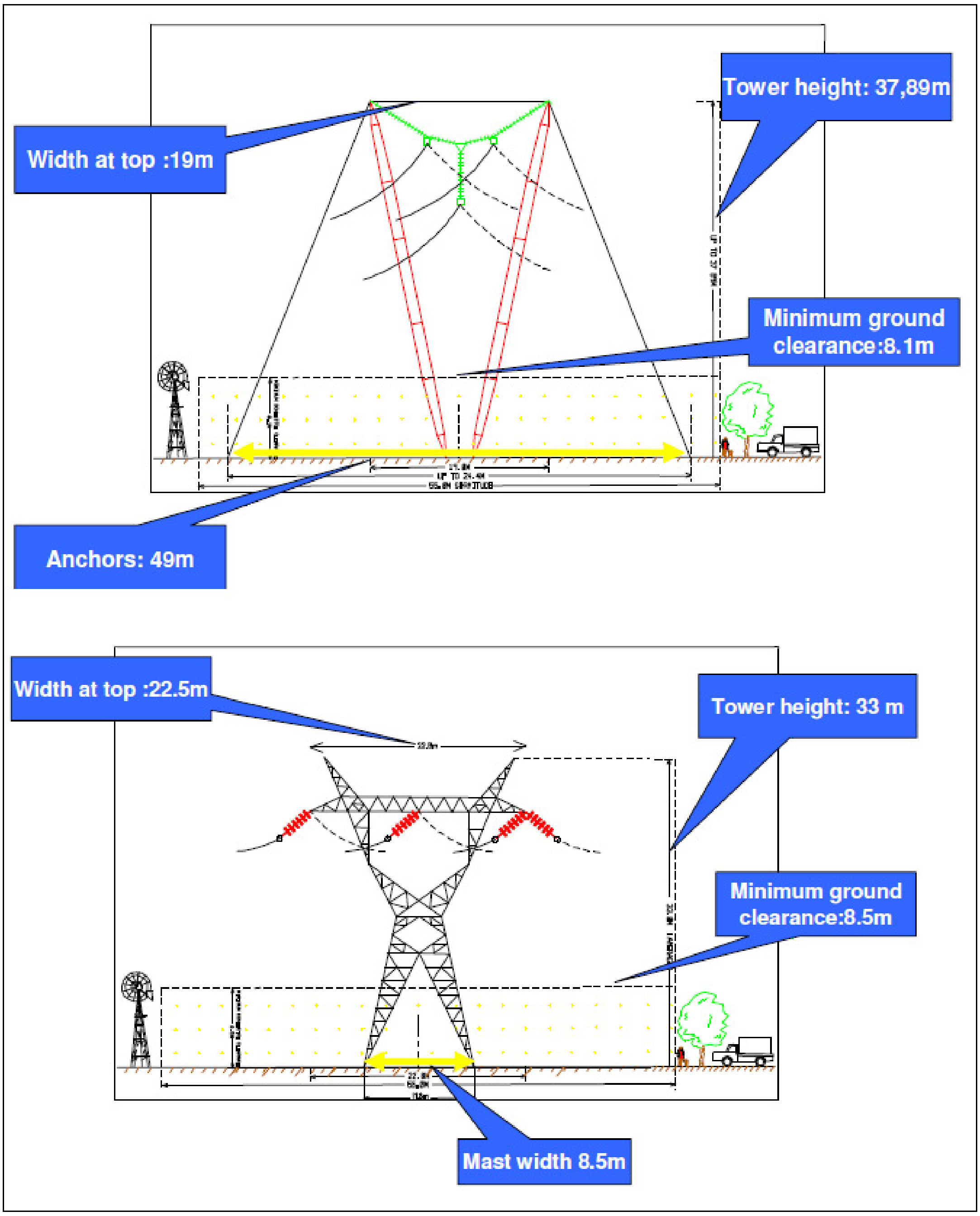


Figure 8.19: Design of a typical 400kV tower: cross rope suspension tower (top) and supporting strain tower (bottom).

