4 PROJECT ALTERNATIVES

4.1 Introduction

In terms of the EIA Regulations published in Government Notice R543 of 2 August 2010 in terms of Section 24 of the National Environmental Management Act (Act No. 107 of 1998), feasible and reasonable alternatives have to be considered within the Environmental Impact Assessment, including the 'No Go' option. All identified, feasible and reasonable alternatives are required to be identified in terms of social, biophysical, economic and technical factors.

The consideration of project alternatives is a key requirement of an EIA as it provides a basis for choice for the competent authority. The NEMA EIA Regulations of 2010 define alternatives in relation to a proposed activity as "*different means of meeting the general purpose and requirements of the activity which may include alternatives to the:*

(a) property on which or location where it is proposed to undertake the activity;
(b) type of activity to be undertaken;
(c) design or layout of the activity;
(d) technology to be used in the activity;
(e) operational aspects of the activity; and
(f) option of not implementing the activity."

Alternatives are considered as a means of reaching the same need and purpose as the originally proposed project in a way that minimises its negative and maximises its positive impacts.

A key challenge of the EIA process is the consideration of alternatives. Most guidelines use terms such as 'reasonable', 'practicable', 'feasible' or 'viable' to define the range of alternatives that should be considered. Essentially there are two types of alternatives:

- incrementally different (modifications) alternatives to the Project; and
- fundamentally (totally) different alternatives to the Project.

Fundamentally different alternatives are usually assessed at a strategic level, and EIA practitioners recognise the limitations of project-specific EIAs to address fundamentally different alternatives.

Tower design and corridor alternatives were considered and assessed during this EIA.

4.2 The 'no go' alternative

In the context of this project, the no-go alternative implies that the powerlines linking the Tabor substation to the new Bokmakirie (Nzhelele) Substation in order to strengthen the

northern grid or that the expansion of the Bokmakirie substation to accommodate the new 400kV infrastructure will not be constructed.

The no-go alternative can be regarded as the baseline scenario against which the impacts of the powerlines are evaluated. This implies that the current biophysical and socio-economic conditions associated with the proposed routes will be used as the benchmark against which to assess the possible changes (impacts) to these conditions as a result of the powerlines.

In most cases, the no-go alternative will imply that the identified negative impacts of proceeding with the project will not be incurred. Conversely, selection of the no-go alternative will also result in the benefits (including the potential economic development and related job creation, and increased security of electricity supply for the northern areas of the Limpopo Province) of the project not being realised.

The 'no go' alternative is, however, be investigated further in the EIA phase as an alternative as required by the EIA Regulations.

4.3 Tower Design Alternatives

There are several tower design options available for use in the transmission line development, as described below. A variety or combination of tower designs are likely to be utilised for construction of the lines, depending on the characteristics and needs of the land and communities concerned (**Figures 4.1 – 4.5**). This section details the types of tower designs that could be placed along the length of the transmission line development. The final tower design alternatives will be decided based on a walk down of the final proposed alignment, and upon discussion with the relevant parties involved, including landowners. The various tower designs can all be utilised for 400 kV powerlines.

In some cases particular towers are more appropriate for use, such as:

- Self supporting strain towers are always utilised on a turn or before and after particularly long spans, especially where mountainous terrain is concerned.
- The compact cross rope suspension and guyed suspension towers are preferred when grazing land or game farming occurs due to the small footprint area of the base of the tower.
- The self supporting tower is preferred on areas where crop farming occurs, due the fact that there are no guy ropes, which can make ploughing difficult.

