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TRANSMISSION PROJECT

BOSA TRANSACTION ADVISORY SERVICES

FINAL CORRIDOR SELECTION PROCESS REPORT

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CONTENTS

Figures

Tables

SECTION 1

1 Transmission Line Corridor Route Selection Process

1.1 Introduction

The Transaction Advisor is responsible for the preliminary design and the Environmental and Social Impacts Assessment (ESIA) for the Isang to Watershed 400kV transmission lines as well as the review of the preliminary design and ESIA done by Eskom for the portions between Watershed B and Pluto as well as Watershed B and Mokoodi substations.

This section of the report documents the process followed to determine the most feasible route(s) between Isang and Watershed B substations for more detailed study in Phase 2, based on technical, environmental, social and strategic considerations.

1.2 Route selection process

The route identification between the Isang substation and the proposed Watershed B substation is an integral component of the project scope for the Transaction Advisor. Once a preferred route has been selected, this will be taken into Part 2 (Feasibility to PIM) of the project, which includes an ESIA and preliminary design.

The optimum routing for an overhead electricity transmission line is ideally a straight line from one point to another, over a flat terrain with no obstacles, sensitive areas, or other constraints. As this is never possible, selection of the best route is an optimisation exercise, which aims to minimise the impacts on the environment and people, while accommodating technical challenges in the most cost-effective way.

The project team followed a structured, systematic and comprehensive transmission line corridor best practice selection process, through which a number of potential corridors were identified. From these base corridors a number of variations were identified resulting, in 19 potential transmission corridors being listed. After further analysis of these 19 theoretical options, 5 corridors were selected as potentially the most viable corridors, to be further evaluated during a Multi Criteria Decision Making (MCDM) workshop. This process followed in the workshop is detailed below.

1.2.1 Identification of potential routes

Prior to the MCDM workshop a rigorous process was followed to identify a range of potential route alignment corridors. The best practice base information used to inform these potential route alignments included:

- Towns / Settlements
- Infrastructure such as Roads / Airports / High voltage Transmission lines
- Rivers / Water Bodies
- Land cover
- Places of Interest
- Protected Areas[1]
- Contours, a Digital Elevation Model, and Slope

[1] All formally protected areas in both South Africa and Botswana were included as base data. Where information was available about privately protected areas this was also included. Information about private conservation areas in South Africa is more readily available than in the case of Botswana. However there is a high density of privately owned game farms in the overall study area which rely on conservation and tourism as a source of income. Despite an awareness of the existence of this conservation and tourism focus in the study area, not all of these farms are formally registered as privately protected areas.

- Constraints identified by ecological, heritage and avifaunal specialists

The following factors typically influence the selection of potential transmission line routes. Ensuring that these considerations inform route selection from the earliest planning phase reduces the potential for associated problems to emerge during the later stages of the project.

Topography and slope

- Slope and topography affects ease of construction and access for construction and maintenance
- Areas with the flattest topography should be selected as far as possible, to allow the straightest line possible to reduce costs and minimise the need for angle poles
- Avoid areas with slope exceeding 1:10
- Slopes steeper than 1:18 are fatal flaws

Water bodies

- Large bodies of water should be avoided
- The maximum span between the tower structures determines the maximum allowable water crossing distance

Ground conditions

- Avoid both rocky and swampy areas
- Extensive rocky outcrops make it difficult to penetrate the ground sufficiently for structure foundations
- Areas with very low bearing soils and marshes may result in instable structure foundations

Existing Infrastructure and other land uses

- Line routes should run parallel to roads where possible
- Minimise distance that lines run parallel to pipelines and railways to reduce possibility of induced current effects
- Where unavoidable to cross, safe clearance distances should be ensured
- Ensure line crosses at the shortest route over railway or road and avoid small angles of intersection
- Line heights and clearance areas around airports as determined by air traffic regulations
- The possibility of cavity or land-falls must be considered in areas with mining activity
- Overhead lines are not permitted through protected areas of military installations

Other power lines

- If unavoidable, ensure crossing of new line over existing where multiple towers and spans can be installed between existing parallel lines
- This reduces the possibility of all power supplies being simultaneously compromised if lines collapse
- Consider positioning of wind energy converter and provide suitable clearance between rotors and overhead lines

Urban or residential areas

- Line corridors must avoid residential areas
- Challenging in rural areas, where residential areas are not well demarcated
- Relocation of people and their homes and assets may become necessary, which is time consuming and costly

Biodiversity

- Avoid protected areas, sensitive aquatic and terrestrial ecological areas and pristine natural vegetation
- Avoid bird flight paths, Important Bird areas and bird breeding and feeding areas

Heritage resources

- Avoid sites with known archaeological, historical, religious or cultural value
- Avoid tourist attractions

The screening for 19 potential sites based on the above was thus applied at a very coarse scale to identify any routes not fatally flawed by factors such as crossing towns and slopes too steep for construction or other considerations identified above. The 19 sites were further screened to identify a total of 5 corridors as potential routes for more detailed assessment, as reflected graphically below and detailed in **Section 1.2.2.** The 19 lines are indicated in **Figure 2** to **Figure 4.**