- ***Route Selection***

According to US-BLM (2009) the following considerations for determining the route alignment for a powerline apply (Refer to **Figures 8.20 & 8.21**):

- Topography is a crucial element in alignment selection. Visually, it can be used to subordinate or hide manmade changes in the landscape. Projects located at breaks in topography or behind existing tree groupings are usually of much less visual impact than projects located on steep side slopes. By taking advantage of natural topographic features, cut and fill slopes can be greatly minimized.

- Topographic breaks frequently exhibit a natural line element that the proposed alignments can repeat or blend with to strengthen the design. This line element is partly established by a visual shadow zone, which will further aid in reducing the contrast of the project.
- Crossings with other linear features or structures, such as roads, fire breaks, etc., should be designed to minimize their visual impact:
  - When possible, crossings should be made at a right angle.
  - Structures should be set as far back from the crossing as possible.
  - In areas with tree and shrub cover, the rights-of-way and structures should be screened from the crossing area.

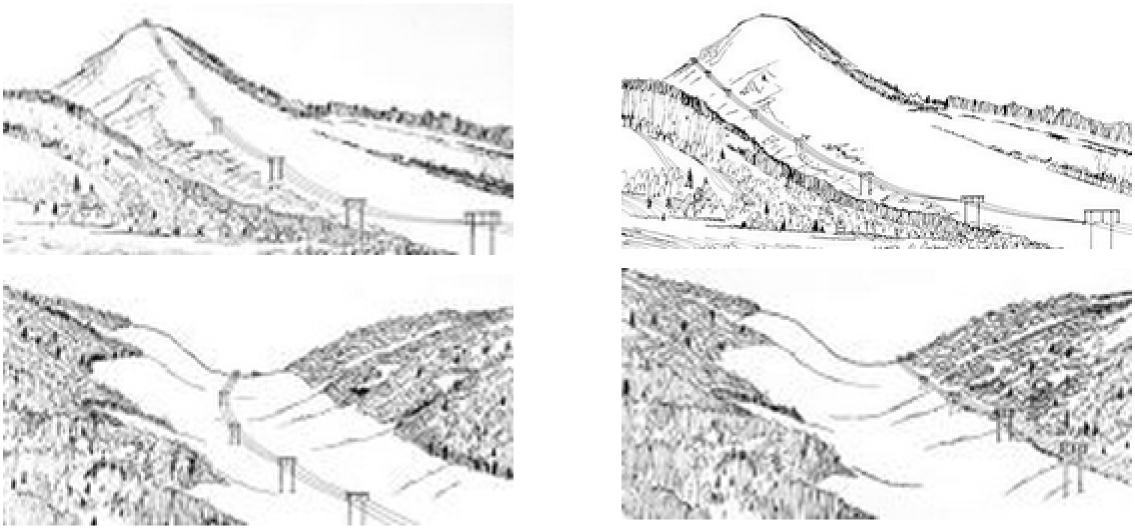


Figure 8.20: Focal points in the landscape should be avoided because the human eye is attracted to these points first. (Source: US-BLM, 2009)