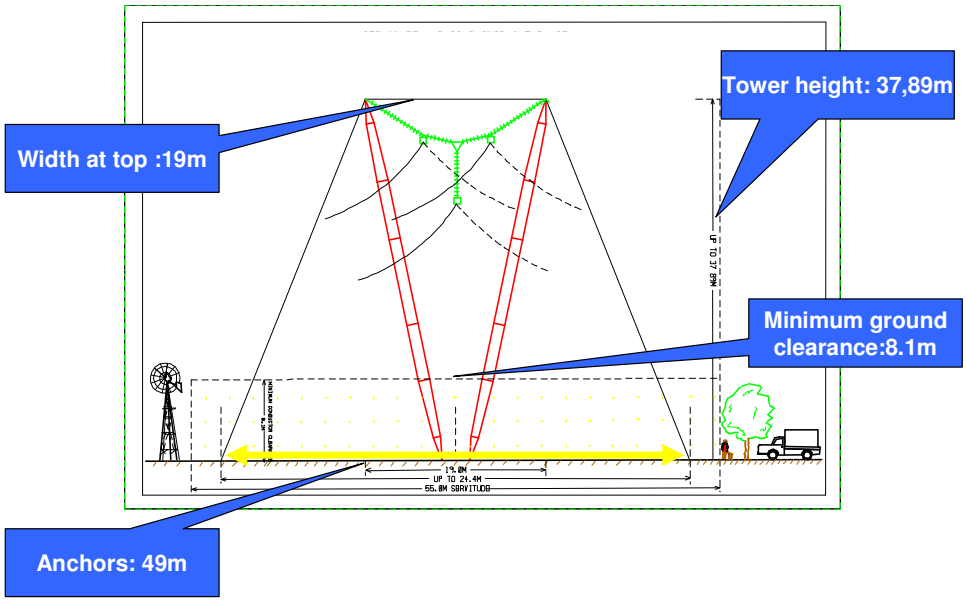

Figure 4.1: Illustration of a compact cross rope suspension tower

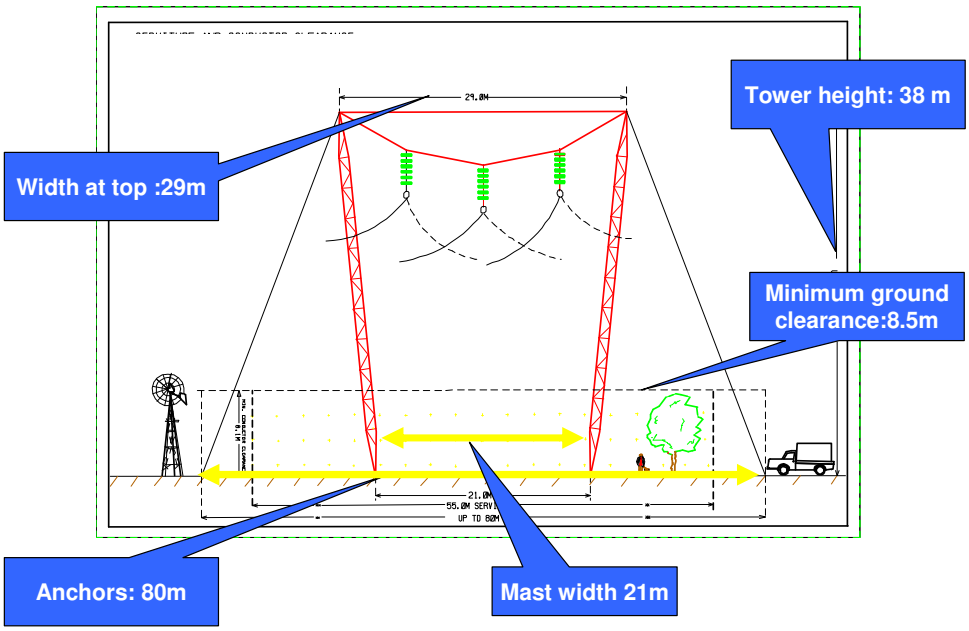

Figure 4.2: Illustration of a cross rope suspension tower

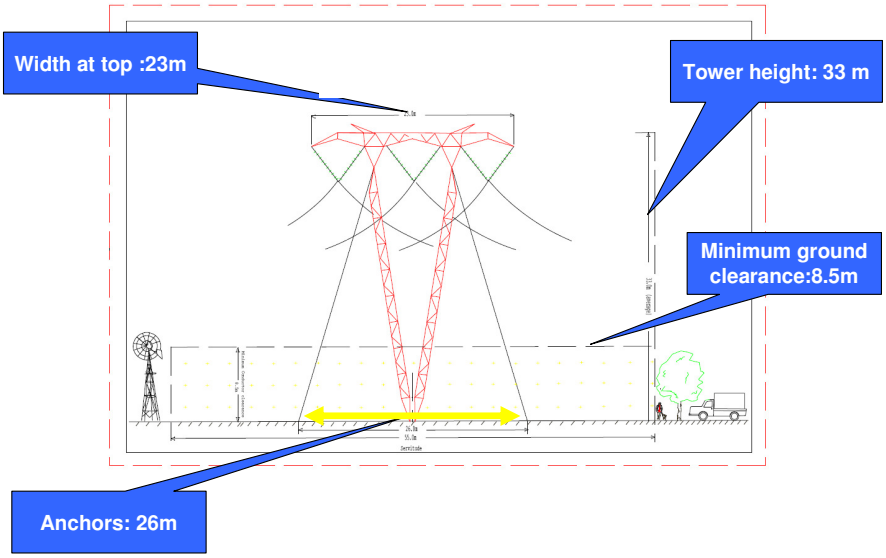

Figure 4.3: Illustration of a guyed suspension tower

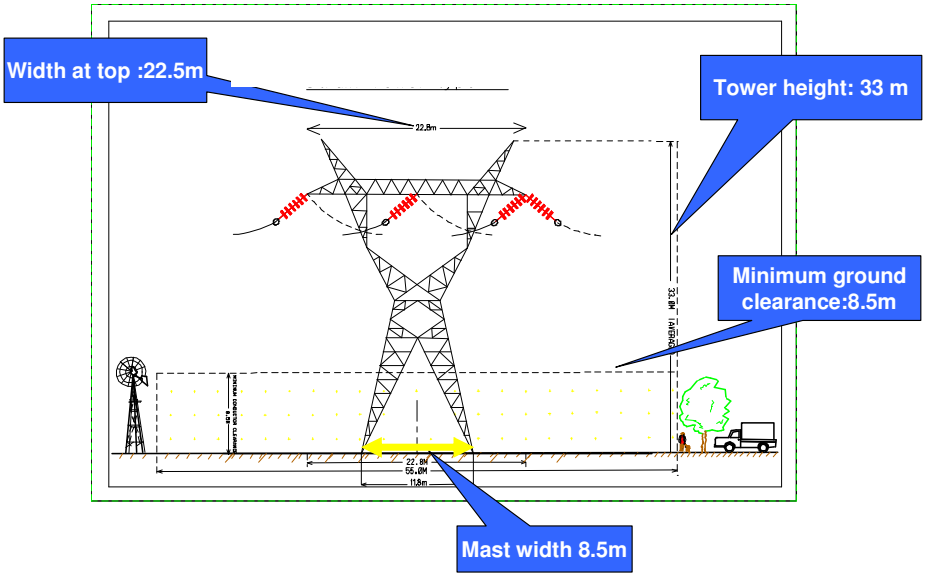

Figure 4.4: Illustration of a self supporting strain tower

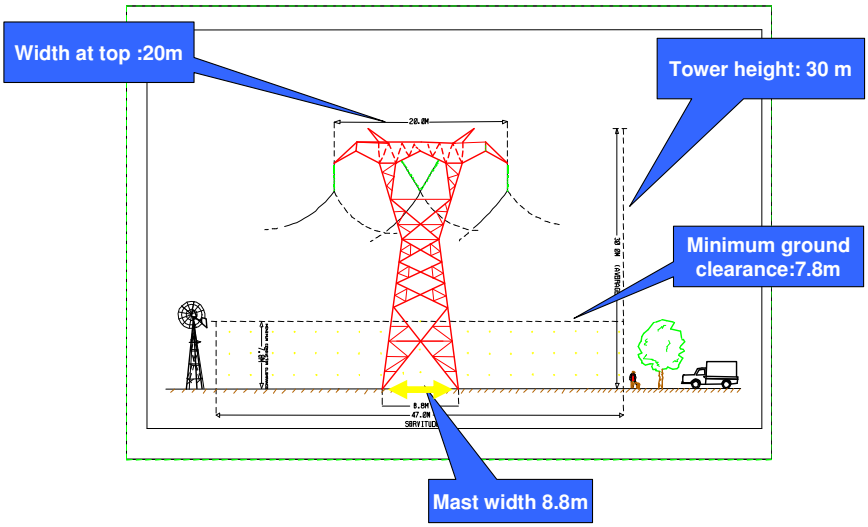

Figure 4.5: Illustration of a self supporting tower

4.4 Access Roads

A formal section of access road is proposed to be constructed through the farms Clydesdale and Vlakfontein. Two sections of the road have been identified to be paved with a suitable surfacing material, such as bitumen or concrete, in order to reduce erosion due to the steepness of the slopes. This road is proposed not only as an access road