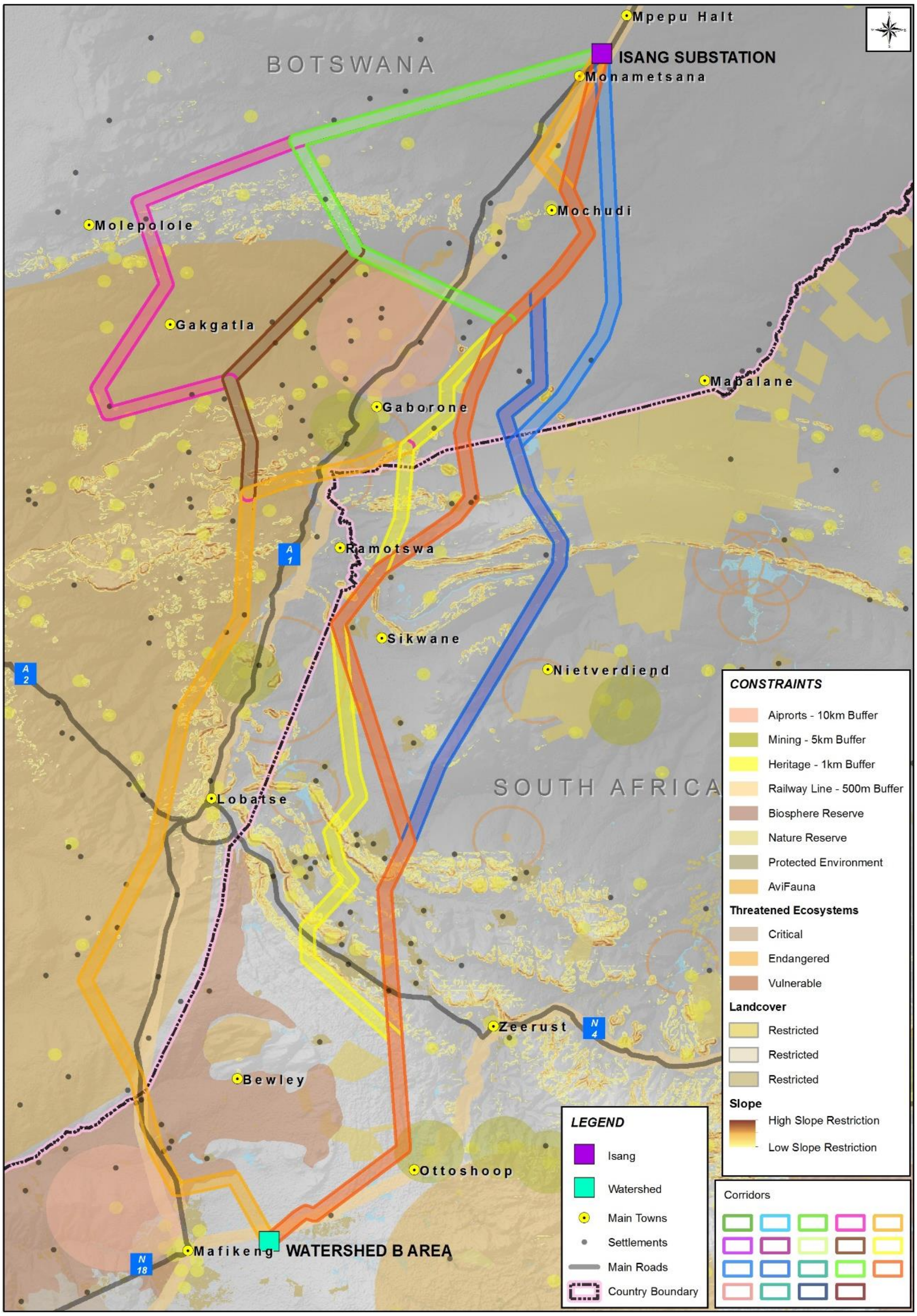

Figure 1: Proposed routing corridors.

Note that sections of the 19 routes take same alignments and as such do not show up as 19 individual lines. The routes indicated above and detailed in the smaller maps below show the routing corridors

