4 PROJECT DESCRIPTION

4.1 INTRODUCTION

This Chapter provides an overview of the proposed Roggeveld Wind Farm. The need and desirability of the project and the consideration of alternatives is included in this section, as well as a discussion of the main project activities for the construction, operation and decommissioning phases.

4.2 NEED AND DESIRABILITY

Global dependence on fossil fuels, rising fossil fuel prices and concern regarding the impacts of climate change has resulted in increasing international pressure on countries around the world to increase their share of energy from renewable sources. Targets for the promotion of renewable energy now exist in more than 58 countries around the world and wind energy is emerging as an important component of the energy market in a number of countries. Globally, wind turbines currently generate more than 1 percent of global electricity.

In South Africa the government has developed a policy framework (the White Paper on Renewable Energy) and set a target of sourcing 10,000 GWh (1) from renewable energy projects by 2013 (2). This amounts to approximately four percent of South Africa's total estimated energy demand by 2013. In the Western Cape, provincial government has also made a commitment to improving sustainability by setting a goal of generating 15 percent of all energy from renewable resources by 2014 (3). At the Copenhagen Conference in December 2009 South Africa's president also set a target for the reduction of CO_2 (4) emissions, as laid out in the Integrated Resource Plan (IRP 2010) (5) which sets a target reduction of CO_2 emissions by 34 percent by 2020, a goal that the renewable energy sector plays a major role in achieving. This goal was reiterated by Minister Edna Molewa at the December 2010 Climate Change Conference in Cancun, Mexico.

Emergency load shedding in South Africa during 2007 and 2008 highlighted the challenges facing South Africa in terms of electricity generation, transmission and distribution. The National Integrated Resource Plan (IRP), drafted at the time, acknowledged the role that independent power producers (IPPs) (including those harnessing renewable energy resources) can play in

(1) For wind farms running about 23% of the year a 1MW turbine will produce approximately 2GWh in a year. To meet this target with wind energy would require about 5000 turbines of 1MW each, although other sources of renewable energy is also being considered.
(2) National Energy Regulator of South Africa South Africa Renewable Energy Feed-In Tariff (2009) NERSA Publications.
(3) Western Cape Sustainable Energy Policy (2010) Western Cape Provincial Government..
(4)Carbon dioxide is generated as a by product of the combustion of fossil fuels such as coal, petroleum and natural gas and is referred to as a greenhouse gas . Increasing concentrations of greenhouse gases in the atmosphere are causing an unprecedented rise in global temperatures, with potentially harmful consequences for the environment and human health.
(5) Department of Energy Integrated Resource Plan (2010).

ensuring sustainable electricity generation, and sets a goal that 30 percent of all new power generation will be derived from IPPs [1] .

In 2009, the establishment of the Renewable Energy Feed in Tariff (REFIT) [2] in South Africa presented opportunities for the renewable energy industry, promoting competiveness for renewable energy with conventional energy generation technologies under an enabling market mechanism which offered a Feed in Tariff for each unit of energy produced from renewable resources. Through REFIT there was be a heightened interest throughout the renewable energy sector (wind, solar, hydro, biomass and geo-thermal) due to these set prices for electricity determined and licensed by the National Energy Regulator of South Africa (NERSA). The Department of Energy has recently released a request for proposals (RfP) under their renewable energy Independent Power Producer procurement programme (IPP Procurement Programme) to select IPPs. The aim of the programme is to contribute towards the renewable energy target of 3 725 megawatts and to stimulate the industry in South Africa. The bid selection process will consider the suggested tariff as well as socio-economic development opportunities provided by the project and the bidder.

The intention of G7 in establishing wind energy facilities is to contribute to South Africa's goal of developing wind resources to generate electricity, thereby reducing the country's dependence on non-renewable fossil fuel resources and contributing to climate change mitigation. The proposed Roggeveld Wind Farm project would contribute to providing a future of increased energy security and sustainability whilst providing energy to facilitate South Africa's continuing development.

G7 has indicated that the Roggeveld site is particularly suited for wind energy development due to the strength of the prevailing wind resources. Topography such as hills and ridges has a significant influence on average wind speed and represent areas of greater electricity generation relative to the number of turbines and the disturbance footprint.

G7 has been measuring the wind resources at the Roggeveld site for over one and a half years now and has determined that the site is definitely viable for commercial electricity generation using wind turbines.

A summary of the project motivation is provided in *Box 4.1* below.

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(1) REFIT is a renewable energy policy that obliges energy suppliers such as Eskom to buy electricity produced from renewable resources at a fixed price, usually over a fixed period. The original REFIT tariff was R1,25 /kWh for wind power. Comparing this with the normal electricity tariff of around 40c/KWh, one can see that through REFIT a significant premium is placed on renewable energy, with Eskom paying more for renewable energy than it can currently be sold for. However, the Department of Energy has since revised this tariff to be based on a maximum R1.15/kWh with full competitive price bidding, possibly affecting the viability of some renewable energy projects. G7 have advised that this potential reduction would not affect the viability of the proposed project.
(2) IEC 61400-1 Wind turbines – Part 1: Design requirements

Box 4.1 *Project Motivation*

- Reduce South Africa's dependence on fossil fuel resources
- Improve reliability and range of electrical services
- Meet demand for diversified energy sources
- Ensure the future of sustainable energy use
- Reduce CO_2 emissions and the nation's carbon footprint
- Contribute to targets for emission reduction as outlined in IRP 2010
- Promote environmental, social and economically sustainable development
- Create long term jobs
- Contribute to reaching South Africa's goal of 10,000 GWh of renewable energy by 2013
- Contribute to meeting the IRP goal of 30 percent of all new energy from IPPs

In addition to the energy benefits produced by the wind energy facility, the proposed project has the added advantage of income generation through the sale of the electricity produced, supplementation of the income of marginally productive farms and contributing towards sustainable community development projects through funding of trust funds for this purpose.

As the proposed Roggeveld Wind Farm is located in the middle of the country, the national grid in this region requires stabilisation and support and the project is able to promote this and may result in a more secure energy supply for energy users in the local area.

4.3 PROJECT LOCATION

The proposed wind energy facility is located to the west of the R354, approximately 45 km south of Sutherland and 30 km north of Matjiesfontein. The site is located in both the Western and Northern Cape Provinces, on parts of the following farms (see *Table 4.1*).