for the proposed 400kV line alternative but also required for the existing 132kV line. Due to the fact that this road was proposed as a result of a direct request from the landowners, for use during the maintenance of the existing 132kV powerline, there are no alternatives and will require establishment even in the event that the proposed parallel 400kV alignment is not considered preferred. **Figure 4.6** gives an indication of the proposed route that has been investigated during the detailed studies.

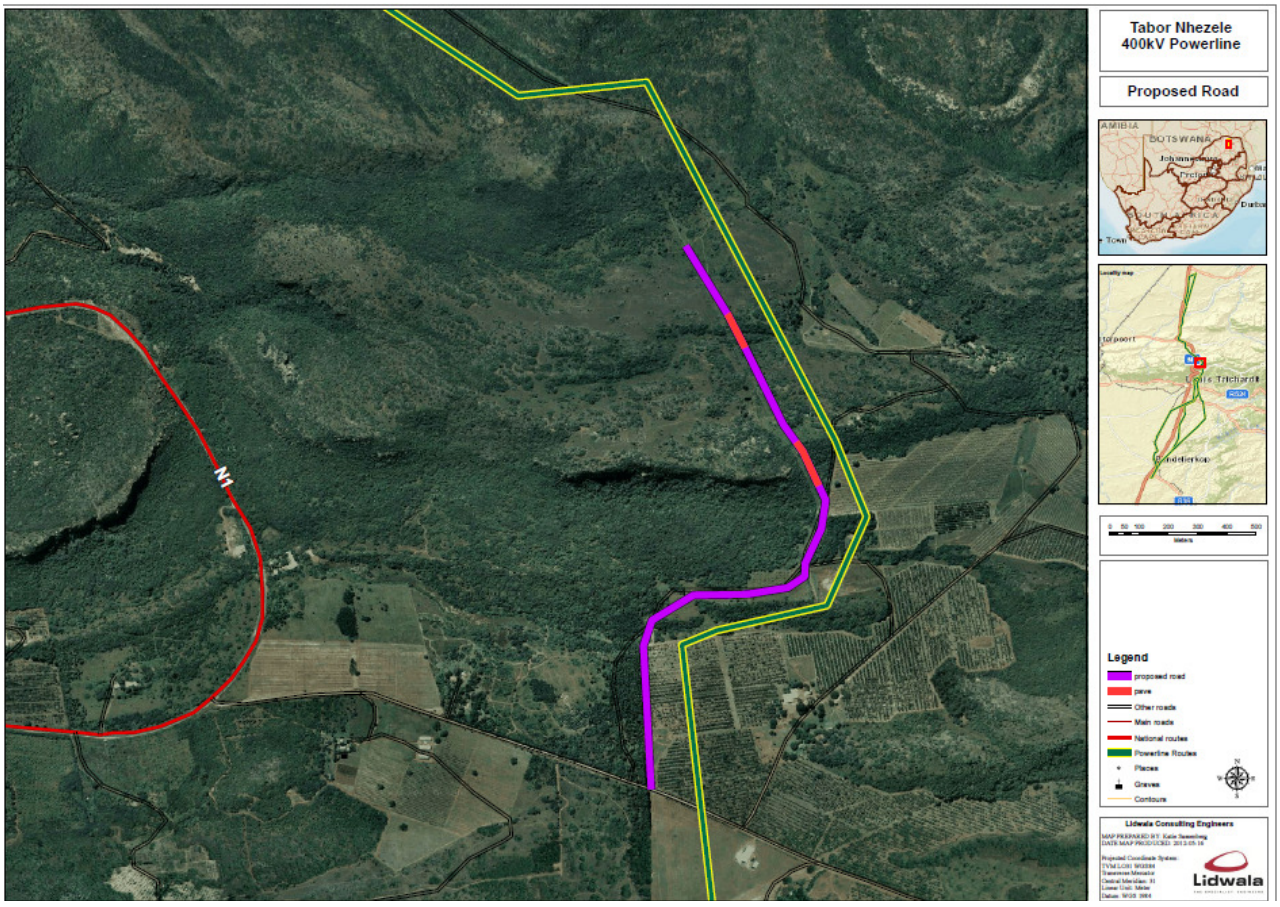

Figure 4.6: Proposed formal access road

In addition to the above access road a further 5 km of access road is proposed to be constructed between the N1 and the proposed new Nzhelele substation. **Figure 4.7** gives an indication of the proposed route that has been investigated during the detailed studies.

