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Droerivier – Blanco(Narina) 400 kV & Gourikwa – Blanco(Narina) 400 kV technical site evaluation(desktop)

This report gives a high level comparison of all the various routes proposed for the proposed new Droerivier – Narina 400 kV and Gourikwa Narina 400 kV lines. For more detailed study of the routes, conceptual profiles will be performed during the concept design stage of the project.

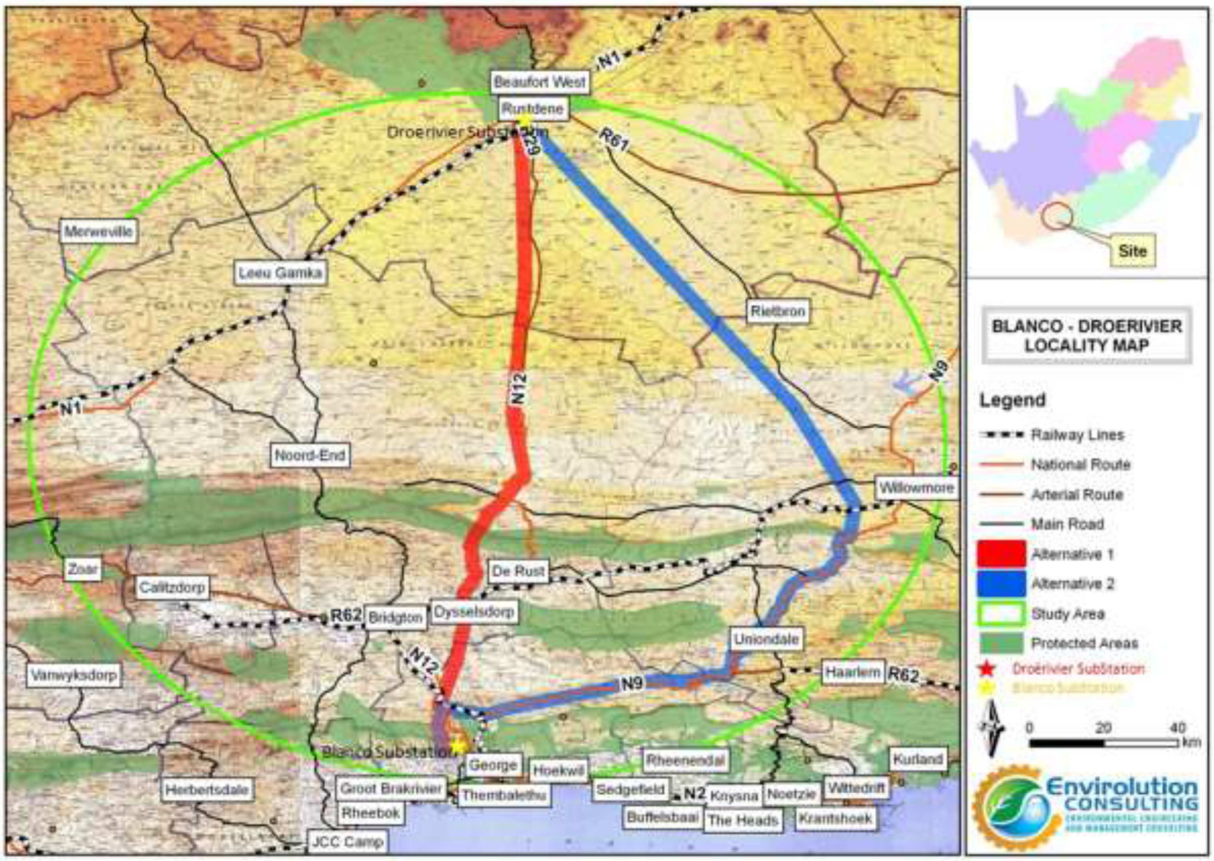

Figure 1: Study Area

1. Droerivier Narina 400 kV suggested routes

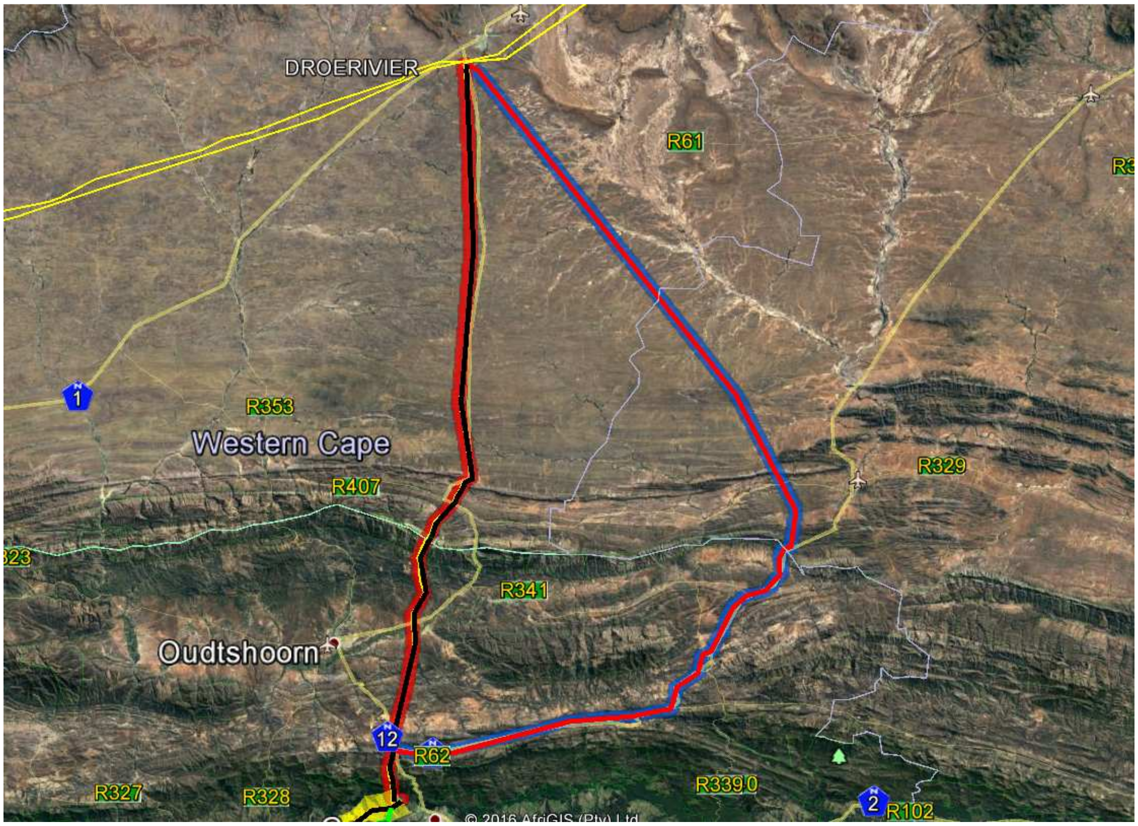

Figure 2: Proposed routes for Droerivier Narina 400 kV line

Route alternative 1

Alternative 1 (Red corridor, black line) is estimated at about 178 km and is a relative straight line connection (shortest route) between Blanco and Droerivier. The line aims to follow the existing servitude of the Droerivier Proteus 400 kV line until a point where the loop in and out of the new Narina substation will be tied in to Droerivier Proteus 400 kV line. It is at this point where the new proposed line will deviate from the Droerivier Proteus 1 400 kV servitude and turn to the new Narina substation.

The line passes about 16.8km east of Oudtshoorn and crosses over the Groot Swartberg Nature Reserve approximately 14km north-west of De Rust (the nature reserve is stretching over the Swartberg for over 200 km). It loosely runs in a corridor west of the N12 towards the Droerivier substation.