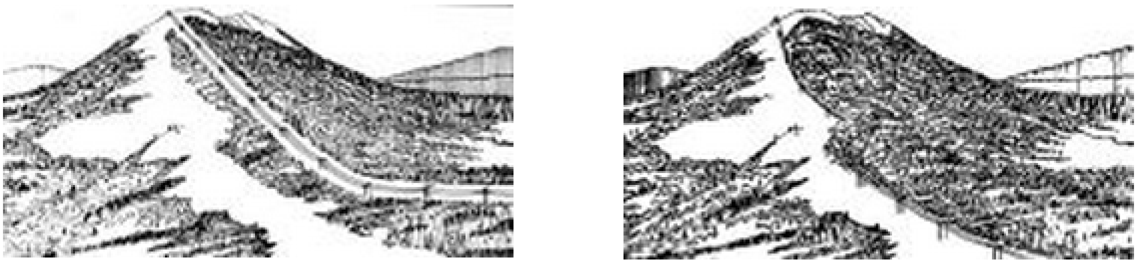
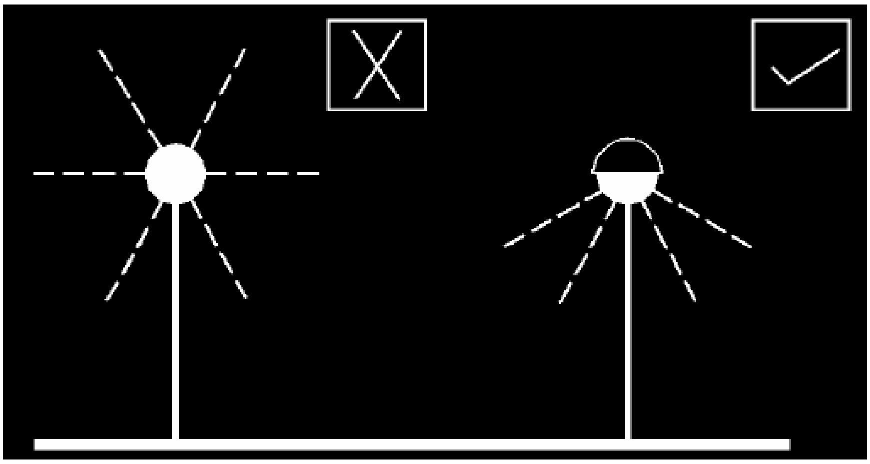


Figure 8.21: New disturbance should be avoided and the natural lines in the landscape should be followed. (Source: US-BLM, 2009)

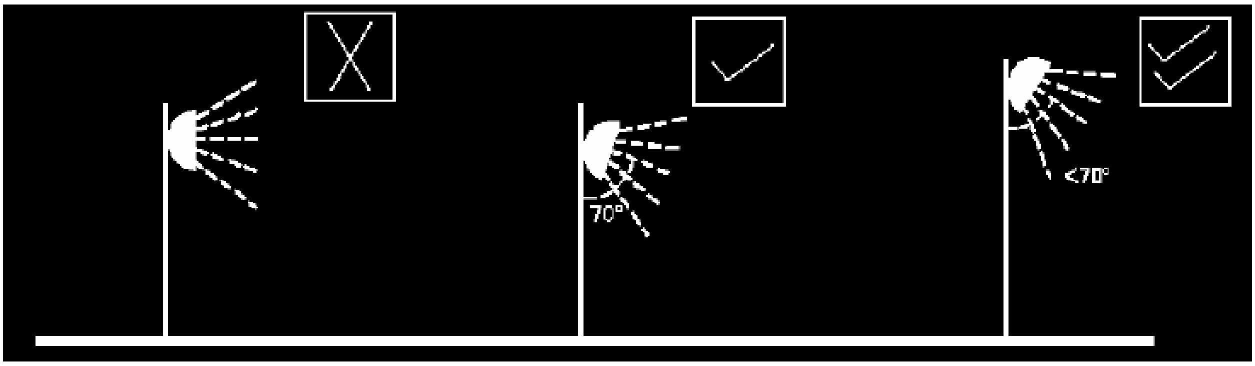
- ***Lighting***

With regard to light pollution, the following mitigation measures should be introduced:

- Use specifically designed lighting equipment that minimises the upward spread of light near to and above the horizontal. Care should be taken when selecting luminaries to ensure that appropriate units are chosen and that their location will reduce spill light and glare to a minimum.



- Keep glare to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70°. Higher mounting heights allow lower main beam angles, which can assist in reducing glare. In areas with low ambient lighting levels, glare can be very obtrusive and extra care should be taken when positioning and aiming lighting equipment.



- ***General Mitigation Measures***

Other mitigation measures include the following:

- Avoid the unnecessary removal of vegetation. Avoid sharp edges along the boundaries of the powerline servitude by leaving trees or clumps of bushes intact, thereby breaking the straight lines of the servitude boundaries.
- Identify sensitive viewer locations from where the clearance of vegetation in the powerline servitude is highly visible, and identify patches of vegetation or individual trees that can be used as landscaping features;
- Introduce trees to the landscape at strategic locations to break full exposure of the powerline. Further studies and analysis in this regard will be required;
- Actively rehabilitate construction sites.
- Rehabilitate of the landscape as much as possible to its original state, after decommissioning and removal of the powerline infrastructure.