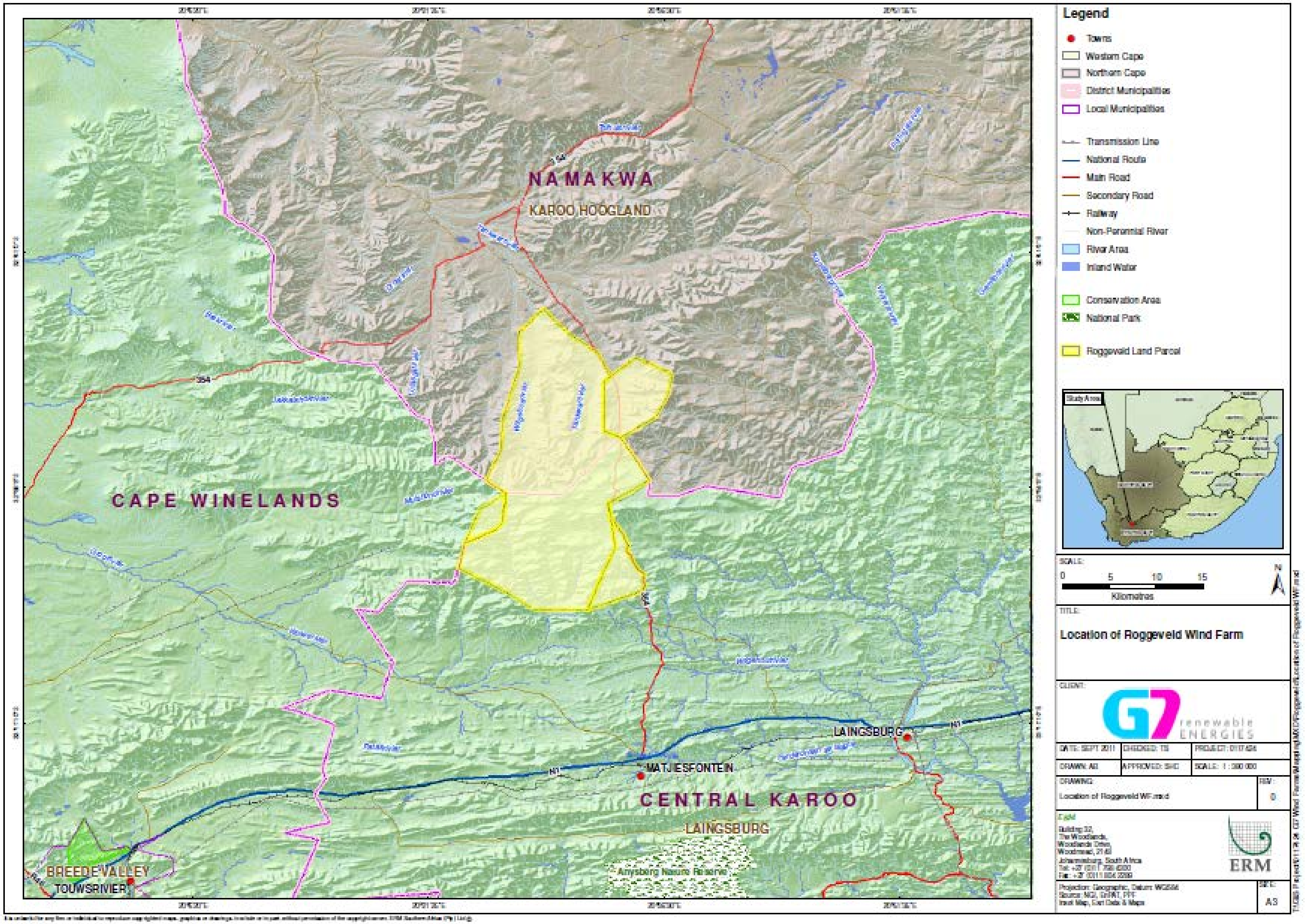
Table 4.4.1 *Roggeveld Wind Farm Location*

Farm Name	Farm Number	Province
Ekkraal	RE/199	Northern Cape
Bon Esperance	RE/73	Western Cape
Wilgebosch Rivier	188	Northern Cape
Rietfontein	197	Northern Cape
Karreebosch	RE/200	Northern Cape
Ek Kraal	2/199	Northern Cape
Klipbanks Fontein	RE/198	Northern Cape
Klipbanks Fontein	1/198	Northern Cape
Bon Esperance	1/173	Western Cape
Ek Kraal	1/199	Northern Cape
Barendskraal	1/76	Western Cape
Barendskraal	RE/76	Western Cape
Fortuin	1/74	Western Cape
Brandvalley	RE/75	Western Cape
Hartjies Kraal	1/77	Western Cape
Brandvalley	1/75	Western Cape

Farm Name	Farm Number	Province
Fortuin	3/74	Western Cape
Fortuin	RE/74	Western Cape
Hartjies Kraal	RE/77	Western Cape
Nuwerus	RE/284	Western Cape
Kabeltouw	160	Western Cape
Appelsfontein	RE/201	Northern Cape
Aprils Kraal	RE 105	Western Cape

The approximate site boundary is shown in *Figure 4.1*. The proposed Roggeveld Wind Farm is located adjacent to the main bulk transmission line network that runs from the Western Cape to major cities in the northeast of South Africa.

Figure 4.4.1 Location of Roggeveld



4.4 *PROJECT COMPONENTS*

It is anticipated that once operational the facility would generate up to 750 MW of electricity which will be fed into the National Power Grid. The key components of the proposed wind farm include the following, which are discussed in more detail below:

- wind turbines;
- electrical connections;
- substation;
- access roads and site access; and
- additional project infrastructure.

In terms of the Department of Energy's requirement that each wind farm application only have a maximum of 140 megawatts, the project has been divided into three phases as shown in Figure 4.2, Figure 4.3 and Figure 4.4 below. Phase 1 is therefore structured with 93x1.5MW turbines (~140MW), however, should a 3MW turbine be used, which will be confirmed during the tender phase, this wold reduce the number of turbines