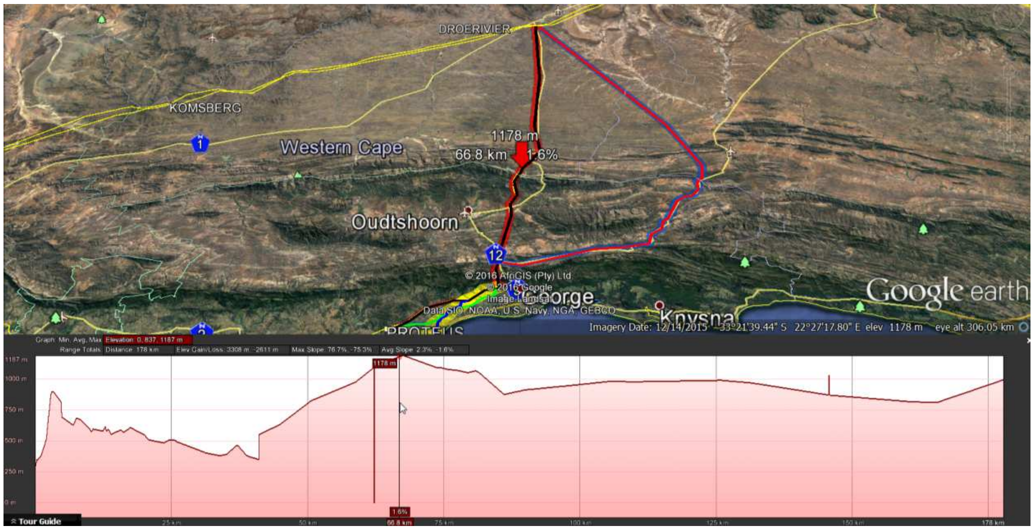

Figure 3: Elevation Profile for route alternative 1

As seen from **fig 3,** the route travels through undulating terrain area ranging from 327 m to as high as 1655m with an average height of 832 m. the high lying areas of the Swartberg Mountains are characterized with snow and the existing line has had a number of outages due to snow, ***see figure 4***. This will call for specialized design and construction to be able to have this line connecting Droerivier to Narina. The risk of working close to existing lines throughout the route during construction will require specialized personnel and equipment. Most part of the servitude is also occupied by Distribution Voltage Lines 132kV so the impacts and designs will be much simpler, ***see figure 5***.

Valleys on the servitude are also characterized by agricultural activities which will require special designs to avoid and disturbance on the farming activities. On the northern parts towards Droerivier the servitude is a typical Karoo (**figure *7*)** and cleared with minimal activity such as game farming ***see figure 6***.

The performance of the existing line is well known in ESKOM and the new design will try and combat all the known design and performance issues on the line.

Figure 4: Picture showing the snow build up on the existing Droerivier – Proteus 400 kV line