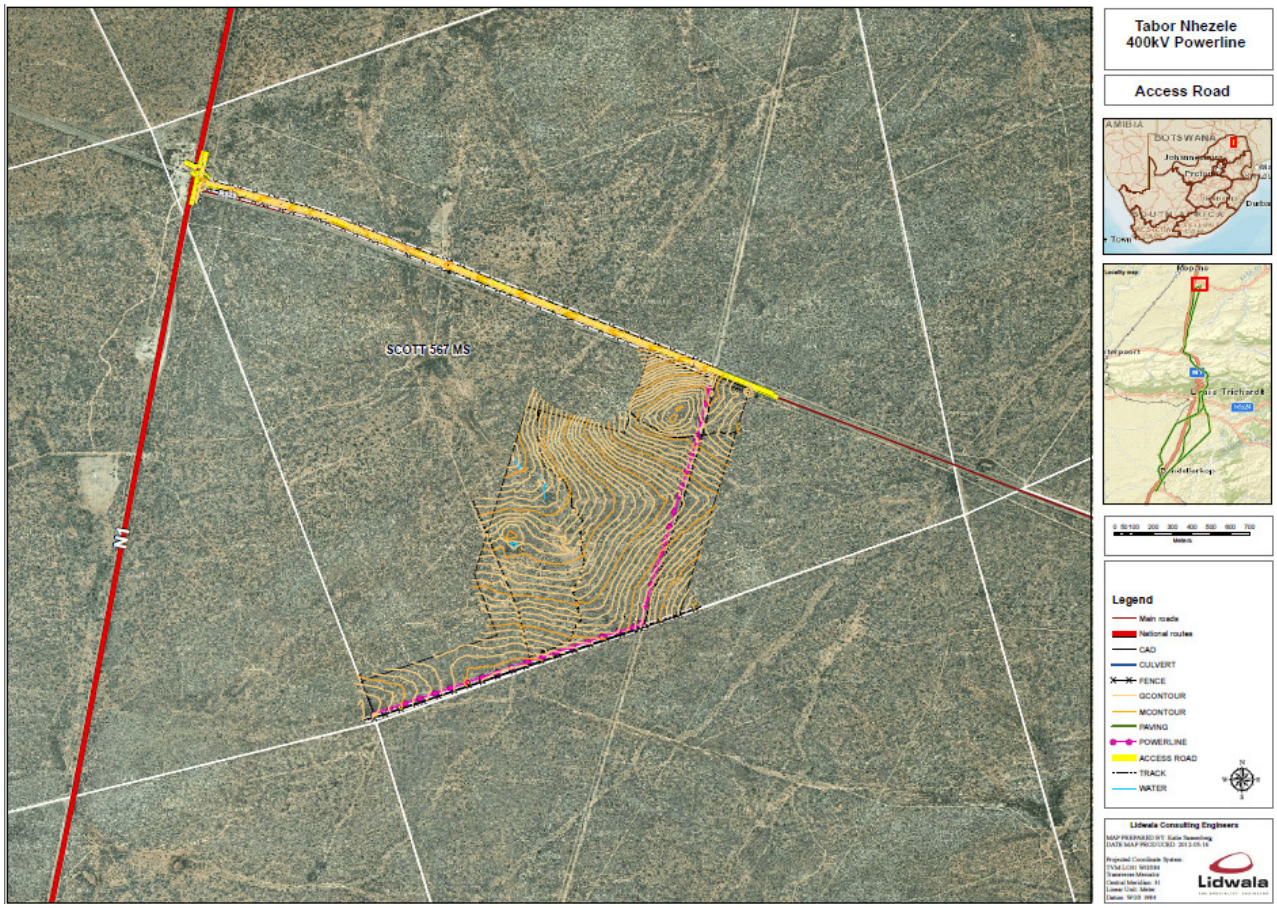

Figure 4.7: Proposed formal access road to the proposed new Nzhelele substation

4.5 Substation

The full scope of work for the substation includes:

- Expansion of Bokmakirie (Nzhelele) Substation with 4 X 250MVA 400KV/132KV transformers and associated infrastructure, including:
    - Terrace the Nzhelele 400kV yard for and end-state of 4x 400kV feeder bays,
    - Terrace the Nzhelele 132kV yard for and end-state of 8x 132kV feeder bays,
    - Establish the control building, telecommunication infrastructure, oil dam,

Although the Bokmakirie Substation is not yet built, it has received an Environmental Authorisation for the building of a Distribution size (2 ha) substation for the new 132 kV powerline that was recently established. The Bokmakirie Substation will be built on the Farm Scott 567MS Portion 2.

This project requires the expansion of the Bokmakirie Substation to allow for both the Tabor – Nzhelele Powerline and well as the Barutho – Nzhelele Powerline. The Bokmakirie Substation will need to be increased to a size of 25 ha to accommodate the above-mentioned infrastructure (**Figure 4.8**).

Due to the fact that the activities involved are expansion activities, there is no alternative site for the substation.