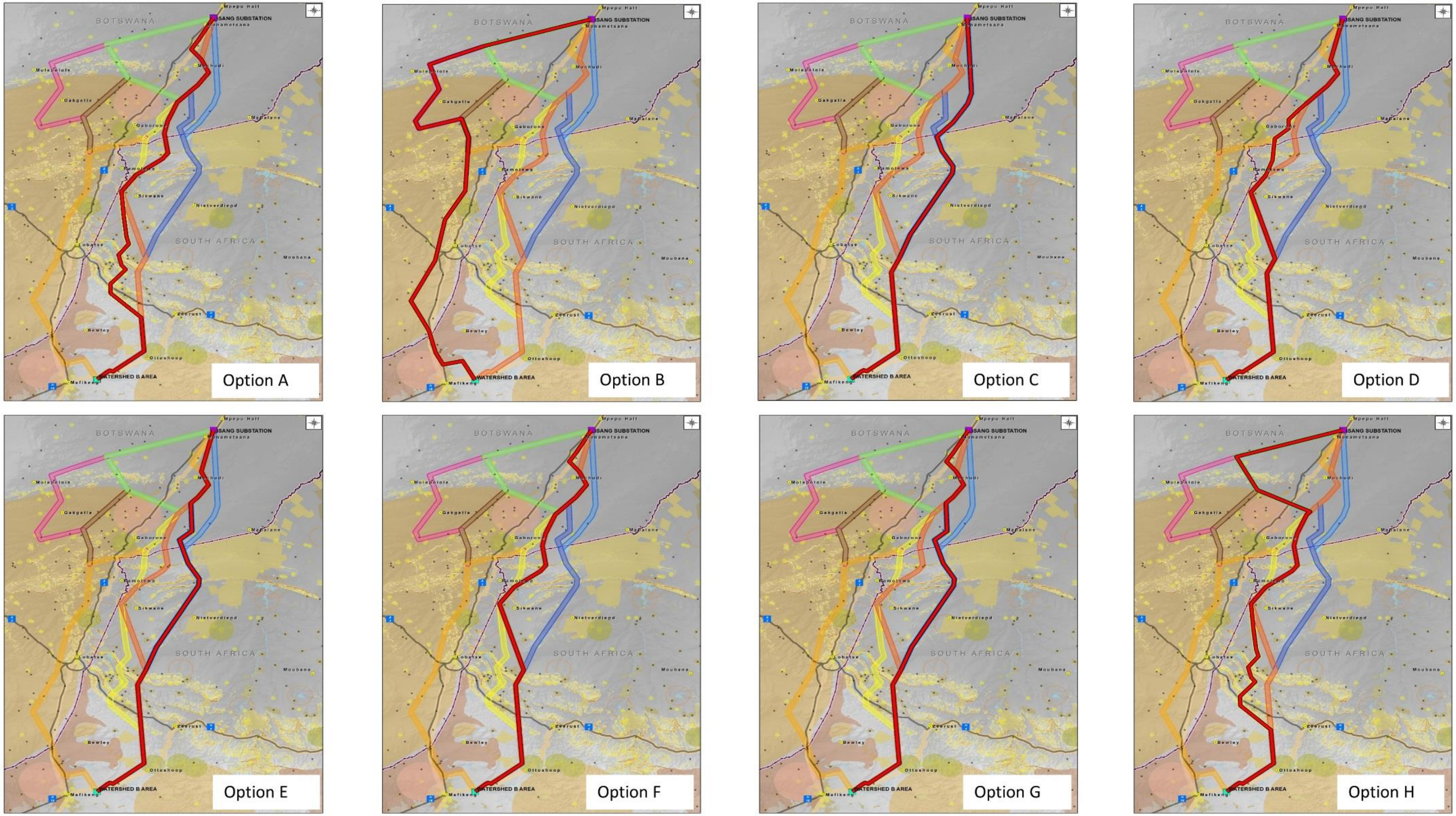

Figure 2: Routes A-H

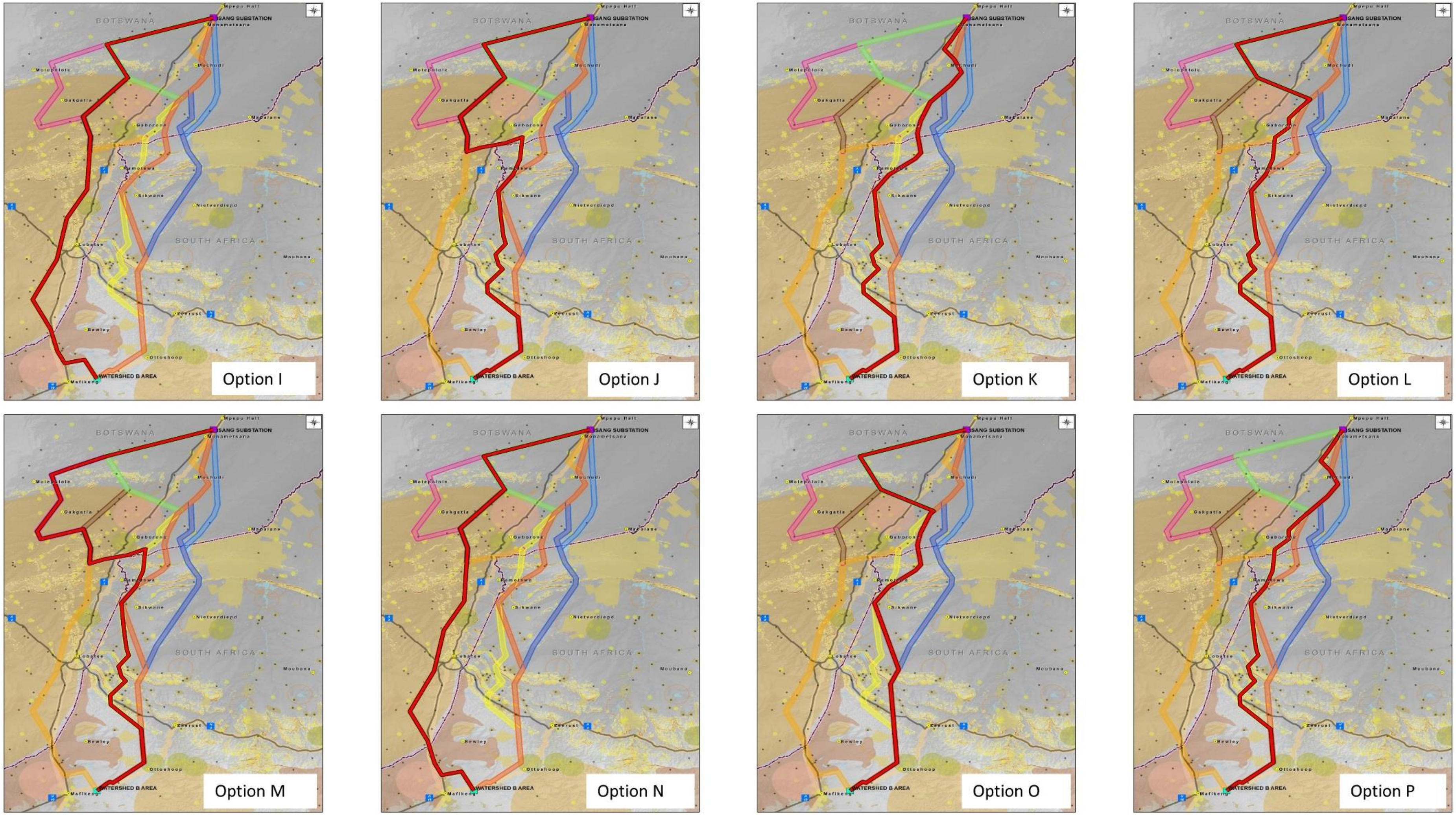

Figure 3: Routes I - P

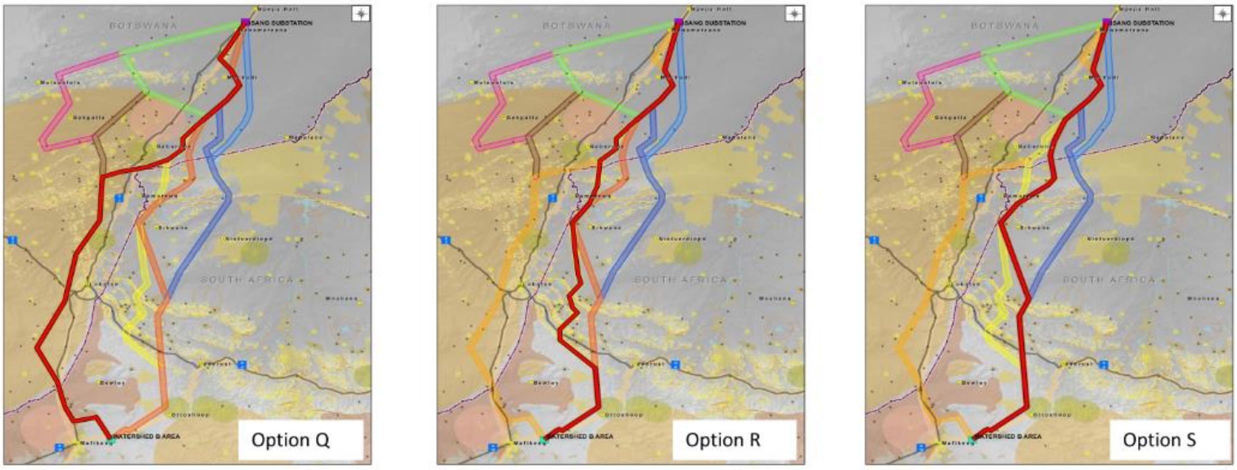

Figure 4: Routes Q – S

1.2.2 High level analysis of significant constraints

Based on the above, 19 potential linkages between the existing Isang substation in Botswana and the proposed Watershed B substation in South Africa were identified (**Figure 2**). It should be noted that these route alignment corridors include buffer areas to allow for the exact siting to be informed by detailed assessment of the study route. The consideration of the routes was performed at a very high level. Of these 19 routes, 12 were considered significantly constrained based on one or more of the following considerations in **Table 1**. Five potential sites were identified for assessment during the MCDM workshop to allow for the choice of the three best alternatives to take forward to the feasibility study for more detailed assessment in Part 2.

Table 1: Details of the 19 route alignments identified

Route Name	Length (km)	Suitability	Comment
A	**226**	**Potential**	**To be assessed further in MCDM**
B	284	Constrained	• Line length – costly to construct • Crossed path of 220kV transmission lines to the west of Isang substation • Crossed formally protected area in South Africa • Crossed area identified as a bird sensitive area in Botswana (high vulture activity) • Crossed large areas of subsistence and formal agriculture – high levels of compensation and possible resettlement required
C	**210**	**Potential**	**To be assessed further in MCDM**
D	216	Constrained	• Line route too close to Gaborone – potential to constrain future development
E	**212**	**Potential**	**To be assessed further in MCDM** **Variation on C**
F	**214**	**Potential**	**To be assessed further in MCDM**

Route Name	Length (km)	Suitability	Comment
G	215	Constrained	• Variation of C; too similar to be considered an alternative • Crossed railway corridor leaving Isang
H	264	Constrained	• Line length – costly to construct • Crossed path of 220kV transmission lines to the west of Isang substation
I	250	Constrained	• Line length – costly to construct • Crossed path of 220kV transmission lines to the west of Isang substation • Crossed formally protected area in South Africa • Crossed area identified as a bird sensitive area in Botswana (high vulture activity)
J	284	Constrained	• Line length – costly to construct • Crossed path of 220kV transmission lines to the west of Isang substation • Crossed area identified as a bird sensitive area in Botswana (high vulture activity) • Crossed large areas of subsistence and formal agriculture – high levels of compensation and possible resettlement required
K	222	Constrained	• Variation on A - too close to be considered an alternative
L	265	Constrained	• Line length – costly to construct • Crossed path of 220kV transmission lines to the west of Isang substation
M	318	Constrained	• Line length – costly to construct • Crossed path of 220kV transmission lines to the west of Isang substation • Crossed area identified as a bird sensitive area in Botswana (high vulture activity) • Crossed large areas of subsistence and formal agriculture – high levels of compensation and possible resettlement required
N	250	Constrained	• Line length – costly to construct • Crossed path of 220kV transmission lines to the west of Isang substation • Crossed formally protected area in South Africa • Crossed area identified as a bird sensitive area in Botswana (high vulture activity) • Crossed large areas of subsistence and formal agriculture – high levels of compensation and possible resettlement required