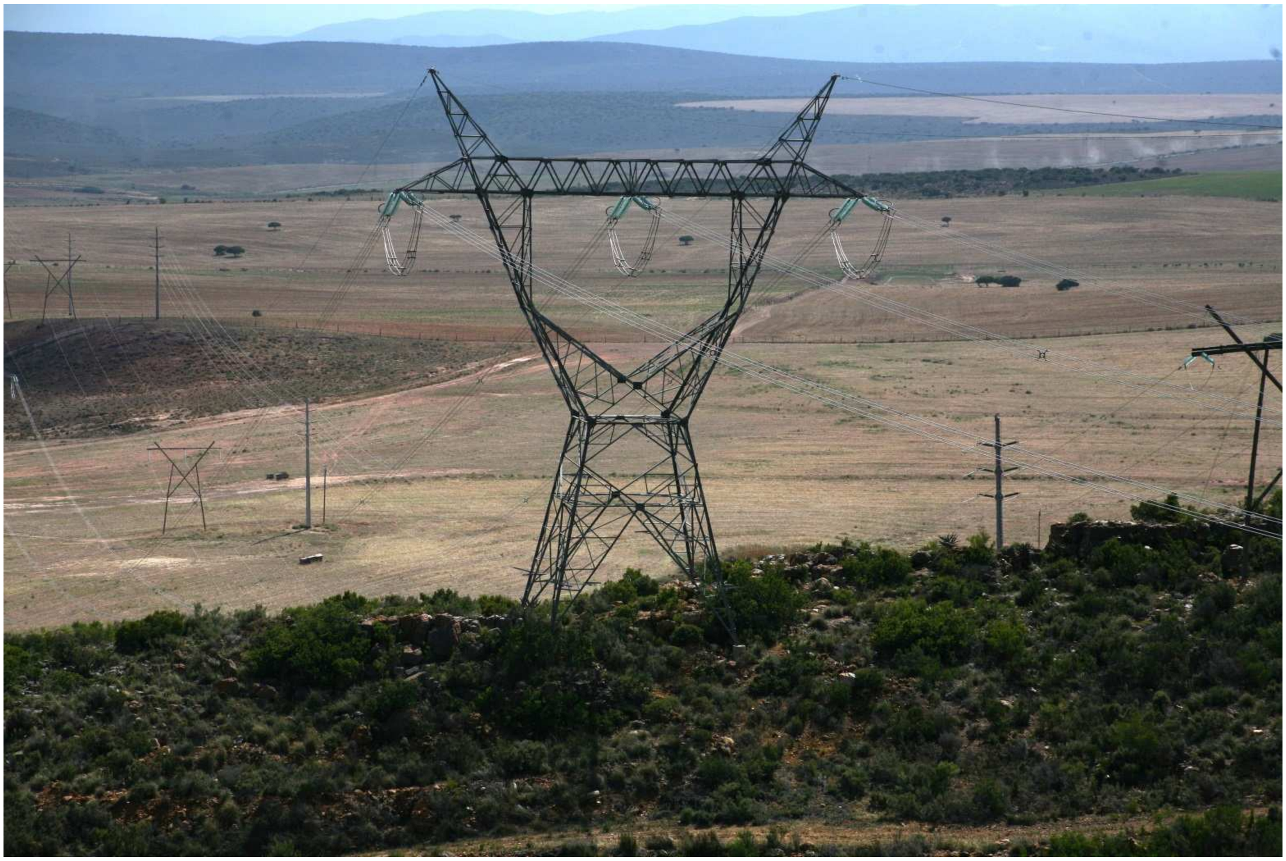

Figure 5: Picture showing 2 Dx lines running parallel to Droerivier Proteus 400 kV line

Figure 6 : Droerivier Proteus 400 kV line traversing through farming activities near Droerivier

Figure 7: Picture showing Droerivier Proteus 400 kV traversing through Karoo area

Route alternative 2

Alternative 2 (blue corridor, pink line) is 270 km long. It will exit the Blanco (Narina) substation and at the intersection of the N9 and N12, the proposed corridor will turn east and follow the N9/R62, running very close to the western side of Uniondale. It will cross the R339 and the R407, and run 14 km to the west of Willowmore and 8 km to the west of Rietbron. This small section of the line falls within the Eastern Cape Province. The section of lands between the R407 and the Droerivier substation appears to be untransformed Karoo veld.

The proposed route runs parallel to existing infrastructure and other power lines from Distribution. This will make access road easily accessible via the current N9 national road and other frequently used regional dirt roads. The crossing over the Swartberg mountain range is also a problem on this route but the altitude is not as high compared to Route Alternative 1.

Figure 8: Pictures showing the Mountains just outside of Wilmore – (R407)