Figure 4.2 Phase 1 of Roggeveld Wind Farm

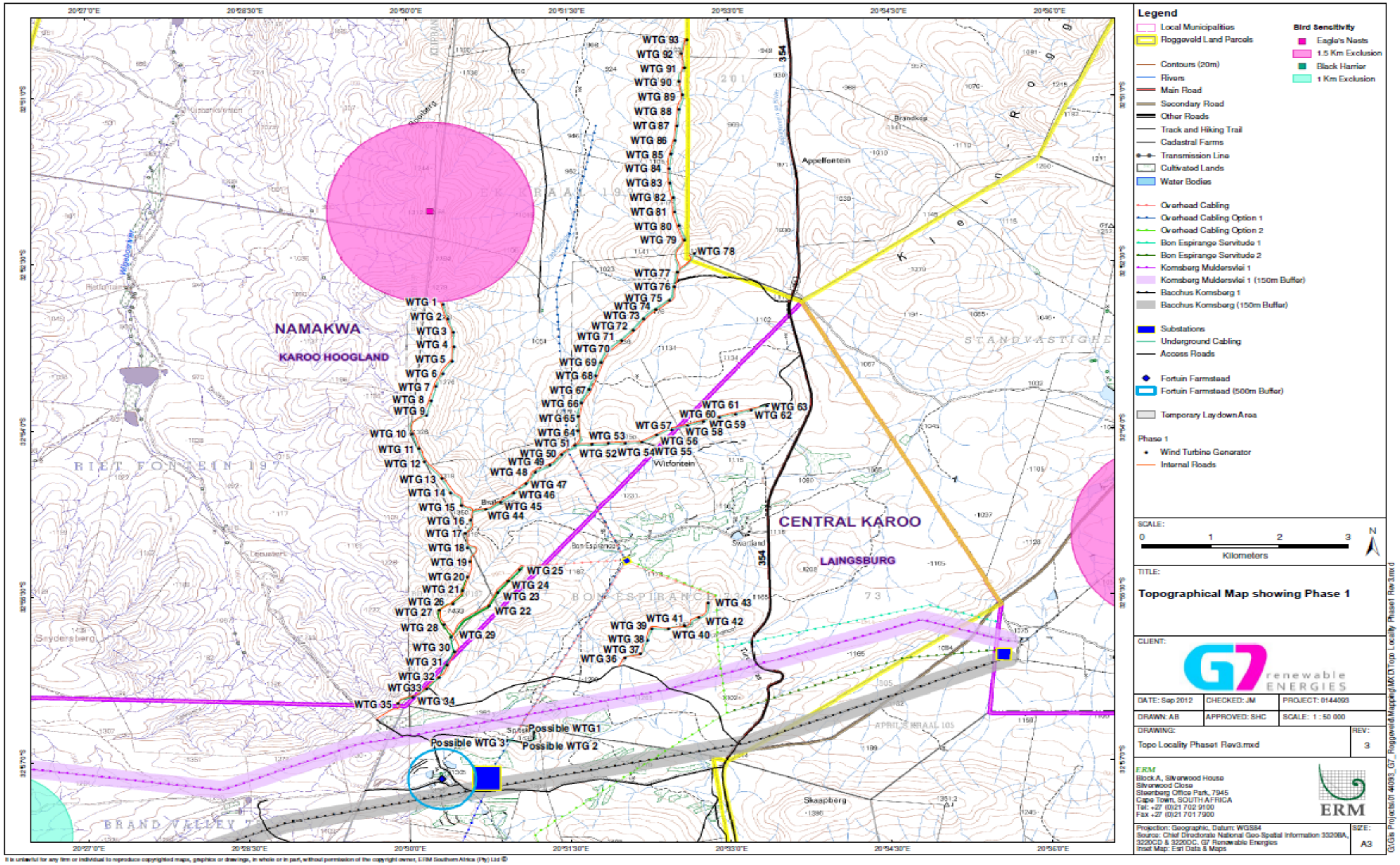


Figure 4.3 Phase 2 of Roggeveld Wind Farm

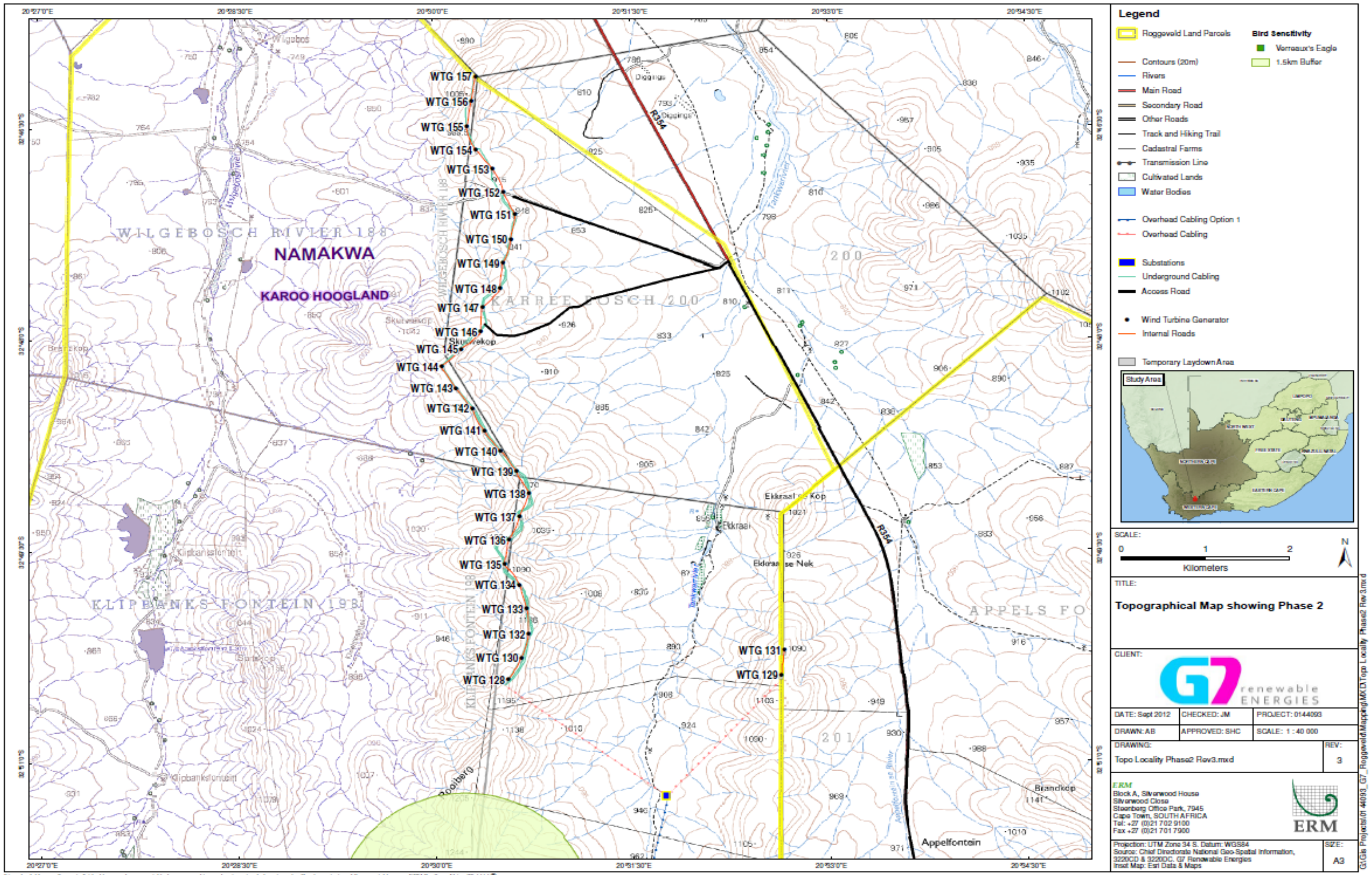


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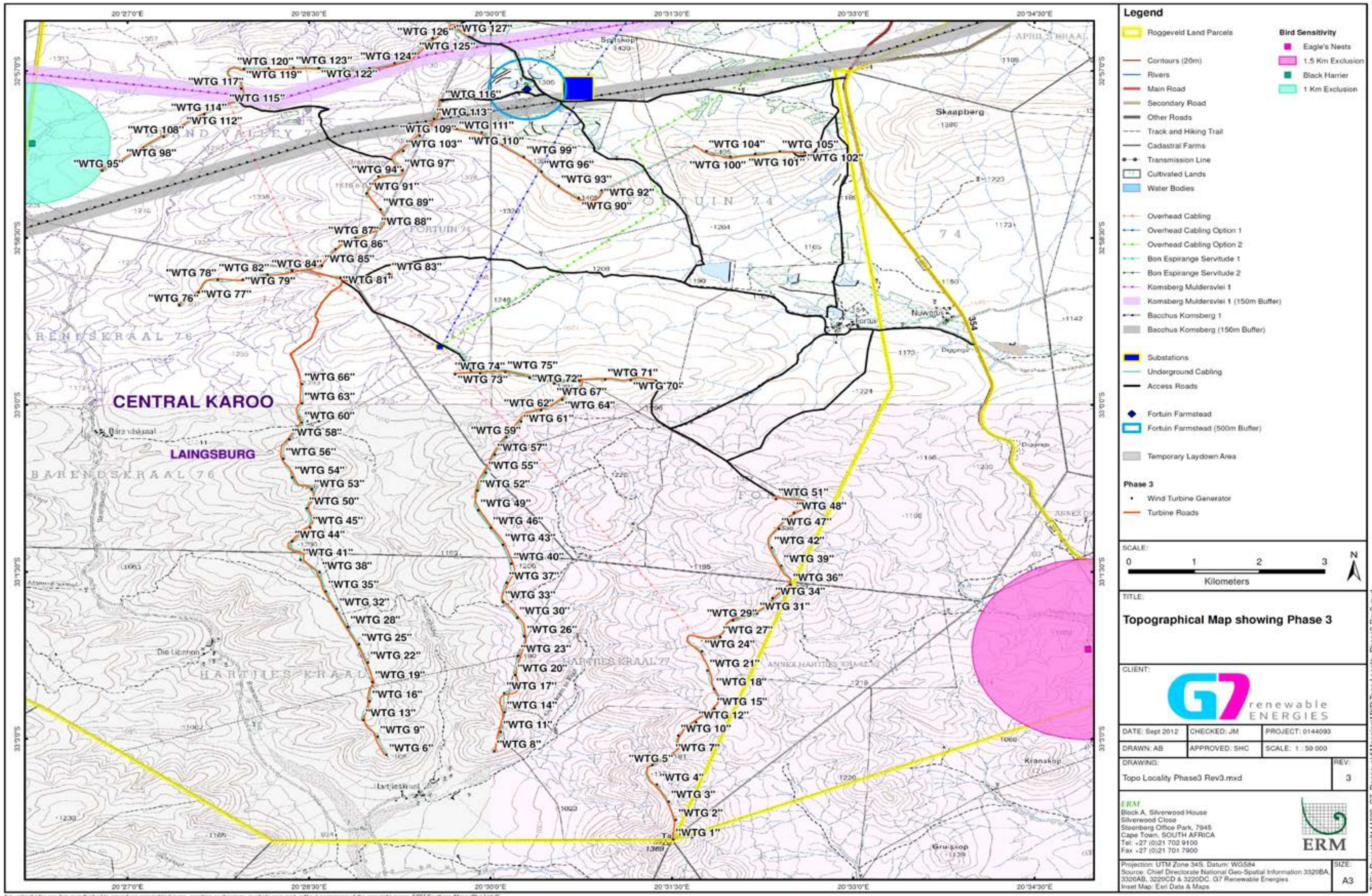
Figure 4.4 Phase 3 of Roggeveld Wind Farm



4.4.1 Wind Turbines

Up to 250 x 3MW wind turbines are proposed for the site. Based on specialist study findings and other technical reasons the Final Layout (Alternative 2) consists of 250 x up to 3MW wind turbines. *Figure 4.3* below shows a typical wind turbine similar to the type envisaged for the Roggeveld Wind Farm. Modern wind turbine designs include a tubular tower, three blades and a nacelle which houses a generator, gear box and other operating equipment. Each of the turbines at the Roggeveld Wind Farm will have an individual capacity of up to 3 MW. The turbines will be approximately 100 m high (to the turbine hub), with a rotor diameter from tip of blade to tip of blade of up to 117 m. Total height from ground to highest blade tip would be up to 163.5 m.

Each turbine will have an above ground, visible concrete foundation of approximately 5 m x 5 m and an underground, non-visible concrete foundation of approximately 20 m x 20 m x 3.0 m (depth) at its base and a gravel hard standing and lay-down area (of approximately 2,500 m^2 [(1)]) adjacent to the turbine foundation as shown in Figure 4.2. The hard standing area will be used for construction activities and for turbine maintenance during operation. The hard-standing will be compacted in order to facilitate the use of a crane during construction and maintenance activities. Each turbine will be accompanied by an electrical transformer. Some turbines may need to be lit to meet the Civil Aviation Authority's safety standard requirements[2].

(1) The area required for all hard standing, lay-down areas and access roads will be kept to the minimum practicably possible (given technical and health and safety constraints) in order to minimise impacts on the environment.
(2) Marking of Obstacles SA-CATS AH 139.01.33