More detailed mitigation and management measures can be found in the Environmental Management Programme included in **Appendix E**.

8.10 Social Environment

The Social Impact Assessment has been included in **Appendix P.**

8.10.1 Potential Impacts

The following potential social impacts were identified:

- Influx of job seekers, mainly unskilled labour, from communities around the power line route having job expectations
- Health impacts from construction sites and camps as a result of exposure to sewage waste, infectious diseases such as measles, TB and HIV/AIDS
- Conduct of construction workforce; Good relationships between community members/ farm workers and Eskom Construction workers can result in issues such as sexual misconduct and the spread of diseases
- Conduct of construction workforce; Bad relationships between community members/ farm workers and Eskom Construction workers leading to violence due to possible perceived stock theft etc.
- Theft of material from camps and construction sites
- Negative attitudes towards the project and the formation of community groups, NGO's, in response to the project
- Land owners denying contractors access to their properties
- Loss of crops leading to economic losses
- Loss of land leading to economic losses
- Impact on farming activities such as sowing, harvesting, and fire management programmes
- Impact on farming activities such as hunting in game farms leading to economic losses. Impacts can also be on guests in lodges leading to economic losses
- Damage to farm infrastructure e.g. irrigation equipment, gates, fences
- Security concerns as a result of poaching of game, stock theft and crop theft

- Security concerns as a result of the presence of workers on properties and communities during construction and during the operational phase for maintenance

- Safety of community members/farm workers/animals during construction and maintenance

- Perceived electromagnetic fields impacts on humans and animals during the operational phase

- Loss of sense of place/income on game farms – Tourists want to see Africa and power line can possibly disturb the rustic African setting;

- Decrease in property values due to the visual impacts of power lines as well as the perceived impacts of electromagnetic fields on humans and animals;

- Poor maintenance of the power line access roads: conflict between Eskom and the landowners on whose responsibility it is to do maintenance on these roads. Farmers use it more often but yet expect Eskom to pay for all maintenance

- Impact of the power lines on aircraft as there are airports within the study area; one is the Louis Trichardt airport and the other is for light aircraft on the road towards Waterpoort from Louis Trichardt

- Increase in the voltage stability

- An assurance of a reliable electricity supply

- Increase of electricity supply making it available for agriculture, tourism and other industries. The increase in electricity may also allow for the undertaking of other activities that may have been that may not have been possible prior to the improved supply of electricity

- No more backlogs in electricity connections

- The inadequate provision of electricity to services such as health facilities will cease

- Numerous rural settlements such as Muraleni,Madabani, Midoroni and Manavhela that do not have electricity may have access to these services in the future

A description of the impacts on each of the alternatives in provided below:

- ***Tab-Nzh1;*** Land use in this corridor comprises of game farming, irrigated agricultural lands, extensive avocado plantations and livestock farming. Sparse settlements such as Welteverede exist within this corridor. The corridor crosses the Ben Lavin Nature reserve at the western boundary (600m) and runs parallel to northern boundary for approximately 4km. This southern section of the corridor stops just before the mountain where alternatives ***Tab-Nzh1b***) and part of ***Tab-Nzh3***; transverses some sections against the lower slopes of the mountain. On the higher slopes, lower “Witflag” road and across the higher “Witflag” road and across the mountain, crop farms will be mostly affected by this route and the loss of cultivated land may lead to economic losses. Along the southern side of the mountain, avocadoes are cultivated in large quantities. The impact on the plantations will be worsened if the existing Eskom line route is not followed. Although the servitude needs to be widened, in the case where the existing Eskom route is followed to accommodate the new 400kV line, existing access roads can be used decreasing the expected negative impact..

- ***Tab-Nzh1a;*** This proposed route within the corridor runs parallel to the existing Eskom 132kV line on the Northern section of the route for the last 13,1 km towards the proposed new Nzhelele substation. This area is comprised mainly of game farms.