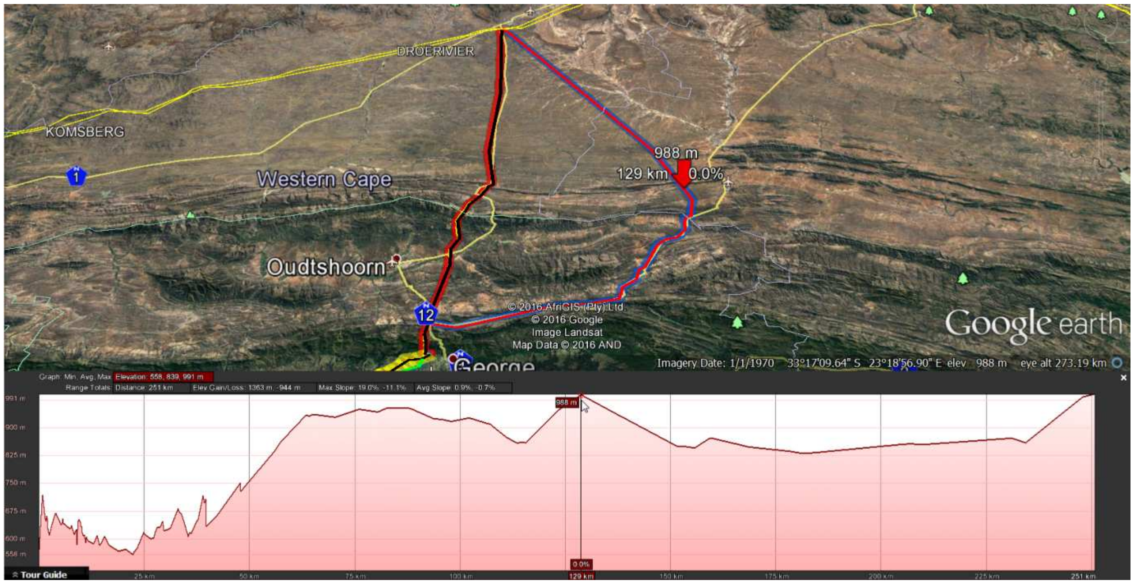

Figure 9: Elevation Profile for route alternative 2

As seen from **fig 9,** the route travels through undulating terrain area ranging from 558 m to as high as 991m with an average height of 839 m. This will call for specialized design and construction to be able to have this line connecting Droerivier to Narina. The smoother the elevation profile, the easier is to place towers on the route.

The table below summarizes the major differences between route 1 and route 2

Criterion	**Route 1**	**Route 2**	**Technical implication(s)**
Length	178 km	270 km	Generally speaking, the longer the line the more the towers to be used. This also increases the length of the conductor to be used. Assuming that the terrain is fairly similar on both routes, **Route 1** will be more preferred. (Route 2 is 51% longer than route 1) *(Approximately 900 towers vs. 600 towers).*
No of bends	45	46	Number of bends translates to the use of strain towers, which can cost up to 7 times the price of a typical 400 kV suspension tower (529A). In this case both routes are fairly even.
Major road crossings (N, M & R's)	4	9	The longer the route the higher the chances of crossing more roads. Crossing over National roads also increases the costs as strain towers have to be introduced. This is both a safety issue and a construction requirement. It is very difficult to cross National roads during construction. Specific methods must be designed based on case per case basis. Since **Route 1** tries to keep

			far away from the developed areas, crossings will be lower and hence preferred.
Railway crossings	2	1	Same as the road crossings, the fewer the crossings the better. Safety and construction. **Route 2** is better. (Introducing 4 extra strain towers compared to 2 strain towers).
Power lines crossings	5	5	The aim is to avoid crossing of power lines where possible as this escalates the costs and also pose a threat on the network (should one of the lines at the crossing collapse, the lines at the crossings will be affected).
Other crossings	Investigate further during design		
Constructability	To be confirmed during Concept design	To be confirmed during Concept design	Construction can become more challenging due to factors such as 1. Crossings 2. Mountains 3. Farms, e.g. wine farms etc.
Elevation	Min 327 m Ave. 832 m Max 1655 m	Min 558 m Ave. 839 m Max 991 m	The stepper the terrain, the more difficult it is to design for and construct. Both sites are in mountainous areas. Route 1 has a higher altitude than Route 2 which is a snow area and thus designs should be such to avoid any line faults. The shorter the mountainous route the better. **Route 1** is therefore better.

Using the table above, it's clear to see that alternative Route 1 is preferred from the technical point of view.

2. Gourikwa Narina 400 kV suggested routes

All routes travelling on the southern side of the mountain range towards George and Mosel Bay are characterized with farming, settlements and industrial activities. The major part of the land is used for different farming activities. Settlements and industrial activities are close to the major cities of Mosel Bay and George. The use of narrow servitude structures and other specialized designs of towers might be required to traverse any densely populated areas.