Figure 4.5 Turbine, internal road and laydown area footprints

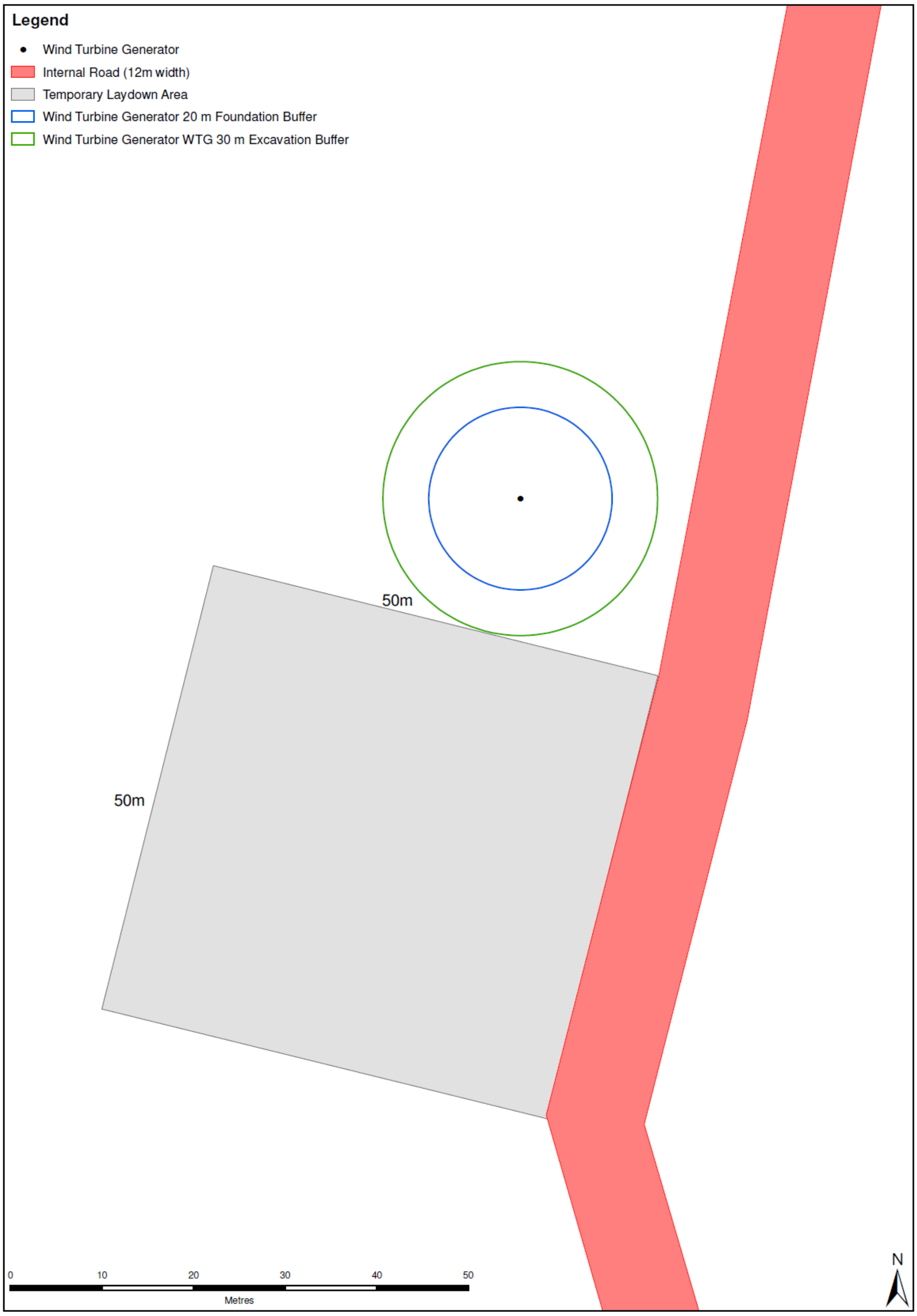
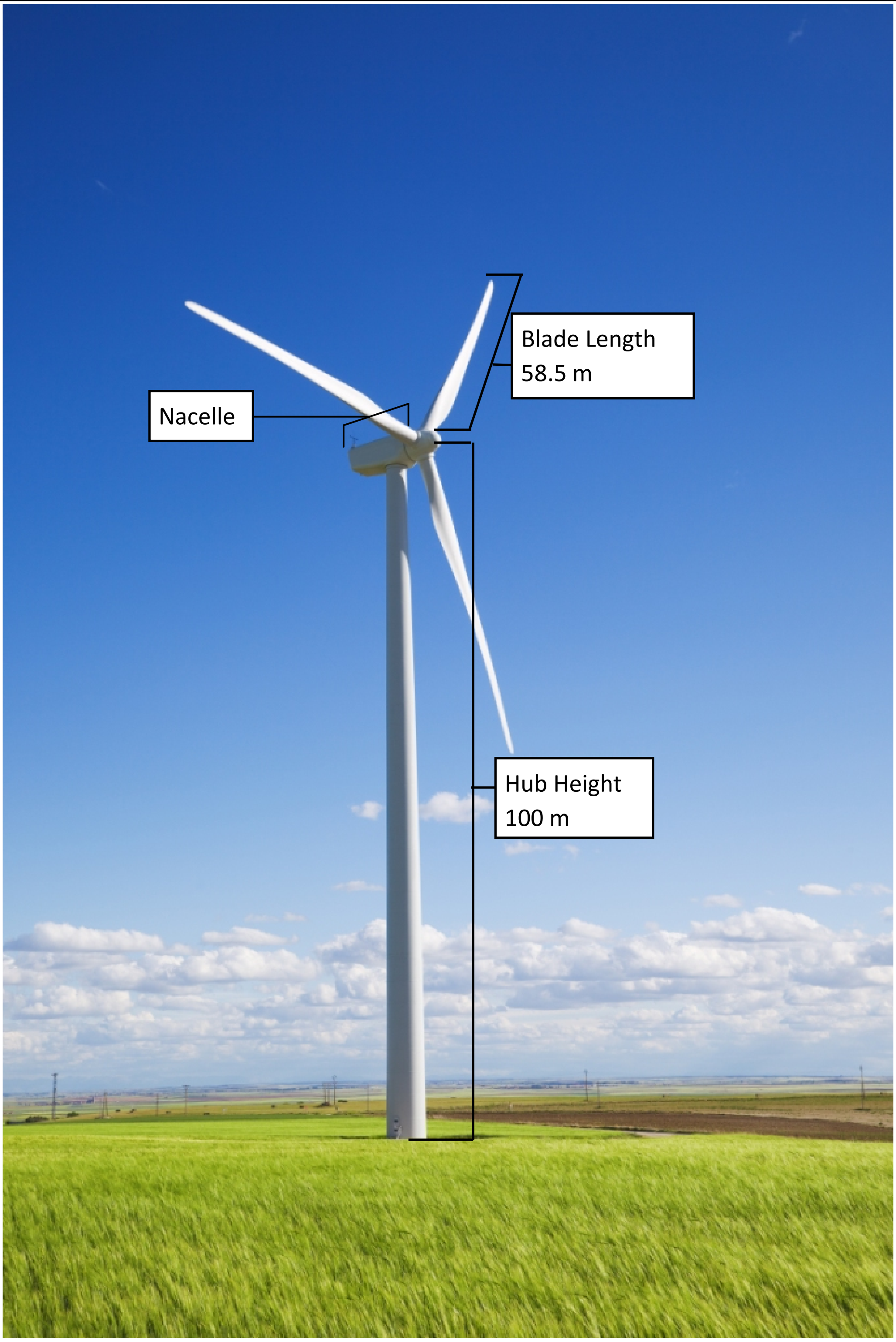


Figure 4.6 Typical Wind Turbine



4.4.2 *Electrical Connections*

The turbines will be connected to each other, and the turbine rows will be connected to a new substation that would be built as part of the development (see below). The electricity generated by the facility would be fed into the national grid network via existing 400 kV overhead lines that pass through the centre of the site. The existing 400 kV lines that pass though the site are the

Komsberg/Muldersvlei and Baccus/Komsberg lines, which link with the Droerivier/Komsberg 1 and Droerivier/Komsberg 2 lines at the Komsberg 400 kV booster station, which is located on the southeastern boundary of the proposed wind farm site.

One main 400kV substation near the centre of the site is proposed with up to six smaller 132kV substations closer to the turbines collecting capacity from groups of turbines. The smaller substations would be connected to the main one via 132kV overhead lines.

A number of different electrical connection options have been considered as part of the development and although a final design has been selected, some minor changes may still be required. Installation of underground cables would require excavation of trenches, approximately 1 m to 1.5 m below ground, within which cables would be laid, following internal access roads as far as possible. The electrical infrastructure of the proposed Wind Farm would consist of the following:

- Connections between the turbines using medium voltage underground electrical cabling.
- Connections between the turbines using medium voltage underground cabling (up to 33 kV).
- Connection of the turbine rows to the relevant 132kV substation using medium voltage (up to 33 kV) underground electrical cabling or overhead transmission lines.
- Connection of the various 132kV substations to the central 400kV substation using high voltage overhead transmission lines (up to 132 kV).
- A large and central 400kV substation adjacent to the existing transmission lines that run through the centre of the site.

4.4.3 Substations

Several new substation facilities would be built as part of the development, to facilitate connection of the wind farm to the national grid network via the existing transmission facilities as outlined above. The new 400kV (Option 1) substation will be located in the centre of the site. The 400kV substation would be a single-storey complex of approximately 400m by 400m in size; it would house electrical equipment and would be fenced for security and safety. The main substation complex would also house site offices, storage areas and ablution facilities. The smaller 132kV substations (up to 6) would be approximately 100x100m large.

An additional property has been secured so that a new substation can be built directly next to the existing substation at Komsberg, which has two 190m x

85m units connecting parallel 400kV lines. The additional substation (Option 2) will be 200m X 200m and will be positioned directly adjacent to the existing substation.