Route Name	Length (km)	Suitability	Comment
O	257	Constrained	• Line length – costly to construct • Crossed path of 220kV transmission lines to the west of Isang substation • Crossed large areas of subsistence and formal agriculture – high levels of compensation and possible resettlement required
P	222	Constrained	• Line route too close to Gaborone – potential to constrain future development
Q	237	Constrained	• Line length – costly to construct • Crossed formally protected area in South Africa • Crossed area identified as a bird sensitive area in Botswana (high vulture activity) • Crossed large areas of subsistence and formal agriculture – high levels of compensation and possible resettlement required
R	223	Constrained	• Line route too close to Gaborone – potential to constrain future development • Variation on P
S	**215**	**Potential**	**To be assessed further in MCDM** **Variation on A**

Table 2: Summary Table of Route Options Assessment

Route Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Length (km)	*226*	*284*	*210*	*216*	*212*	*214*	*215*	*264*	*250*	*284*	*222*	*265*	*318*	*250*	*257*	*222*	*237*	*223*	*215*
To be assessed further in MCDM	✓		✓		✓	✓													✓
Line length – costly to construct		×						×	×	×		×	×	×	×		×		
Crossed path of 220kV transmission lines to west of Isang substation		×						×	×	×		×	×	×	×		×		
Crossed formally protected area in South Africa		×							×					×					
Crossed area identified as bird sensitive area in Botswana (high vulture activity)		×							×	×			×	×			×		
Crossed large areas of subsistence and formal agriculture – high levels of compensation and possible resettlement		×								×			×	×	×		×		
Line route too close to Gaborone – potential to constrain future development				×												×		×	
Crossed railway corridor leaving Isang							×												
Too similar to another route to be considered true alternative							×				×								

* E is Variation on C; G is a variation of C; K is a variation on A ; R is a variation on P; S is a variation on A

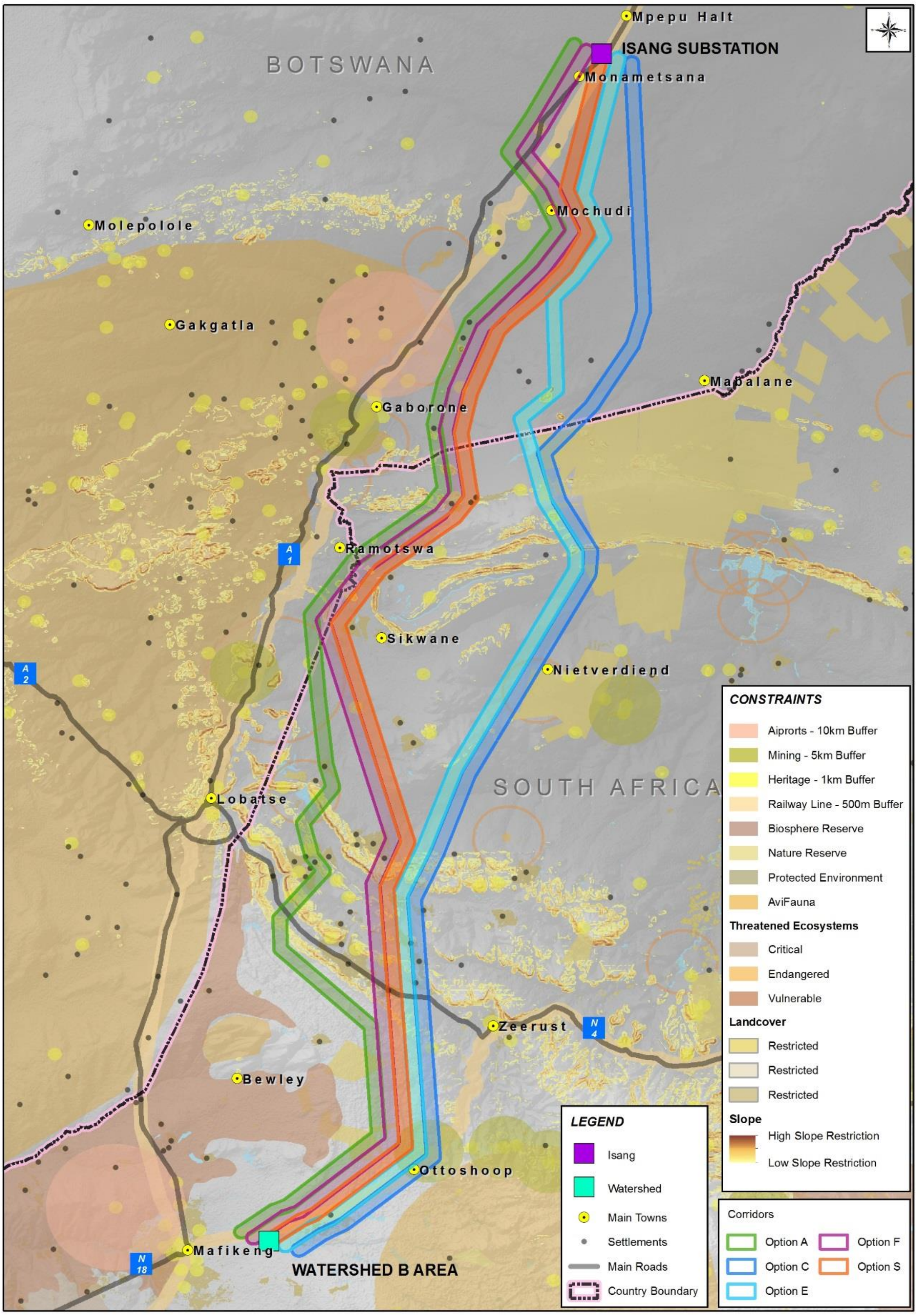

Figure 5: Alignment of 5 potential routes

Map showing the alignment of the 5 potential routes considered in the MCDM, based on constraints identified in **Table 1**. Note that for illustrative purposes the routes are indicated as running next to each other in places but actually run in the same corridor.

1.2.3 MCDM Process

1.2.3.1 *Background*

The Multi-criteria Decision-Making Model (MCDM) process is a discipline aimed at supporting decision makers who are faced with making numerous and conflicting evaluations. It highlights conflicts and derives a way to reach a compromise in a transparent process. The process of MCDM prioritises options against a set of criteria. This process is well-suited to address complex technical, strategic and planning challenges. The MCDM approach thus allows for technical, financial, strategic, environmental and social constraints to inform decision making at the earliest possible stages of the Project. This enhances the sustainability of the Project for its lifecycle and assists in ensuring a smoother transition through the project phases by identifying constraints early and planning for these in the design phase.

This process provides the feasibility study with a documented approach to the options selection process that can later serve as motivation for the selected options (i.e. during an ESIA). The environmental assessment process requires the assessment of one preferred route alignment to be compared against two alternatives and as well as the no-go option. The outcomes of the MCDM process allows for these alternatives to be identified through a participatory and objective process.