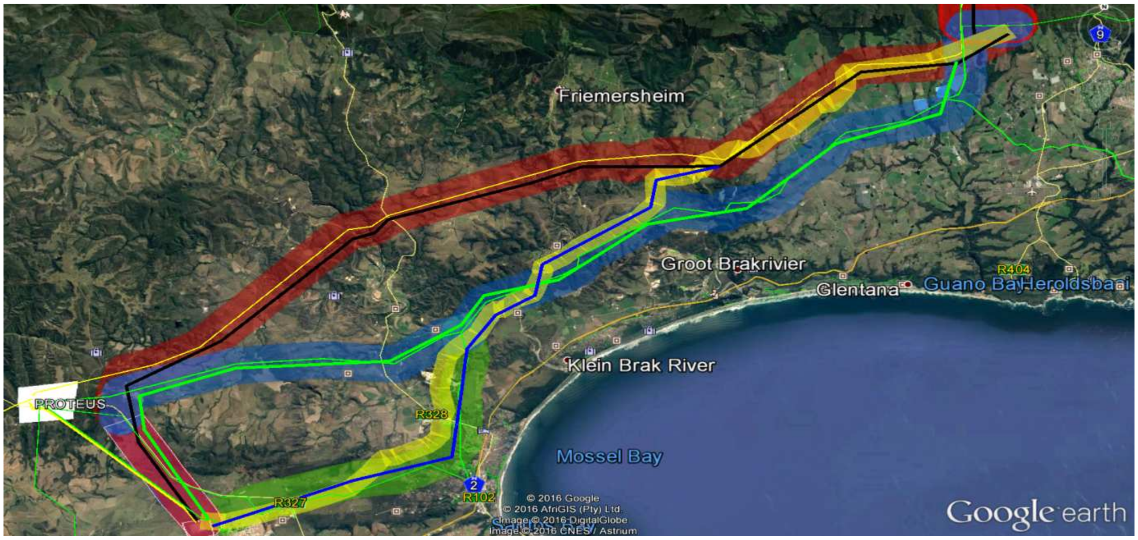

Figure 10: Proposed routes for Gourikwa Narina 400 kV line

Route alternative 1

Alternative 1 (Red corridor, black line) is estimated at about 55 km.