- ***Tab-Nzh1b;*** This route alternative within this corridor runs to the east of the Louis Trichardt town and is the closest to the town. Crop farms will be mostly affected by this route and the loss of cultivated land may lead to economic losses. Especially these sections on the Southern side of the mountain avocados are cultivated in large quantities. This will even be worse if the existing Eskom line route is not followed. Although the servitude needs to be widened to accommodate the new 400kV line, existing access roads can be used decreasing the real impact.

- ***Tab-Nzh2;*** This links to the Tab – Nzh 4. This corridor is highly disturbed and is mainly used for mixed farming practices. Game Farms such as Shiawela Safaris will be affected by this route and the visual and other impacts such as those on animals may lead to economic losses. Some parts of the power line also runs along a railway track. Some communities, such as, will directly be affected. The social impact on communities and settlements can be negative if not managed.

- ***Tab-Nzh3*;** The route runs along the eastern boundary of the Ben Lavin Nature Reserve. The southern side of the route runs through mainly game farming. On the northern side, it comprises agricultural land and game farming, veld and residential area in the form of plats on the farm Vondeling.

- ***Tab-Nzh4;*** The southern side of this route will affect numerous rural settlements such as Hamantsha, Schoemansdal, Madaheni and also the town of Waterpoort. This corridor has the most scattered communities within its vicinity. At least 11 communities will be affected all the way from Hamagau to Gamadulathoka on the southern side of the mountain. The economic impacts of the power lines could be positive in the sense that businesses in the area could benefit and new businesses could open leading to a slight increase in economic growth during construction. On the northern side of the mountain the power line will cross some game farms and possible economic losses can occur due to the change in character caused by the new infrastructure. It will also cross Waterpoort where a railway station is situated. Most of the rest of the line runs parallel to the railway line with mixed farming on both sides. The last section of approximately

10 km to the new substation will traverse pristine game farming area with no existing access routes to the specific the corridor.

- ***Tab-Nzh5;*** The proposed corridor on the Waterpoort side of the mountain traverses mixed land uses such as crop cultivation and livestock. Part of the route along the R523 is used as game farming whereas the last part of the corridor for approximately 18 to 20 km runs through mainly game farming area with no existing access routes. This will affect the game farming business that is predominant in this area.

8.10.2 Recommended Mitigation and Management Measures

These mitigation measures are a response to the environmental impacts identified. In certain cases two or three similar impacts are grouped together, e.g. job creation and expectations within a community when a project starts.

- Influx of job seekers, mainly unskilled labour, from the communities around the power line route having job expectations
    - Identify all labour requirements before construction starts;
    - Identify possibilities and creation of a liaison desk 4 months before construction starts;
    - Communication strategy well in advance of project start.
    - Ensure that there is a Community liaison officer from affected communities and together with them study possibilities of jobs for community members e.g vegetation clearing, food vendors
    - Where the jobs have been identified, these must also be formalised through issuing of permits to avoid conflicts within the community and to avoid loitering.
    - Where possible, ensure that all interested community members get an opportunity to work on the project during construction e.g for vegetation clearing, each community member can be allocated a period of working and when this period elapses, other community members should be given an opportunity to also work and generate some impact.
    - Have clear rules and regulations for access to the camp / site office to control loitering. Consult with the local SAPS to establish standard operating procedures for the control and/or removal of loiterers at the construction site. Ensure that community members are aware of the possible results of loitering before construction starts

- Health impacts from construction sites and camps as a result of;
    - Exposure to sewage;
        - Construction workers are prohibited from using their surroundings to relieve themselves
        - Pit latrines are prohibited on the construction camps or sites. Only mobile or portable toilets shall be used and these must be sufficient for all workers at a ratio of 1 toilet to 15 persons and provided with toilet paper.