1.2.3.2 *MCDM Workshop*

An MCDM workshop was held on the 25 May 2016 to interrogate the potential route alignments identified to provide assistance to the project team; with the selection of the best three route alignment corridors to be taken forward to the more detailed study. The workshop was attended by representatives from the DBSA and SAPP, Eskom and the technical team (Aurecon, G&A Heritage, Archi Consultants, Chris van Rooyen Consulting, RPM Consulting and Equispectives Research and Consulting Services. The Botswana Power Corporation could not attend the workshop and Aurecon presented the outcomes to them in Gaborone on 14 June 2016 to ensure agreement on route alignments. The Biodiversity Specialist (Brian Colloty of Scherman Colloty & Associates could also not attend the workshop but his inputs to the workshop was provided.

This MCDM process thus included not only the relevant environmental and social specialist team, but also Aurecon technical team and representatives of Eskom and the Botswana Power Corporation, in order to ensure that all relevant information, local knowledge and transmission expertise was duly taken into consideration in the final decision; and that all interested parties agree on the way forward.

Within the MCDM workshop, participants representing particular fields of expertise or interests were asked to discuss and assess the suite of options against one another, on a one to one basis, and reach consensus on which option is preferred and by what margin. This process was repeated until all options and scenarios had been compared with all other options and scenarios using each of the pre-selected criteria. The MCDM Model then arithmetically collated preference scores and provided an overall ranking of the options. The MCDM model works on the premise that an experienced professional can readily determine which options are preferred when considered against certain criteria, e.g. environmental, without the need for detailed assessment.

1.2.3.3 *Criteria used in the MCDM*

The potential routes were assessed against the criteria identified below. Specialist input was obtained to draw up the criteria, which are deemed to have most relevance to the selection of route alignments. While there are a number of criteria that need to be considered in the ESIA Part when assessing the significance of impacts related to the proposed developments, the only criteria that are considered in route selection are those criteria that differentiate one site against another. Where the same criteria will apply to all routes equally, these have been disregarded as being relevant to this aspect of the study.

The criteria used to assess the route alignments fall into specific categories, described below and detail in **Table 2.**

- ***Technical category.*** This relates to the impact of a specific route alignment with regard to achieving the technical goals of the project while reducing cost and increasing ease of both construction and maintenance activities.
- ***Environmental category.*** This component refers to the need to select a route that minimises the risk to ecosystem functioning and environmental integrity. Therefore, the environmental criterion prioritises the anticipated impacts on the both terrestrial and aquatic fauna (especially avifauna who are negatively impacted by high voltage transmission lines) and flora.
- ***Social Category.*** This aspect considers the impact of route alignment on people. Specifically avoiding residential areas, areas where assets and livelihoods may be affected (e.g. the loss of agricultural land for tower structures, the impact on tourism activities in game farm areas) and the need for compensation. Visual impacts and the impacts on heritage resources is also an important consideration in routing power lines.
- ***Strategic category.*** This aspect relates to the potential to either provide bulk power to large users in the area in future or allow for ease of connection to large generators of power in the future.

The criteria that were used in the MCDM are as follows:

Table 3: MCDM Criteria

Category	Criteria	Description
Technical (Inc. Financial)	Te1. Slope	Avoid steep slopes more than 1:10
	Te2. Access	Constructability and maintainability in terms of construction and access to site
	Te3. Length	Line length and associated cost
	Te4. Width	Ability to construct 2 single circuit transmission lines spaced between 7 to 10 km apart within the corridor
Environmental	En1. Biodiversity	Aquatic and terrestrial ecology; Ecological services
	En3. Avifauna	Flight paths; Nesting areas, Focal points
Social	So1. Heritage	Archaeological and cultural heritage resources
	So2. Compensation	Homes or other assets that will require resettlement or other compensation
	So3. Social	Proximity to existing large villages or towns that will remain; Distance to communities
	So4. Visual	Visibility on ridges
Strategic	St1. Proximity	Proximity to potential new Generation and Large Power Users

1.2.3.4 *Results*

The results of the MCDM workshop are discussed below based on each category and the individual criteria used to assess the route alignment, showing how each alignment scored without comparison against the other categories. A discussion is then provided in the Sections below showing the preferred route alignments when all criteria were integrated to show the best routes overall.

The criteria were weighted to ensure that criteria considered as more important in terms of site selection were given more significance in the site selection process. The weighting is detailed below and the results presented in the report are based on this weighting.

However, it is important to note that the same order of route alignment preference was achieved with all criteria having the same weighting, although the degree of preference was minimally altered (i.e. there was marginally less preference between Route C and Route E, although Route C is still the preferred option).

- Technical 30%
- Environmental 30%
- Social 35%
- Strategic 5%

As stated above, the ecologist was unable to attend the workshop and sent his analysis of the routes to the MCDM facilitator, which was used in the workshop. After discussion it was determined that the ecologist had considered aspects that were already included in other criteria (i.e. he considered the lines close to the Madikwe protected area and the impact on tourism activities). He reassessed the routes based only ecological criteria which changed the outcomes of the workshop in order of the preference of the first and second best routes. The results in this report indicate the revised input from the specialist and the original results.

TECHNICAL

Route C was considered the best route from an overall technical perspective (Figure 2). Technical considerations ensure the most cost-effective solution for the lifecycle of the project for the planning stages, through construction and operation to decommissioning. The individual criteria are discussed in more detail below.

Table 4: Individual Criteria

SLOPE

- Considered terrain for each route, based on desktop analysis and GIS information.
- Within the 2km route corridors, the line can be deviated to navigate.
- Routes E and C exit/ enter Watershed B substation to the east where there is less mountainous terrain and therefore cross less difficult terrain than Options F and S.
- Route A crossed numerous slopes from the Watershed B substation for approximately 100km, making this route least favourable.

ACCESS

- Considered access roads close to the routes, based on difficult terrain and accessibility via main and secondary roads. Fences, gates, cattle-guards and other obstacles are taken into account for vehicle access.
- If there are no roads then alternative means of access must be available, such as a helicopter.
- Ease of accessing individual towers and/ or spans and serviceable line components, sufficient, working clearances for live line maintenance personnel, capacity of line components to carry personnel and equipment and serviceability of line components are considered for maintenance.
- This affects how easy it will be to construct the line and later access the site for maintenance.
- Accessibility was better for Routes C and E, with Options F and S scoring worse that the first two options.
- Route A has particular access challenges due to the mountainous terrain.

LENGTH, COST AND BENDS

- Transmission lines cost less when they are as short and straight as possible.
- Construction and material costs increase with increasing length and with more bend points.
- Table 3 below indicateds the weighted cost based on the lenght and bends.
- There is a preference for Route C, followed by Route E, then Route S and Route F with Route A scoring worst based on costs associated with length and angles.

WIDTH

- Two lines will be built within the corridor (N-1 contingency).
- This sepation is required in veld fire prone areas to ensure that if there is damage to one line connection can be maintained between the two points.
- The existing settlements and infrastructure (220kV lines and railways) close to the route options were evaluated.
- Each route was scored based on obstacles within that route corridor that would restrict the ability to construct two lines within 7km of each other.
- Route C only has one potential issue with a settlement but it can be deviated within the 2km corridor width identified.