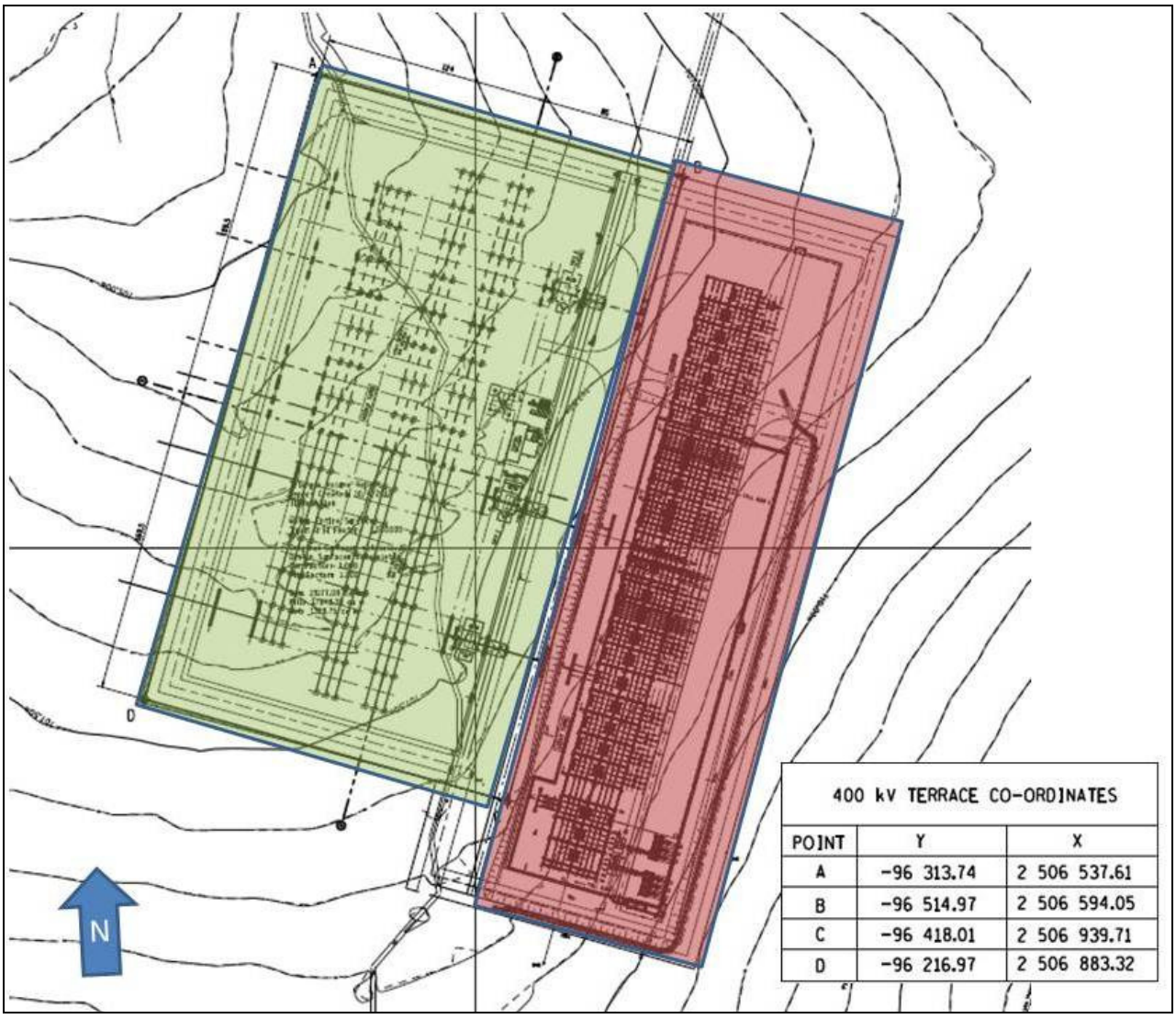

Figure 4.8: Proposed Nzhlele Transmission Substation expansion footprint versus the approved Bokmakirie Distribution Substation expansion footprint

4.6 Corridor Alternatives

The proposed powerline includes:

- One 400 kV powerline from the Tabor substation to the Bokmakirie (Nzhelele) substation.

This report will recommend the most preferred corridor for the powerline. Once the most preferred corridor have been recommended and authorised, the exact alignment of the powerlines within the corridor(s) will be finalised by Eskom. The corridor width investigated during the EIA phase is 1 km (500 m either side of centre line). The final alignment will be investigated via an EMPR walk-down of the pole positions. The results of the walk-down will be included in the Final EMPR and will include pole specific mitigation measures.

4.6.1 Initial corridor alternatives

The initial routes are identified by Eskom prior to the EIA consultants being appointed. The Eskom process of corridor identification is as follows:

Collation of Data

Before Route Selection can commence the detailed Project Scope is required from Eskom's System Planning Department. This information includes:

- Voltage of Proposed Line
- Power line Terminal Points/Substations
- Possible Tower Types to be utilized
- Type of Conductor
- Design Specifications
- Separation distance between lines
- Building Restriction widths
- Critical Span lengths
- Size of Site e.g. 400kV = 600m x 600m
- Telecommunication tower
- Access road requirements

The Eskom Drawing Office upon request from the Eskom Environmental Practitioner will compile the relevant data for the route selection process. This includes:

- Topographical Maps such as 1: 50 000/1:250 000 Map Sheets in raster and/or vector format
- Existing Eskom Infrastructure – Power lines (Tx & Dx), Substations, Vacant Servitudes
- General Land Use Maps
- High level Environmental Maps
- Fire & Lightning data for the study area

Care is exercised in selecting suitable plans for this preliminary work. Depending on the rate of development in the area, plans of a suitable vintage must be sought. Older maps might not reflect the current status of the topographical cover and can be misleading.

Route Selection Meeting (Desktop Study)

The route selection meeting is convened as soon as the above data is collated. An informal meeting is held during which the team utilises both the Topographical and Google maps collectively to analyse various corridor options. The general discussion points at this meeting include:

- the Project overview
- known environmental issues
- Identification of vacant servitudes
- Identification of existing Transmission and Distribution Power Lines within the Study area.
- Identification of "no go zones" such as aerodromes, open cast mining, human settlements, environmental heritage sites and reserves etc.
- Identification of possible corridors - utilizing a 3D modelling tool (Topographical and Google maps), analyse each corridor and mark up possible issues, alternatives and route deviations

Site Investigation

The outcome of the desktop study yields alternative corridors. A field investigation is necessary to determine the feasibility of each alternative. The field investigation must be represented by:

- Line Design Engineer
- Eskom EIA Specialist
- Project Surveyor
- Project Negotiator
- Project Environmentalist
- Grid Representative

The following is recommended for the field investigation:

- The first inspection is to be carried out by vehicle. The team will after this inspection gain an overall view of the study area.
- Following the vehicle inspection, an aerial investigation by helicopter must be undertaken to confirm findings on the ground and finalise corridor alternatives. Positions of possible alternative routes must be captured by GPS. Positions of "no go areas" must also be captured and plotted on the corridor maps.

On completion of the field investigation the team will be able to recommend corridor alternatives which are technically feasible and financially viable to the independent EIA consultants. Based on the above, the following potential corridors were put forward by Eskom for further investigation (**Figure 4.9**).

Table 4.1 includes Eskom's initial descriptions of the various sections of the three alternatives as illustrated in **Figure 4.9**.