        - The toilets shall be emptied and cleaned regularly and the contractor shall ensure that waste is not spilled. This can be done through measures such as covering the ground with a water proof material. Furthermore, the toilets and their tanks shall be serviced on a regular basis and where necessary replaced.
        - Construction workers are required to be treated for worms
    - Waste
        - Littering on site should be prohibited and the ECO should inspect this
        - Fines could be implemented for littering"
        - Waste shall be collected at regular intervals in sealed containers that will be removed from site and camps before overflowing. The containers will then be disposed of at recognised facilities. The waste shall be separated before removal from the site and any reusable or recyclable waste identified.
    - HIV/AIDS
        - An intense HIV/AIDS and STI awareness campaign should be launched. These should be directed at all construction workers and communities as well.
        - "Condoms should be distributed by placing them at centrally located points and by ensuring that construction workers and community members are aware of the availability and location of condoms. The distribution of condoms should be approached with the necessary cultural sensitivity".
        - Local women who may form relationships with construction workers should be empowered through measures such as job creation on the project as this will result in them becoming financially independent and in turn reduce their likelihood of having relationships with construction workers in return for financial favours.
        - Access at the construction site should be controlled to prevent sex workers from either visiting and/or loitering at the construction village.
    - Other diseases e.g. TB, measles
        - All construction workers should be treated for these and proof of this should be retained.

- Conduct of construction workforce; Good relationships between community members/ farm workers and Eskom Construction workers can result in issues such as sexual misconduct and the spread of diseases;
    - In the Environmental Management Programme (EMPR) ,state that no unauthorised personnel are to enter the site without permission from the site officer/ Environmental Control Officer (ECO)
    - An Environmental Control Officer (ECO) must be appointed to ensure contractors conduct themselves in an appropriate way. A fining system for non-compliance must be set in place

- Conduct of construction workforce; Bad relationships between community members/ farm workers and Eskom Construction workers leading to violence due to possible perceived stock theft etc.;

  - In the Environmental Management Programme (EMPR) ,state that no unauthorised personnel are to enter the site without permission from the site officer/ Environmental Control Officer (ECO)
  - An Environmental Control Officer (ECO) must be appointed to ensure contractors conduct themselves in an appropriate way. A fining system for non-compliance must be set in place;
  - Liaising with the local police and having security personnel on the site will ensure that any possible eruption of violence can be avoided

- Theft of material from camps and along construction sites
  - Fencing shall be erected around the construction camp and access shall be controlled through a lockable gate and security personnel. The fence shall be constructed of high quality material bearing the SABS mark. Furthermore, the fence shall be inspected on a daily basis and any damages should be fixed as soon as it is practicable. To increase security, shade cloth can be attached to the fence and similar to the fence, shall be inspected daily and fixed as soon as it is practicable. Storage facilities shall be lockable.
  - In addition to the above, all persons or vehicles entering or leaving the construction camp shall be subjected to a search
  - At each site, ensure that there is security personnel

- Negative attitudes towards the project and the formation of community groups, NGO's, in response to the project;
  - Ensure that there is on-going communication with the affected parties and provide contact details of persons that they can contact should they have queries or comments about the project
  - Highlight the benefits of the project.
- Land owners denying contractors access to their properties
  - There must be communication with landowners in regards to procedures for entering onto farms
  - Eskom must ensure that land owners are informed of the construction dates as well as dates for maintenance
- Loss of crops leading to economic losses;
  - Ensure that construction takes place when the land is fallow and with no crops
  - Where possible, power line towers should be located along the boundary of the farm to lessen the loss of crops
  - Where power lines can't be places along property boundaries, ensure that construction takes place when the land is fallow and with no crops
  - Discuss with land owners that the loss of land will only be during the construction phase as some activities such as crop farming can still occur below the power line after construction has ended

- Loss of land leading to economic losses;
  - Where possible, power line towers should be located along the boundary of the farm to lessen the loss of land

  - Discuss with land owners that the loss of some land may be temporary and will only be during the construction phase as some activities such as crop farming can still occur below the power line after construction has ended; in addition after construction, land will be rehabilitated to as close as possible to its original status
  - Where the loss of land is permanent, Eskom should discuss compensation with landowners

- Impacts on farming activities such as sowing, harvesting, and fire management programmes leading to economic losses
  - Construction should not take place during seasons when there is likely to be high activity on farms e.g. In the case of sowing, construction can occur before this happens, and in the case of harvesting, construction can occur after this has taken place.