Table 5. Technical information per route option related to length, angles required and associated costs

Route	Length	Angles	Cost factor for angles = (angles x 1.8) + length	Unit Cost
C	209	11	228.8	1
E	211	11	230.8	1.008741
S	215	14	240.2	1.049825
F	218	17	248.6	1.086538
A	225	21	262.8	1.148601

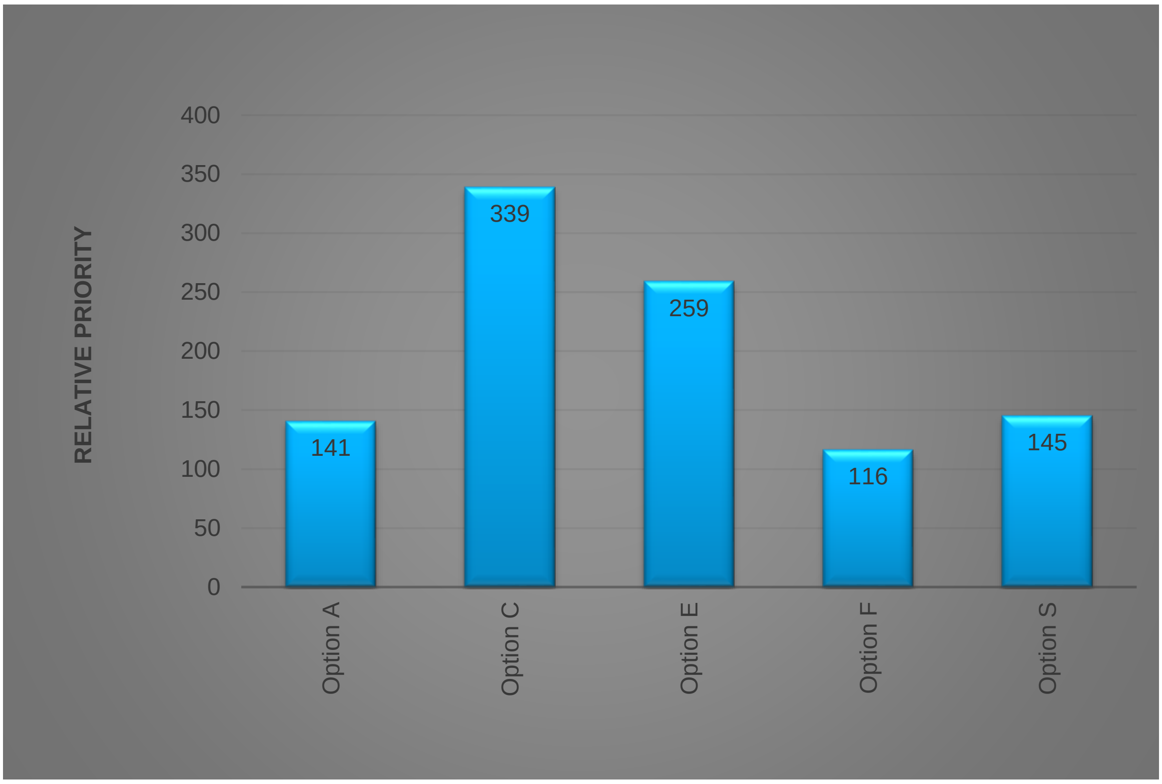

Figure 6. Ranging of routes from a technical perspective

ENVIRONMENTAL

Potential impacts on the biophysical environment include loss and alteration of terrestrial and aquatic habitat, loss of protected species and introduction of alien invasive plant species. The significance of the impact of a proposed transmission line is influenced by current level of disturbance along the route and the degree to which the proposed line will increase the levels of disturbance, as well as the uniqueness of the environmental resources that will be affected. Due to the nature of transmission lines, the construction phase is the most environmentally disruptive and many ecological systems can continue to function under the lines once operational. Limited area is lost through the construction of the towers and access roads. Animals will return to the site following construction. Environments with trees are most compromised by overhead lines as a corridor will need to be cleared and maintained as such to ensure sufficient clearance between the lines and trees. Most wetland areas within the 2km corridors can be avoided in the design phase.

One of the main considerations for high voltage lines is possible bird collisions with the conductors. The collision potential is influenced by the flight behaviour of sensitive species and visibility of the conductors. Breeding areas, roosting and feeding areas and migration routes all influence where there will be high avifaunal activity and which areas will be most sensitive in terms of avifauna. The following aspects were considered when ranking the routes in order of preference:

- Proximity to vulture breeding areas
- Proximity to Important Bird Areas (IBA)
- Proximity to dams (avifaunal focal points)
- Proximity to vulture restaurants (avifaunal focal points)
- Proximity to protected areas

The ranking for each route and order of preference are indicated in The summary result finds an overall preference for Route C, followed very closely by Route E. Route C is preferred for all categories, except from a purely environmental perspective where Route E is marginally preferred to Route C. Route A is showed the lowest preference for all criteria. There was a slight preference for Route S compared to Route F (**Table 7** and **Figure 10**).

Based on the above outcome it is recommended that Route C be taken forward as the preferred alternative for more detailed assessment, with Routes E and S to be assessed as potential alternatives. Routes F and A would then be screened out for further assessment.

The preferred routes will be assessed in detail in the ESIA to follow which will allow for identification of potential mitigation measures to further reduce predicted impacts from the project.

Table 7 and Figure 7 respectively. The preference from both an ecological and an avifaunal impact perspective broadly followed an east (most preferred) to west (least preferred) pattern.

Table 6. Description of routes from an environmental perspective (where 1 = preferred & 5 = least preferred)

Route	Ranking	Issues & Sensitivities encountered
E	1	• Traverses 4 ridge complexes[2] which usually contain high number of plants, with high numbers being Species of Special Concern • Crosses 2 broad floodplain areas • Slightly further away from the fence of a protected area (Madikwe) than Route C • Least sensitive from an avifaunal perspective (not as close to avifaunal focal points or IBA or breeding areas
C	2	• Very similar to Route E – while close to the Madikwe boundary the route avoids the broad sections of ridges or passes between ridge complexes • Least sensitive from an avifaunal perspective (not as close to avifaunal focal points or IBA or breeding areas
S	2	• Avoids broad ridges when compared to Route A • Avoids Madikwe protected areas when compared to Routes C and E • Avoids one floodplain when compared to Option A • Intersects with an inselberg[3] and transverses a broad water course in the Kalkpan area • Intersects an inselberg when compared Option E
F	2	• Intersects inselbergs when compared Option E • Crosses a broad water course at Kalkpan • Avoids one floodplain when compared to Option • Avoids broad ridges when compared to Route A • Avoids Madikwe as per Routes C and E
A	5	• Traverses 3 broad ridges and 3 smaller ridges • Traverses inselbergs and several wide floodplain areas • Crosses over sensitive ridges • Several broad floodplains are encountered • Most sensitive from an avifaunal perspective by a significant margin

[2] North West Province in South Africa have a number of ridge development policies in place which may constrain potential development
[3] An isolated hill or mountain rising abruptly from a plain