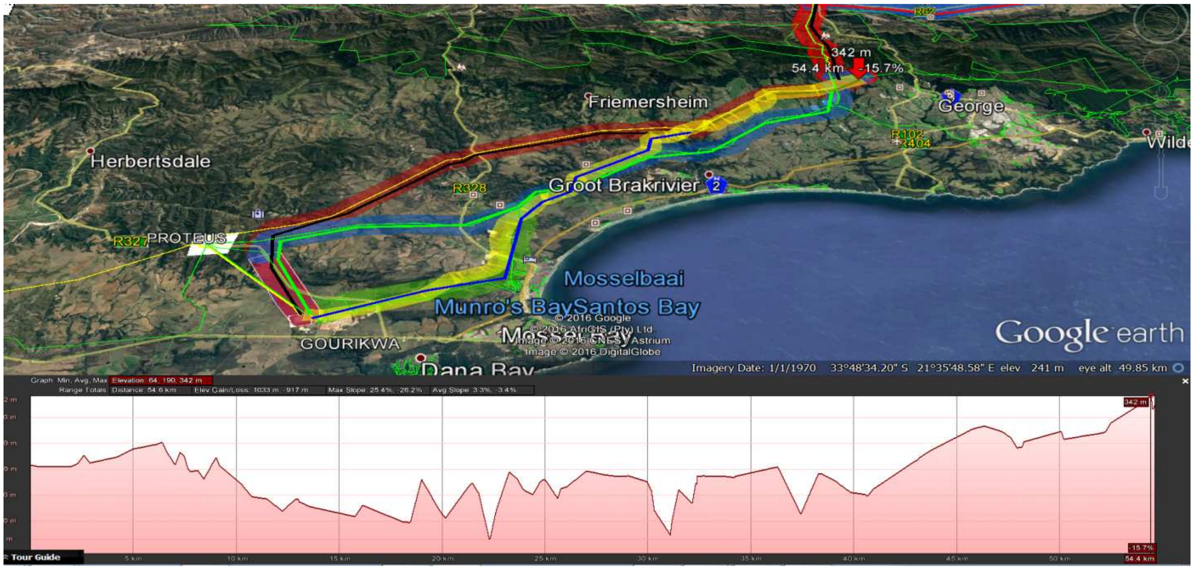

Figure 11: Elevation Profile for route alternative 1

As seen from **fig 11,** the route travels through undulating terrain area ranging from 64 m to as high as 342 m with an average height of 190 m. The area is comprised of farming activities. Special considerations for the farming activities will be looked at during design stage of the project. Although these are small mountains (hills), the steepness of the terrain will be a challenge in terms of finding the proper locations where towers can be erected.

Route alternative 2

Alternative 2 (blue corridor, green line) is estimated at about 46 km

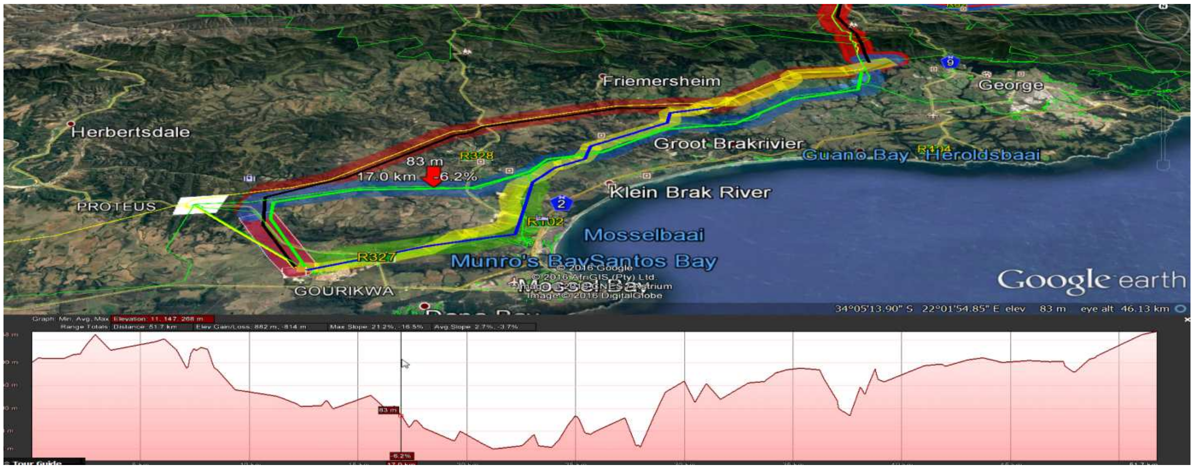

Figure 12: Elevation Profile for route alternative 2

As seen from **fig 11,** the route travels through undulating terrain area ranging from 34 m to as high as 256 m with an average height of 152 m. just like route 1, the area is comprised of farming activities. Special considerations for the farming activities will be looked at during design stage of the project. This route appears to be less steep than route 1 and is also 9 km shorter.