- Impact on farming activities such as hunting in game farms leading to economic losses. Impacts can also be on guests in lodges leading to economic losses.
  - In game farms, maintenance can be undertaken outside the hunting season.
  - In lodges, maintenance can be undertaken during low peak seasons and this can also be extended to weekdays when guests are likely to be fewer.

- Damage to farm infrastructure e.g. irrigation equipment, gates, fences
  - Where possible towers should be placed on the edges of farm boundaries and along any existing roads as infrastructure is likely to be minimum or absent with the exception of farm fences and gates which if damaged by contactors should be fixed.
  - Where possible, farm infrastructure can be moved for the duration of construction; where this is not possible, the power line route can be altered to avoid the damage to the infrastructure

- Security concerns as a result of poaching of game, stock theft and crop theft;
  - Construction should only take place outside the hunting season
  - Where possible, animals should be fitted with tracking devices or placed in secure enclosures for the duration of construction.
  - Land owner can also appoint guards to ensure that construction workers and their equipment are inspected prior to leaving the property.

- Security as a result of the presence of workers on properties and communities during construction and during the operational phase for maintenance
  - In general, access to farms must be according to AgriSA's Protocol for access to farms must be adhered to
    - Advice landowners and community members about construction and maintenance dates
    - Advice landowners and community members about the number of workers expected
    - Upon arriving in a community or farm, workers must inform the community leader and farm owners or managers respectively

  - Ensure that construction workers are easily identifiable by construction uniform with logos and identification cards with logos and a photograph of the worker. Construction vehicles must also be marked
  - Construction workers should also carry their Identity documents with them and the land owner should be allowed to inspect these
  - The landowner should be allowed to check the identification cards and note the names of construction workers present on site.
  - Provide the landowners and community members should be provided with contact details of Eskom and the local SAPS to report any suspicious behaviour on their property as well as the presence of what seem to be unauthorised

- Safety of community members/farm workers/animals during construction and maintenance
  - Ensure that the construction sites and camps are fenced off and signage, in local languages, placed in a conspicuous place near the construction sites
  - Liase with community leaders/farm owners to ensure that they warn community members/farm employees of the possible dangers of moving close to the construction sites
  - Ensure that animals are secured during construction for their safety as well as that of construction workers

- Perceived electromagnetic fields impacts on humans and animals during the operational phase
  - Inform communities and landowners about the perceived impacts of power lines
  - Ensure that there are no developments below the power line so that although adverse impacts are uncertain, communities are not paces at risk.
  - On farms ensure that no buildings either for human or animal habitation are placed below power lines

- Loss of a sense of place/income on game farms – Tourists want to see Africa and the power line can disturb the rustic African setting;
  - Plan construction in those parts so that hunting season is avoided;
  - Choose those corridors that will have the least impact on the gaming industry;
  - Construction camps should not be placed in or close to game farm areas

- Decrease in property values due to the visual impacts of power lines as well as the perceived impacts of electromagnetic fields on humans and animals
  - Vegetation can be used to screen the power lines
  - Other measures can be discussed with Visual Impact Specialist

- Poor maintenance of the power line access roads: conflict between Eskom and the landowners on whose responsibility it is to do maintenance on these roads. Farmers use it more often but yet expect Eskom to pay for all maintenance
  - Put a firm negotiated contract in place during the operational phase

- Impact of the power lines on aircraft as there are airports within the study area; one is the Louis Trichardt airport and the other is for light aircraft on the road towards Waterpoort from Louis Trichardt
    - Information not available on Louis Trichardt airport. National aviation should provide information on seriousness of this issue;
    - Consult legislative restrictions and possible permit application.
    - Ensure that power lines are clearly visible to aircrafts;
    - Distribute information on the presence of new power lines to relevant air transport organisations

More detailed mitigation and management measures can be found in the Environmental Management Programme included in **Appendix E**.