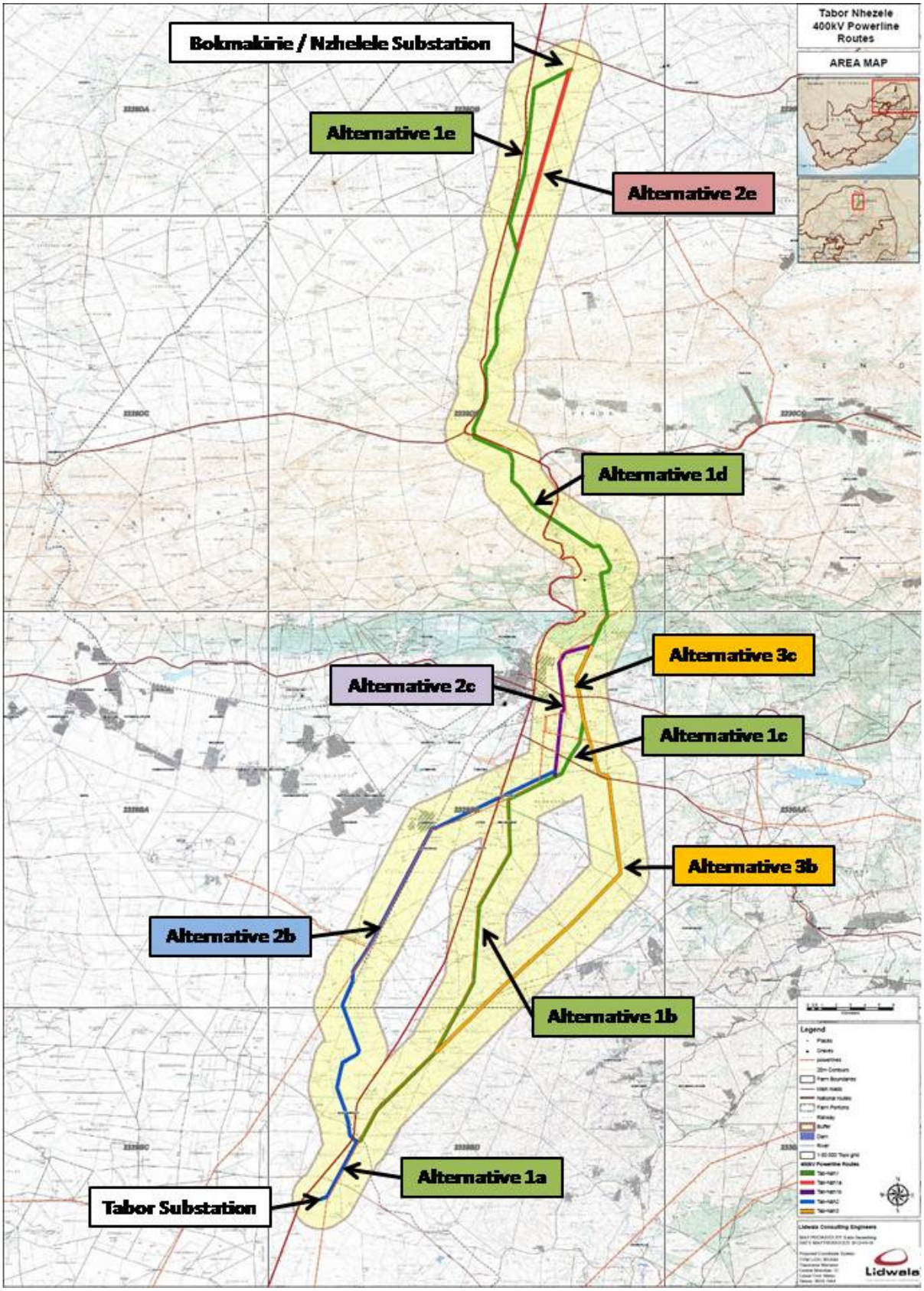

Figure 4.9: A map indicating the various sections of each corridor alternative as described in Eskom's initial route selection report.

Table 4.1: Eskom's initial descriptions of the various sections of the three alternatives from the route selection report

Alternative	Section	Description
1	A	The proposed alignment exits the substation from the North, and then runs parallel on the western boundary of two Distribution HV lines for approximately 4km. Land use comprises mainly of game farms for this section. Topography is flat with access to the route available via the existing service roads for the Dx lines. The N1 lies approximately 1km to the west of the proposed route
	B	At this point the line crosses over the Dx HV lines and runs parallel on the eastern side of the Tabor – Louis Trichardt 1 132kV Line for approximately 30km. Land use in this section comprises of mainly game farming and naturally irrigated agricultural lands were noted in some areas. Access is available and the section runs generally parallel about 2km away from the N1 to the west. Topography is generally flat over this section. To the north of this section lies the Ben Lavin Nature reserve. The proposed route crosses the reserve at the western boundary (600m) and runs parallel to the northern boundary for approx. 4km.
	C	The route then traverses to the east of Louis Trichardt town, this has been done to avoid existing and proposed development in the area. Land use in this section is mainly residential and agricultural farming. Access is available via secondary roads which crosses the route at various points. Topography can be classified as moderately flat to undulating as we move further to the North.
	D	From here-on, the route follows parallel to the existing Louis Trichardt - Messina 132kV line over the mountainous areas north of Louis Trichardt and into the old Venda area. During the site investigation, it was noted that a second HV line parallel to the existing line was being constructed. Land use in this section varies between game farms, agricultural, tribal residential and bushveld. The proposed route crosses the N1 National road at two points. Access along this section will be slightly more challenging due to the terrain. Topography is undulating with steep hills to be negotiated. The harsh topography flattens out as we enter the old Venda area. From a technical perspective it was confirmed by the design engineer (LES) during the flyover that the line is technically feasible
	E	Approximately 13km before Nzhelele, the route deviates from the 132kV line to the west and traverses parallel to the N1 up to Nzhelele. This deviation from parallel has been done to avoid a koppie and a well-developed lodge situated adjacent to the Louis Trichardt 132kV line. Land Use comprises mainly game farms, agricultural lands and tribal land. Access is available as the route runs parallel to the N1. Aside from a few koppies, the topography is moderately flat over this section
2	A	Same as 1a
	B	From Tabor Substation alternative 2 runs parallel to the two 132kV lines. At the point where the two 132kV lines split (end of section 1a), section 2b follows parallel to the Tabor – Flurian 132kV & Flurian – Louis Trichardt 132kv. These lines lie west of the N1 national road. Land use in this section is mainly game farming with small agricultural fields noted in some areas. To the north, the section passes close to residential villages and parallel to the northern