4.4.4 *Access Roads and Site Access*

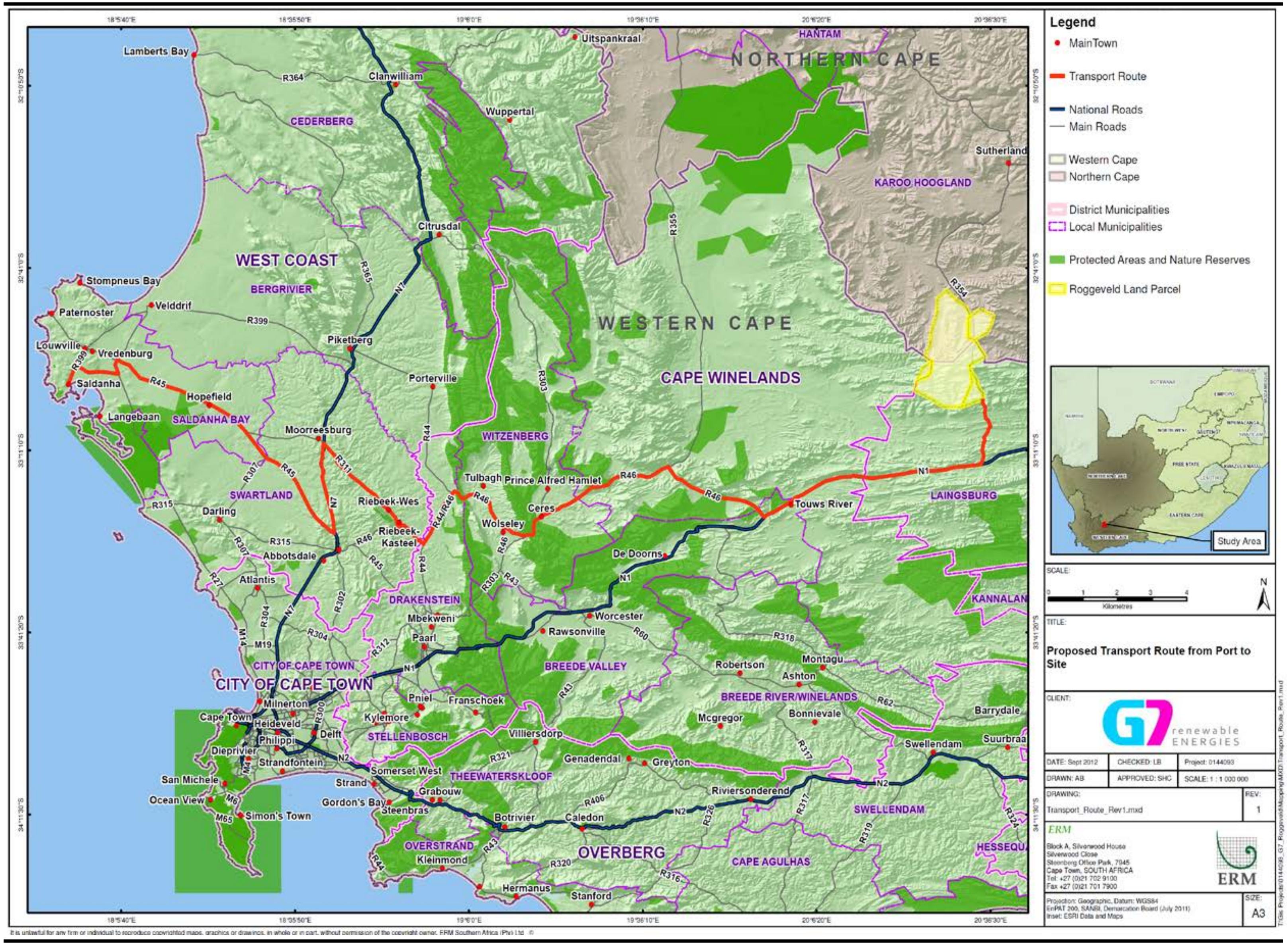
The site would be accessed via the R354. Some existing public roads may need to be upgraded to facilitate the transport of the turbines and other construction materials to the site. Within the site area existing farm tracks would be used, some existing farm tracks may be up-graded and new gravel roads may be constructed to facilitate movement of construction and maintenance vehicles.

It is likely that there would be two or more site access roads including one accessing the south of the site from the R354 and one accessing the north of the site from the R354. There may also be a site access road accessing the centre of the site from the R354. In addition to site access roads there would be a network of access roads between each of the turbines. Site access roads would be up to 12 m wide with drainage trenches adjacent to the road.

A number of different site access road options are being considered as part of the development. The final design of the access roads will be based on a number of environmental, technical and economic considerations which will be explored further during the detailed project design phase.

In terms of transporting the turbine components from the Port of Saldanha to the site, the route envisaged is shown in Figure 4.7 below. The route generally follows the R45 then onto the N7 followed by the R46. Then route continues on the N1 until it reaches the R354 which meets the boundary of the site.

Figure 4.7 Port to site route



4.4.5 *Additional Project Infrastructure*

Additional infrastructure that would be required for the project includes the following:

- Four wind measuring masts (lattice structure; 60 m high) have been erected to collect data on wind conditions for at least a 12 month period and an expected maximum period of 3 years. This will likely be followed by up to five more 60m masts in 2012. Higher 80 m masts would have to be erected before erection of the turbines.

- Site fencing (as required).

- A temporary site compound (during construction) for the storage of chemicals, equipment, with additional worker facilities, is envisaged to occupy approximately 2500 m^2. It is not yet known where this would be located. Within the site storage area there would be bunding (1) for transformers or any other oil containing equipment to ensure full containment in the event of any oil leakage.

- A temporary construction lay-down area adjacent to each turbine of approximately 2,500 m^2 (hard-standing) for the temporary lay-down of the turbine and to provide a level surface for a crane pad. A portion of the lay-down area not required for future maintenance would be rehabilitated after construction.

- It is likely that borrow pits (subject to the appropriate permits) would be required within the site area to obtain aggregate material for construction of the internal roads and possibly turbine foundations. Final road capping may, however, have to be obtained from a commercial quarry and transported to the site, to ensure the materials meet the quality requirements for the road surface layer. Siting of the borrow pits would require a separate geotechnical investigation which will prioritise sourcing of material from previously impacted habitats as far as possible. This will require additional investigations involving an ecologist to provide advice on potential ecological risks and remediation. The size and location of the borrow pit(s) would depend on the terrain, suitability of the subsurface soils and the requirement for granular material for access road construction and other earthworks. Should borrow pits be required they would be reinstated as far as possible at the end of construction using surplus material excavated from foundations or other site excavations.

- An on-site batching plant will also be developed (subject to the appropriate permits) to mix concrete on site, located on previously disturbed land adjacent to the R354 next to the entrance gate of the Fortuin farm (approximately 90m by 70m). This location is currently being used as

(1) A concrete spill containment area

the batching plant for the concrete required for Eskom's new Kappa Omega 765kV currently under construction on the site (DEAT reference 12/12/20/99/10).

4.4.6 *Summary of Project Infrastructure*

Table 4.1 below provides a summary of the individual infrastructure components of the wind farm:

Table 4.2 Summary of Wind Farm Infrastructure Components and Land Requirements

Component	**Size**	**Footprint**	**Land Requirement (ha)**
250 x 3MW wind turbines	100m hub height Total height: 163.5m	20x20m = 400m^2 per turbine = 100000m^2	10ha
Lay down areas for each turbine	2500 m^2	625,000 m^2	62.5 ha
Access Roads	12 m wide x ~124.5 km	12,000 m^2 per km x 124.5 km = 258,000m^2	149.4 ha
Substations	Option 1:1x400m x 400m or Option 2: 1x200mx200m Up to 6x100m x 100m	160,000 m^2 40,000 m^2 60,000 m^2	~26 ha
Mini substations at each turbine	2m x 2m	4m^2	0.0004 ha
Cable trenches	1m wide x 195 km	28,000 m^2	2.8 ha
Construction Camp & storage area	2500 m^2		0.8 ha
Borrow pits / quarry	500 x 100 m	50,000 m^2	5 ha
Excavated material (borrow pits)*	500 x 100 x 10m deep	500,000 m^3	5ha
			~ 261.5ha total
* subject to further geotechnical investigations			

4.5 PROJECT PHASES AND ACTIVITIES

The project life-cycle can be divided into five phases as follows:

- Site selection- pre-feasibility / screening study;
- Detailed development design;
- Construction;
- Operation (including maintenance and repair); and
- Decommissioning.