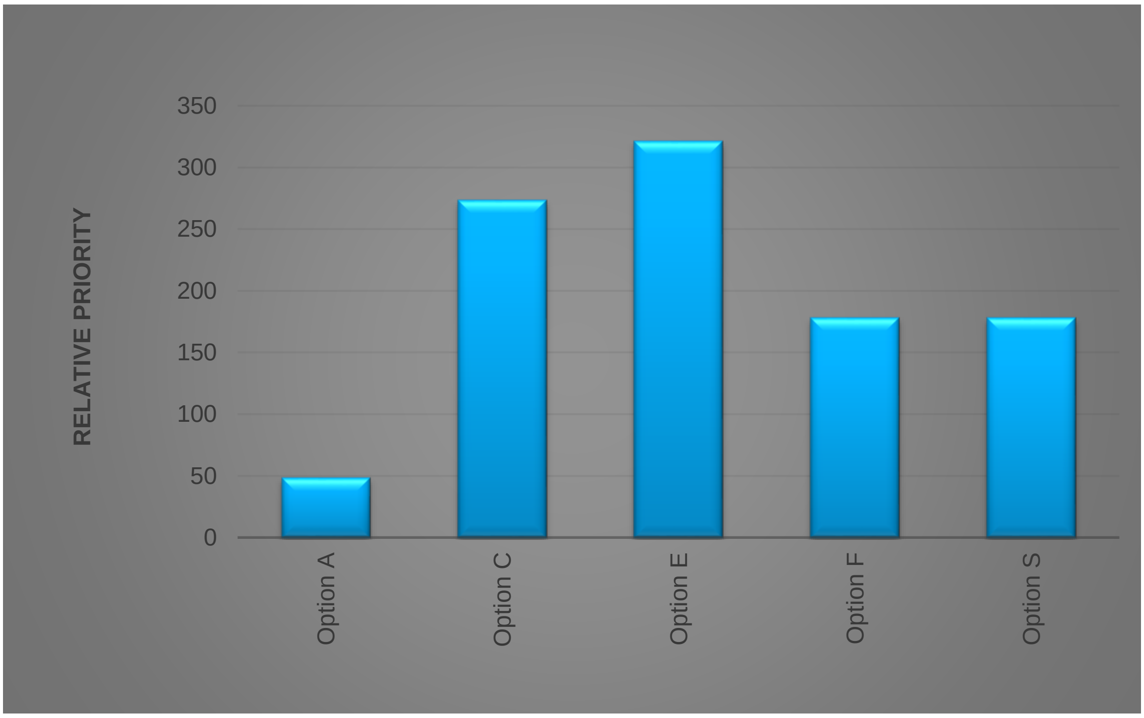

Figure 7 Ranging of routes from an environmental (ecological and avifaunal) perspective

SOCIAL

Transmission lines can have a range of impacts on people in the affected area. These impacts are discussed below in terms of heritage aspects, social and compensation issues and the impact on visual resources.

Heritage

- Heritage resources are protected by law and considerations affecting line choices are as follows
- There is very little information on specific sites within the South African section of the proposed line route.
- The study area does not contain any National or World Heritage sites.
- The main areas of concern are the elevated areas in the north (along the Botswana border) and the areas around the Bankeveld further south, which are known for the iron-age mega-site cities such as Kaditshwene and Boitsimogale.
- The three western route options traverse through more elevated areas with likely site occurrences than the two eastern options.
- While Routes C and E have similar alignment, Option E appears to pass through ports or necks in the mountains rather than across them.
- Sites are more likely to be found on the mountains rather than in the passes and Route E is thus favoured slightly more than Route C.
- The majority of sites of heritage significance in the Botswana section are located in and around the Gaborone area. Routes A, F and S are all closer to this node than Routes Options C and E.
- Route C is closer to important heritage sites at Modipane.
- Route E has the least potential impact on sites on the Botswana and South African sections of the route.

Relocation / Compensation

- Route selection considered the impact on smallest number of properties - attempted to avoid homesteads and commercial properties as far as possible during route selection.
- Relocation is the most severe of social impacts – to be avoided as far as possible.
- The compensation includes the loss of economic assets such as cropland.
- Most agricultural activities on route appear to be subsistence and route alignment must avoid physically dividing property as far as possible.
- The impact during construction will be limited and most agriculture can continue under lines when operational.
- The game industry is active in the area. Impacts in terms of sense of place can affect marketing of hunting.
- Transmission lines can interfere with game counts and capture by helicopters.
- The preferred routes are C, E, S, F and A, in that order.

Proximity to towns / distance from communities

- Construction close to communities oftens result in safety issues and creates expectations around employment and project benefits.
- While there are few community benefits from transmission lines, there are also relatively small impacts on communities after construction.
- The route selection process followed focussed on avoiding communities or aligning the route to skirt the edge of the communities.
- From a social perspective, the preferred routes are C, E, S, F and A, in that order.

Visual

- Transmission lines can affect the aesthetic quality of a landscape from a visual perspective.
- Routes were considered in terms of the sensitivity of visual receptors (i.e. are the receptors residing in the area or passing through), the visibility of the project, the length of proposed line and the presence of large game reserves and areas of high tourism value.
- Route C crosses the least number of settlements and towns. It crosses the R49 various times but visual receptors on the road will be less sensitive to an overhead transmission line than individuals residing in the area.
- Routes C and E cross smaller areas of topographical significance (i.e. raised areas), which will make them less visible from a distance than the other three route alternatives.
- Routes C and E have lower visual exposure as they are located further away from the majority of bigger towns and settlements.
- None of the proposed routes cross large game reserves.
- The route were ranked, from most preferred to least preferred, as follows: C; E; S; F and A.

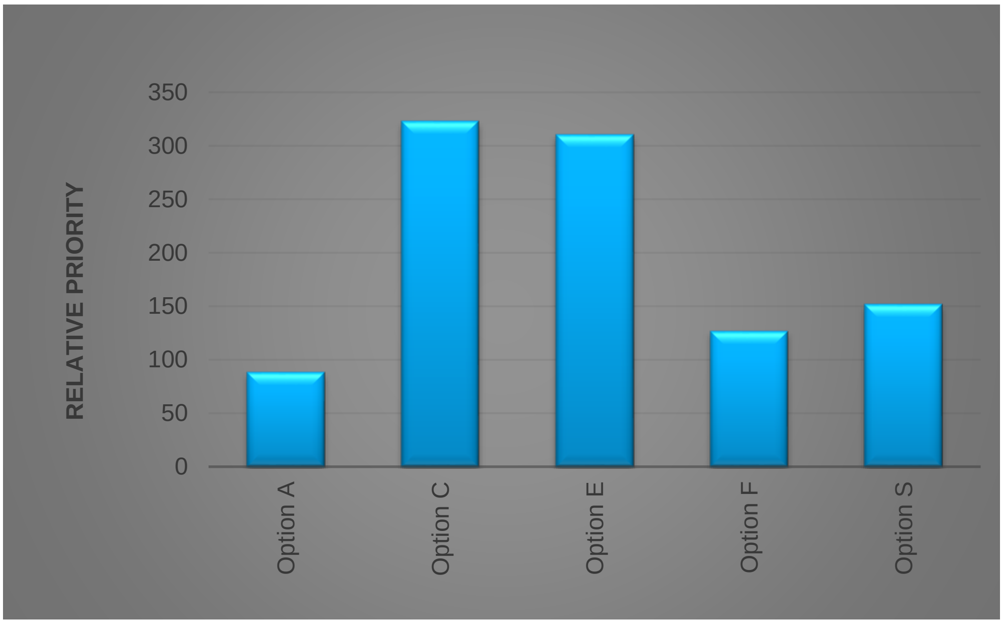

Figure 8. Preference of routes from a social perspective (including heritage, compensation, disruption and visual considerations)

STRATEGIC

This category and criterion considered the potential to either provide bulk power to large users in the area in future or allow for ease of connection to large generators of power in the future. Only Routes C and E transverse close to identified bulk consumers towards the east where there are potential chrome and coal deposits. These two route options were thus preferred for this aspect.