Route alternative 3

Alternative 3 (yellow corridor, blue line) is estimated at about 45 km

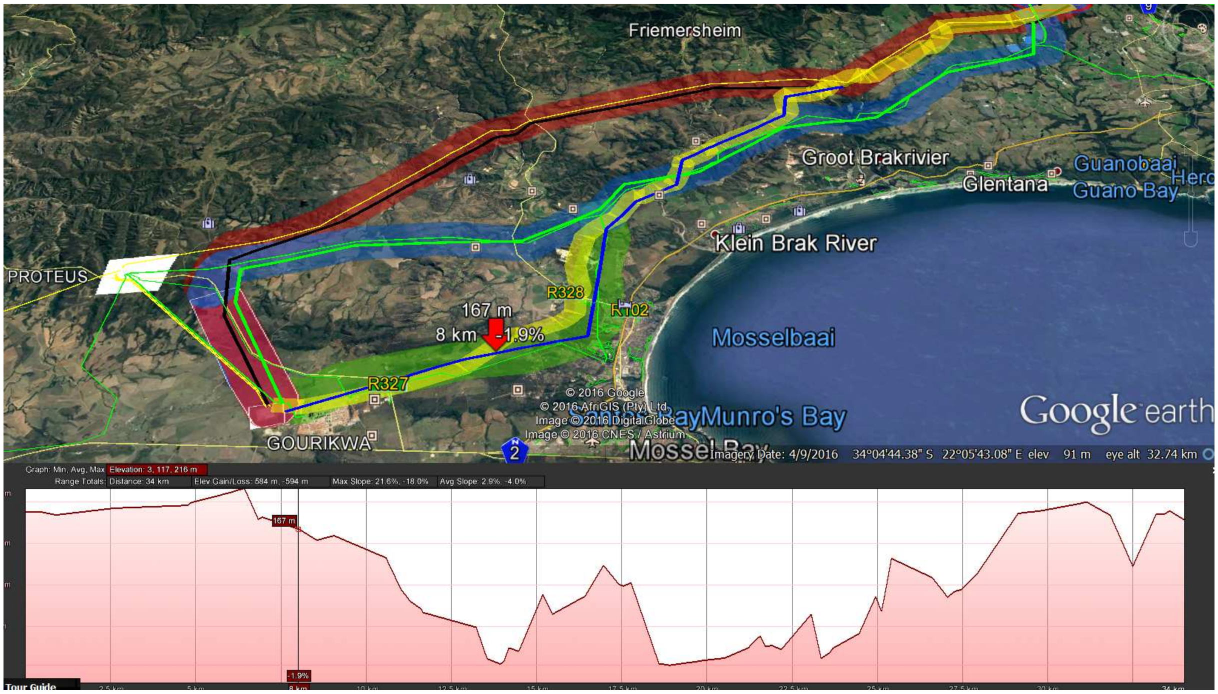

Figure 13: Elevation Profile for route alternative 3

As seen from **fig 12,** the route travels through undulating terrain area ranging from 3 m to as high as 216 m with an average height of 117 m. just like route 1 and route 2, the area is comprised of farming activities. Special considerations for the farming activities will be looked at during design stage of the project.

The table below summarizes the major differences between route 1 and route 2

Criterion	**Route 1**	**Route 2**	**Route 3**	**Technical implication(s)**
Length	55 km	46 km	45 km	Generally speaking, the longer the line the more the towers to be used. This also increases the length of the conductor to be used. There is not much difference in length between **route 2** and **route 3** Assuming that the terrain is fairly similar on both routes, **Route 1** will be the least preferred. (Route 1 is 20 % longer than route 2 and route 3) *(Approximately 180 towers vs. 155 towers).*
No of bends	12	14	11	Number of bends translates to the use of strain towers (e.g. 518D), which can cost up to 7 times the price of a typical 400 kV suspension tower (529A). In this case both routes are fairly even.
Major road crossings (N, M & R's)	2	2	2	Crossing over National roads also increases the costs as strain towers have to be introduced. This is both a safety issue and a construction requirement. It is very difficult to cross National/regional/Metro roads during construction. Specific methods must be designed based on case per case basis. All three sites have the same number of major road crossings.
Railway crossings	Nothing visible on google earth			Same as the road crossings, the fewer the crossings the better. Investigate further during design stage.
Power lines crossings	2	3	3	The aim is to avoid crossing of power lines where possible as this escalates the costs and also pose a threat on the network (should one of the lines at the crossing collapse, the lines at the crossings will be affected). Not much to choose from between the 3 options. **Route 2 & route 3**
Other crossings	Investigate further during design			
Constructability	To be confirmed during Concept design	To be confirmed during Concept design		Construction can become more challenging due to factors such as 4. Crossings 5. Mountains 6. Farms, e.g. wine farms etc.
Elevation	Min 64 m Ave. 190 m Max 342 m	Min 34 m Ave. 152 m Max 256 m	Min 3 m Ave. 117 m Max 216 m	The stepper the terrain, the more difficult it is to design for and construct. **Route 3** seems to have smoother profile than route 2 and route 1.

Using the table above, it's clear to see that alternative route 3 is preferred from the technical point of view then followed by route 2