These phases are outlined in the sections below.

4.5.1 *Pre-feasibility / Screening Study - Site Selection and Alternatives*

Prior to ERM's appointment as the independent environmental consultant and before the EIA process was initiated, the Roggeveld Wind Farm site was selected by G7 amongst a number of other potential sites in the area as potentially suitable from a wind resource perspective. Once landowner agreements had been granted the wind measurement campaign commenced with the erection of a temporary 15 m wind monitoring mast (pre-August 2010) and two permanent 60 m wind monitoring mast (constructed during November 2011), followed by a further two in 2011[1]. During the site selection phase G7 commissioned an environmental and social pre-feasibility assessment of the site and several others. This study, which was undertaken by Coastal and Environmental Services (CES) (2009) included a high-level screening of potential environmental and socio-economic issues or 'fatal flaws'. The Roggeveld site was selected by G7 as one of five priority sites and the EIA and other permitting processes have now commenced.

4.5.2 *Detailed Development Design*

The site has been chosen by G7 based on a number of technical, financial, environmental and socio-economic criteria. The design of the facility including the preferred and final turbine layout and location of other project components presented in this report has been determined using information gathered from the wind measuring masts, the information gathered during the specialist studies phase and environmental and socio-economic considerations established so far during the EIA phase.

The detailed development layout has considered key parameters such as topography used as a criterion to determine turbine positions, road layout, substation location and dimensions etc.

4.5.3 *Construction*

Construction Activities

Prior to the installation of the wind turbines, the site would be prepared as required; this would include the following activities:

- vegetation clearance;
- subcontractor mobilisation;
- erection of fencing;
- construction/upgrading of on-site access roads;
- construction of site office and storage facilities;
- levelling of hard-standing areas;
- excavation, laying and concreting of turbine foundations;
- piecewise erection of the individual turbines with a specialised crane;
- digging of trenches and laying of underground cables;
- stringing of overhead lines; and
- substation construction.

---

(1)The 60 m masts do not require approval as part of the EIA process according to the new regulations under which it was built. Should this be required, a land use status that gives the mast the same lifetime as the project will be applied for through the land-use planning authorisation of the wind farm.

Due to the sheer size of the project and DoE's 140 Megawatt cap requirement, construction will likely take place in several phases. Total construction time per phase is envisaged to take approximately 15-18 months, largely depending on weather conditions. The site preparation activities may take up to 9 months. The turbines and other construction materials would be delivered to site via public roads on low-bed trucks. Once the turbine components have arrived on site, it would take approximately 6-9 months to complete the turbine assembly and electrical connections. Delays can easily result should the erection of turbines take place over the winter months since the high wind speeds experienced in winter prohibit the safe operation of the crane lifting the very large turbine components.

Figure 4.3 shows a wind turbine during assembly. After the completion of the internal electrical connections between the turbines, turbine function testing would take place to verify the correct operation of the facility.

Each turbine would require underground excavations of approximately a 20 m x 20 m footprint, and 3 m depth (1200 cubic metres). Blasting is likely to be required to excavate the foundations for the turbines, and possibly for road construction, however the extent of it being required would be determined after final geotechnical studies have been completed prior to construction, and would be minimised as far as practicably possible.

Several large borrow pits may be required for road construction and would require a separate mining permit or right in terms of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) once the precise locations are determined.

After installation of the turbines the crane pads and access roads would remain, while the rest of the construction-affected areas which are not likely to be used during the operational lifespan of the project could be rehabilitated.

Construction Employment

During the construction period local people would be directly employed by the project; namely for site security, manual labour, transportation of goods and other similar services. The exact number of jobs that would be directly created by the project during construction is not known at present, but it is estimated to be approximately 346 positions during construction. The turbine assembly and testing would be undertaken by a highly-skilled team of turbine construction specialists (the majority of which would likely be from overseas as a workforce of this type is not currently available in the South African market). As part of the project, opportunities to employ and train up to 46 South African's to become skilled wind farm construction staff would be identified and implemented.

Figure 4.8 Turbine Installation

4.5.4 *Operation*

Once construction of the facility is complete and it becomes operational it is expected that the wind farm will have a minimum life span of up to 25 years. Regular maintenance would be required to ensure that the turbines are kept in optimal working order. Most day to day facility operations would be done remotely through the use of computer networks but some of the maintenance and repair activities would be undertaken on site. During operation wind farms can function in parallel with daily farming activities due to the relatively small footprint of the turbines, hard-standing areas and access roads. A small team of up to 46 technical wind farm maintenance specialists (including trainees) would be employed by the project during the operations phase. Some additional ancillary 25 employment positions would be created by the project, including administrative staff, security and general maintenance of the wind farm site.

4.5.5 *Decommissioning*

Once the facility has reached the end of its life the turbines may be refurbished and continue operating as a power generating facility, or the facility can be closed and decommissioned. If decommissioned, all the components of the wind farm would be removed and the site would be rehabilitated. The concrete foundations of the turbine would be removed to below ground level and would be covered with topsoil and replanted to restore natural habitat cover. Some access roads may also be removed and rehabilitated at the request of the landowner.

4.6 *CONSIDERATION OF ALTERNATIVES*

4.6.1 *Overall Site Alternatives (Pre-feasibility Study)*

The study by CES (2009) [1]considered the anticipated risks associated with securing the obligatory environmental authorisations and other associated permitting and licensing requirements potentially applicable for each of the 14 site alternatives. A preliminary desktop assessment of the anticipated environmental impacts associated with each site alternative was also conducted in order to determine the possible significance of these impacts on their respective receiving environments. This was intended to inform whether these potential impacts could be deemed environmental fatal flaws that could prevent a given site alternative from receiving environmental authorisation. Another key factor considered in the overall risks associated with the individual site alternatives is any ancillary permitting and/or licensing processes that may be required to be completed prior to the commencement of construction activities, even after the required environmental authorisations have been obtained.

The CES (2009) pre-feasibility/ screening study was also intended to assist in refining G7's decisions as to which site alternatives should be prioritised for the development of wind energy facilities. It addressed the biophysical and social-economic environmental constraints and opportunities, as well as the potential cumulative impacts of the preferred sites. The document provided G7 with important information to inform their decision on whether or not to proceed with the full EIA process. This section gives a summary of the purpose, methodology and main findings of the screening process.

Key Informants

International and National Guideline Documents

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(1) [1] Coastal & Environmental Services, December 2009: Pre-Feasibility Assessment for 14 proposed wind energy facility sites in South Africa, CES, Grahamstown. Available online at http://data.g7energies.com/eia/20091218_CES_Prefeasibility_Assessment_for_G7_FINAL.pdf

The pre-feasibility/ screening report was informed by various international and national guideline documents, statutes and regulatory frameworks of relevance to the project, including:

- The ***1992 United Nations Framework Convention on Climate Change (FCCC),*** which is relevant *as* the proposed project will contribute to a reduction in the production of greenhouse gases by providing an alternative to fossil fuel-derived electricity, and will assist South Africa to begin demonstrating its commitment to meeting international obligations.