		boundary of the Ben Lavin Nature reserve. The proposed route does not encroach over the reserve. Topography can be described as moderately flat. Access is available via the existing servitude road for the 132kV line and also via gravel roads which intersects the route at various points. This section crosses the N1 on two occasions, the first to the north of Tabor and the second closer to Louis Trichardt.
	C	From the end of section 2b, the route traverses to the north and on the eastern side of the two 132kV lines. This section then crosses the 132kv Lines and runs parallel on the western side of the Dx lines. This has been selected to minimize the impact on housing developments. The route then traverses north, crosses the 132kV lines and runs parallel to a gravel road for approx. 2km. From here-on the route runs parallel to the existing Dx lines which are common to section 1d. Land use in this section is mainly residential with small subsistence farming noted in some areas. Topography is flat to moderately undulating. To the north the topography becomes undulating. Access is available via existing service roads and other roads which intersect the route.
	D	Same as 1d
	E	This route runs from the end of section 1d but continues along the same corridor as the existing 132kV line that links to the Bokmakirie Substation
3	**A**	Same as 1a
	B	This alternative was developed to route the proposed powerline to the eastern boundary of the Ben Lavin Nature reserve. From the end of section 1a, the route continues parallel (east) of the 132kV Tabor – Louis Trichardt line for approximately 8km. From here-on the route traverses in a north eastern direction towards the southern and eastern boundary of the nature reserve (section 3b). Close to the southern boundary of the reserve the route turns to the north and runs parallel to the reserve boundary on the east. The route then crosses the R578 and continues in a northerly direction through vacant ground on the east of Louis Trichardt town (section 3c). The route then crosses the R524 and turns to the north east until it joins up with the 2 X 132kV Dx lines. From here-on the route is common to Alternative 1. Land use for Section 3b is mainly game farming. Topography is moderately flat with access being limited to existing gravel roads which crosses the routes at certain points. Land Use for section 3c comprises agricultural farming, residential and veld. The topography of section c is moderately flat becoming undulating towards the north. Access is available via existing tar and gravel roads which crosses the route at various points.
	C	
	D	Same as 1d
	E	Same as either 1e or 2e

Table 4.2 provides the initial summary of the alternative routes as discussed in Eskom's route selection report

Table 4.2: Alternative Summary

Issue	Alternative 1	Alternative 2	Alternative 3
Length	93km	95km	95km
Number of Bend points	50	54	42
Number of Transmission Line Crossings	0	0	0
Number of Distribution Line Crossings	5	8	5
Number of National Road Crossings	2	4	2
Number of Railway Crossings	1	1	1
Land Use	Game farms, Agricultural, residential, veld	Game farms, Agricultural, residential, veld	Game farms, Agricultural, residential, veld
Topography	Flat and Undulating (including mountainous section north of Louis Trichardt)	Flat and Undulating (including mountainous section north of Louis Trichardt)	Flat and Undulating (including mountainous section north of Louis Trichardt)
Access	Good	Good	Fair

4.6.2 Additional Corridors

Through the public participation process undertaken during the review of the Draft Scoping Report it was highlighted that there was a need to identify additional route alternatives for the crossing of the Soutpansberg Mountain Range. Therefore, an additional route alternative was identified and has been assessed along side the above-mentioned route alternatives in this report.

The new proposed Alternative 4 is partly common to the original Tabor – Nzhelele Alternative 2 which traverses west of the N1 and parallel to an existing non-electrified railway line. The common section is referred to as Section 2b in the original report. For the current route investigation, the entire route has been divided into three sections i.e. Section 4a, 4b and 4c. Each of these sections will be described below, however, Section 4b which traverses through the valley of the Soutpansberg Mountain will be covered in greater detail as it is the most challenging section in terms of constructability of a powerline.

The new proposed Alternative 5 runs parallel to the R523 on the Northern Side of the Soutpansberg Mountains linking the end of Alternative 4b to Alternative 1d.

Table 4.3 includes Eskom's initial descriptions of the various sections of the additional alternatives as illustrated in **Figure 4.10.**

Table 4.3: Eskom's initial descriptions of the various sections of the additional alternatives

Alternative	Section	Description
4	A	This section exits from the northern side of Tabor Substation and proceeds parallel to the existing 2 X 132kV lines. At the point where the 132kV lines split the proposed route for the 400kV line turns to the north west and follows the Tabor – Flurian 132kV line which route across the N1 national road. From here on the route follows parallel and left of the existing non electrified railway line and the 132kV line mentioned above. Makhado air force base lies some 12km west of the proposed line route and will not infringe on civil aviation clearance restrictions. Further north, where the 132kV line turns to the north east, the new proposed route continues north and then bends in a westerly direction around existing Ha-Magau and Madombidza villages. The route continues in a north westerly direction following parallel to the Madombidzha and Tshiozwi village boundaries. The route continues further and then turns to the west and follows the existing railway line heading in the direction of a valley within the Soutpansberg Mountains.
	B	From the intersection of the R522 the proposed route traverses in a north westerly direction running generally parallel to the railway line. The terrain for the first 4km is moderately undulating however it is technically feasible. From here on the proposed route enters a narrow valley between the Soutpansberg Mountains. The Sand River flows along this valley where at certain points the width of the bottom measures less than 100m. To the sides of the valleys lie steep rock faces where it is technically unfeasible to position 400kV towers. The existing railway line traverses the bottom of the valley and a section of the rail route traverses through a tunnel. Access along the valley is extremely poor and the only feasible means of transporting material and equipment would be via helicopters. This in itself will be extremely dangerous. There is also a possibility of flooding of the Sand River thereby affecting the powerline if positioned close to the valley bottom. From an environmental perspective, the valley is also populated with lodges due to the serene nature of the area. Ancient rock paintings can be found within this valley.
	C	This section exits the Soutpansberg Mountain Valley and proceeds parallel to the non-electrified railway track in a north easterly direction. At approximately 26km away from the R523, the route turns further to the north east away from the railway track and proceeds towards Nzhelele site. Before entering the site the route crosses over the N1 national road. This section of the route traverses over moderately flat terrain and land use is mainly game farming. Access is available via the railway track service road for majority of the length of the route.
5		Runs parallel to the R523 on the Northern Side of the Soutpansberg Mountains linking the end of Alternative 4b to Alternative 1d.