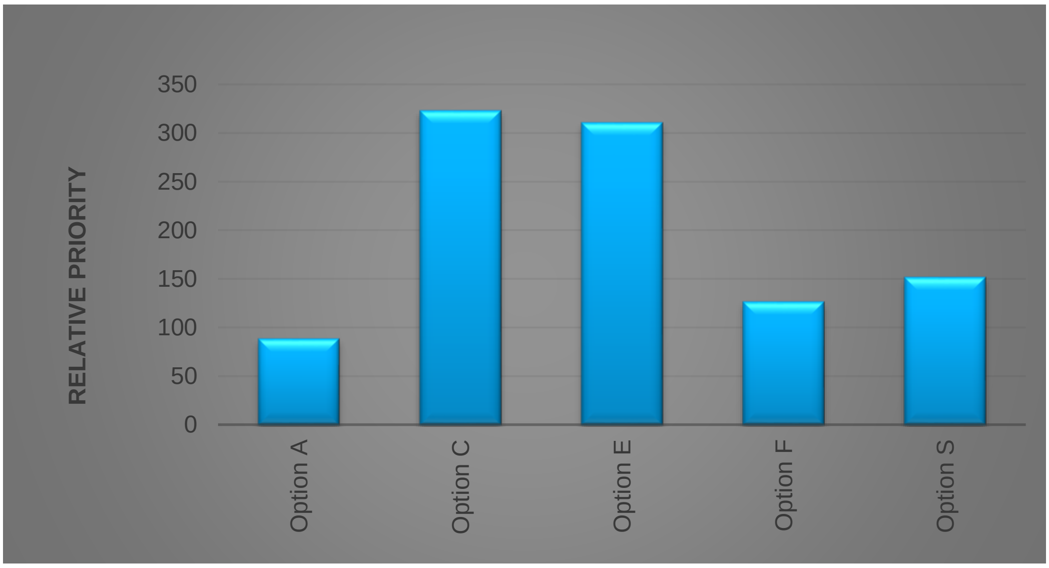

Figure 9. Preference of routes from a strategic perspective.

1.2.4 Overall outcome

The summary result finds an overall preference for Route C, followed very closely by Route E. Route C is preferred for all categories, except from a purely environmental perspective where Route E is marginally preferred to Route C. Route A is showed the lowest preference for all criteria. There was a slight preference for Route S compared to Route F (**Table 7** and **Figure 10**).

Based on the above outcome it is recommended that Route C be taken forward as the preferred alternative for more detailed assessment, with Routes E and S to be assessed as potential alternatives. Routes F and A would then be screened out for further assessment.

The preferred routes will be assessed in detail in the ESIA to follow which will allow for identification of potential mitigation measures to further reduce predicted impacts from the project.

Table 7. Preferences per category and criterion for each route (1 = most favoured and 5 = least favoured)

Category	Criteria	A	C	E	F	S
Technical (Inc. Financial)	Te1. Slope	3	1	1	2	2
	Te2. Access	3	1	1	2	2
	Te3. Length	5	1	2	4	3
	Te4. Width	1	2	2	3	3
Environmental	En1. Biodiversity	4	2	1	3	3
	En3. Avifauna	3	1	1	2	2
Social	So1. Heritage	5	4	1	3	2
	So2. Compensation	5	1	2	4	3
	So3. Social	5	1	2	4	3
	So4. Visual	5	1	2	4	3
Strategic	St1. Proximity	2	1	1	2	2

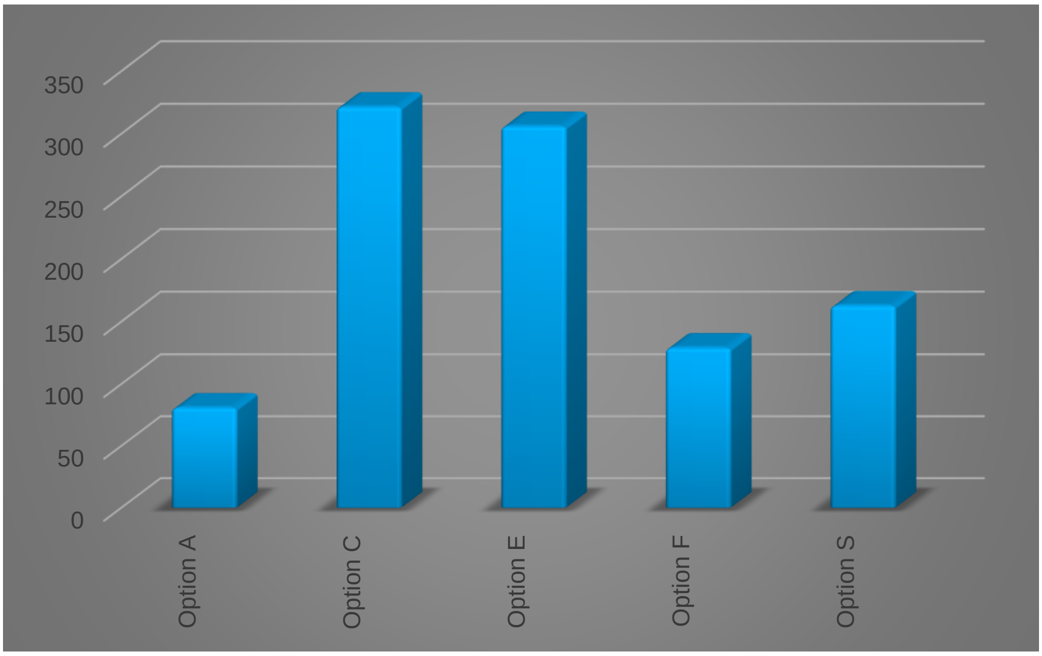

Figure 10. Overall preference for each route based on all criteria.

SECTION 2

2 Conclusion and Way Forward

The early application of MCDM as part of engineering project development provides an effective tool for environmental planning at the project alternative level. It allows for assessment of alternatives required in terms of the ESIA process to commence at the earliest stages of the project, where it can add value and help to prevent challenges later in the process. It also addresses one of the key weaknesses of conventional alternatives assessment in ESIA, being the structured and defendable rating or scoring of alternatives to determine a preference ranking. The mathematically based, transparent and logical system of comparison is undertaken in a reproducible methodology which ensures that the project team can demonstrate the basis of their recommendation or decision. Applied in an interactive workshop environment and ensuring the appropriate participation of decision makers, engineers and environmental and social practitioners, it ensures that project outcomes are widely acceptable and supported.

The MCDM process found that the preferred alternative for detailed assessment is to link the Watershed B and Isang substations via Route C, with Route E and S being viable alternatives for the ESIA study.

The results provided will inform preliminary design in the next phase of the BOSA Corridor Project. This document will also inform the ESIA for the pursuit and implementation of any of the preferred options. The information contained herein will contribute to the "consideration of alternatives" aspects of such a study as well as providing background information to the public and authorities on the screening of options, at that time.