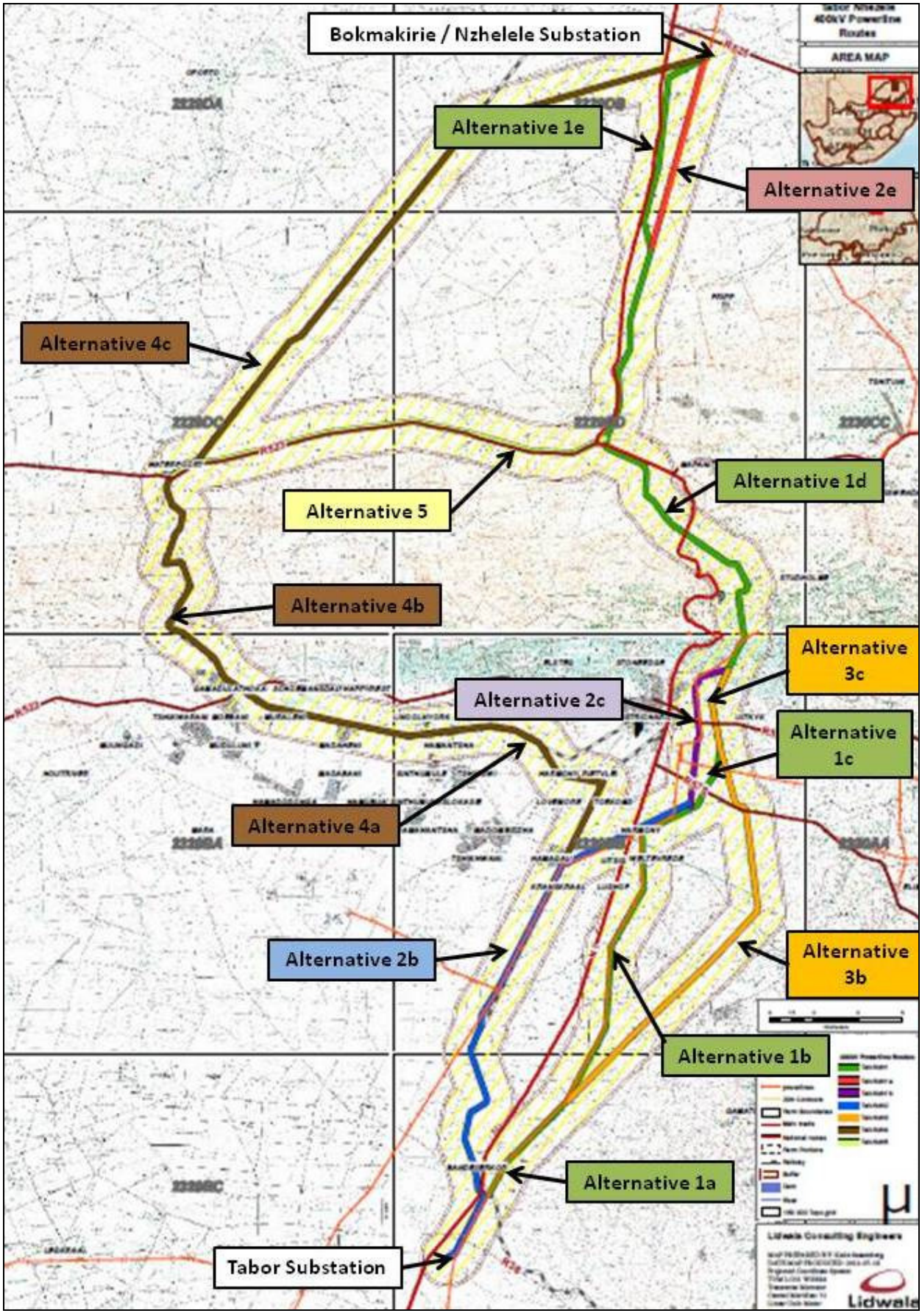

Figure 4.10: A map indicating additional route corridors in relation to the original corridors

Table 4.4 provides an updated summary of the alternative routes

Table 4.4: Updated Alternative Summary

Issue	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Length	93km	95km	95km	119.3km	126.1km
Number of Bend points	50	54	42	±32	±40
Number of Transmission Line Crossings	0	0	0	0	0
Number of Distribution Line Crossings	5	8	5	unknown	unknown
Number of National Road Crossings	2	4	2	2	2
Number of Railway Crossings	1	1	1	4-5	4-5
Land Use	Game farms, Agricultural, residential, veld	Game farms, Agricultural, residential, veld	Game farms, Agricultural, residential, veld	Game farms, Agricultural, residential, veld	Game farms, Agricultural, residential, veld
Topography	Flat and Undulating (including mountainous section north of Louis Trichardt)	Flat and Undulating (including mountainous section north of Louis Trichardt)	Flat and Undulating (including mountainous section north of Louis Trichardt)	Flat and Undulating (including mountainous section northwest of Louis Trichardt)	Flat and Undulating (including mountainous section northwest of Louis Trichardt)
Access	Good	Good	Fair	Fair	Fair