- ***The Kyoto Protocol (2002)*** which is relevant for the same reason as above.

- ***The Constitution Act (108 of 1996),*** placing an obligation on G7 to ensure that the proposed development will not result in pollution and ecological degradation; and that the proposed development is ecologically sustainable, while demonstrating economic and social development.

- ***The National Environmental Management Act (NEMA) (107 of 1998***) which requires the developer to be mindful of the principles, broad liability and implications associated with NEMA and to eliminate or mitigate any potential impacts. Also for the developer to be mindful of the principles, broad liability and implications of causing damage to the environment.

- ***National Environment Management: Biodiversity Act (10 of 2004)*** which suggests that the proposed development must conserve endangered ecosystems and protect and promote biodiversity; must assess the impacts of the proposed development on endangered ecosystems; that no protected species may be removed or damaged without a permit; and to ensure that the proposed site must be cleared of alien vegetation using appropriate means.

- ***The National Forests Act (84 of 1998)*** requiring that if any protected trees in terms of this Act occur on site, the developer will require a licence from the responsible authority to perform any of the above-listed activities.

- ***National Heritage Resources Act (25 of 1999)*** requiring amongst others that an archaeological impact assessment be undertaken during the detailed EIR phase of the proposed project.

- ***Atmospheric Pollution Prevention Act 45 of 1965*** requiring that the "best practicable means" for the abatement of dust during construction if approved have to be taken.

- ***The White Paper on Energy Policy for South Africa (Energy White Paper).*** The proposed Wind Farm project is a direct consequence of the Government's White Paper on Energy Policy and the requirements therein to improve energy security of supply through diversification, as well as the demonstration and introduction of cleaner energy technologies and the promotion of competition and empowerment in the electricity market.

- ***The White Paper on Renewable Energy Policy (Renewable Energy White Paper)***. The proposed Wind Farm project is in line with the above policy with regards to diversification of energy supply and the promotion of universal access to clean energy.

- ***Electricity Regulation Act (Act No. 4 of 2006)***. The proposed Wind Farm project is in line with the call of the Electricity Regulation Act No. 4 of 2006 as it has the potential to improve energy security of supply through diversification.

- ***Electricity Regulation on New Generation Capacity (Government Gazette No 32378 of 5 August 2009)***. The proposed Wind Farm project is required to comply with any guidelines relating to the IPP bid programme and the REFIT programme.

- ***Aviation Act (Act No. 74 of 1962): 13th Amendment of the Civil Aviation Regulations 1997****.* A wind turbine generator is a special type of aviation obstruction due to the fact that at least the top third of the generator is continuously variable and offers a peculiar problem in as much as marking by night is concerned.

- ***National Water Act (Act No. 36 of 1998)*** controlling a number of activities related to: the abstraction of any raw water from any nearby surface water resources during the construction phase of the respective projects; Road access infrastructure that will require, for example, the construction of culverts over water courses. Should any of the 14 sites under consideration require a Water Use Licence Applications (WULA) process it would in all likelihood result in project delays due to the length of time that these application processes take to secure authorisation – at this time anything from 12 to 24 months.

- ***Other national legislation*** that may be relevant to the proposed G7 wind energy project including: The **Telecommunication Act (1966)** which has certain requirements with regard to potential impacts on signal reception. The **Environment Conservation Act No 73 of 1989 (ECA) Noise Control Regulations**, which specifically provide for regulations to be made with regard to the control of noise, vibration and shock, including prevention, acceptable levels, powers of local authorities and related matters.

In addition to the above, and aside from the environmental authorisation, the pre-feasibility report identified other permits, contracts and licenses that will need to be obtained by the project proponent for the proposed project some of which fall outside the scope of the EIA, these include:

- National Energy Regulator of South Africa (NERSA): Generation License; and

- Eskom: Connection agreement and Power Purchase Agreement (PPA)

Criteria for Impact Identification during the Pre-feasibility Phase

The following criteria were used for identifying potential impact ratings:

Visual Impact Considerations

- *Proximity to scenic areas/ Scenic character:* The closer a proposed facility is to areas of high scenic quality it can be anticipated that the development of a wind farm in the area would be more contentious than in areas of low scenic quality.

- *Sense of place/prevailing land use:* Rural or agricultural areas are for the same reasons stated above most likely to result in public dissatisfaction for wind farm developments in comparison with their placement in an urban setting.

- *Areas of conservation or recreational use:* Areas designated as parks, nature reserves or public open space in close proximity to wind farm locations could result in negative public perceptions with regard to the project. It can be expected that regulatory authorities will also be resistant to application processes that potentially impinge on the use or quality of recreation experience associated with these areas.

- *Topography/Visual exposure/Viewer incidence:* The surrounding topography of a site alternative can potentially screen some of the visual impacts by reducing the visual exposure of the facility to surrounding landowners or residents. Similarly, the viewer incidence of these facilities by passing motorists for example can also be reduced should the topography facilitate this. If the landscape is relatively flat, or the facility is placed on a ridge/skyline as is the case for most wind farms it can be assumed that this would increase the viewer incidence and exposure to the facility.

- *Proximity to dense settlements:* The higher the population density in a given area the proposed project can realistically lead to a larger degree of public dissent.

- *Shadow flicker:* This will be determined by the proximity of a facility to either settlements or dwellings in close proximity to the facility. In addition, it is anticipated that this will be of greater concern in agricultural areas where the landowner will continue to conduct agricultural activity on the affected land parcels.

Acoustic Impact Considerations

- *Proximity to settlements/Sensitive receptors*: Facilities located within a 1km radius of dwellings or settlements could potentially impact on these areas. Sensitive receptors such as individual residential dwellings in rural areas within 500m of a facility are likely to be subject to potentially significant noise impacts.

- *Surrounding land use/Presence and proximity to existing ambient noise sources*: Surrounding land use practices can to a large degree negate the noise impacts of the facilities should these practices result in elevated ambient noise levels.

Avifauna (Birds and Bats) Impact Considerations

- More than 100 Important Bird Areas (IBAs) occur in South Africa, as well as five Endemic Bird Areas (EBAs). The Succulent Karoo Ecosystem Programme (SKEP) Bird Areas data has been utilised for this assessment, along with Bird Life South Africa's IBA data sets. IBAs are key sites for conservation – small enough to be conserved in their entirety and often already part of a protected-area network.

- Presence of Species of Special Concern (SSC/Listed species): The presence of bird or bat SSC can potentially be considered as a potential fatal flaw for a site alternative. Should a site be a confirmed roosting/breeding/foraging habitat for SSC it will be accorded the maximum rating and designated as a potential fatal flaw.

- Migration and/or preferential flight corridors for avifauna in general.

- Migration corridors of SSC.

- *Potential for bird/bat strikes:* In areas of high incidence of SSC or avifauna in general it can be expected that higher rates of bird strikes and mortalities will occur.

- *The effects of wind farms on Bats.* A confounding number of bat fatalities have been found at the bases of wind turbines throughout the world. Echo locating bats should be able to detect moving objects better than stationary ones, which begs the question, why are bats killed by wind turbines (Baerwald et al. 2008) Bat fatalities at wind power facilities are highly variable throughout the year, but there are many more bat fatalities than bird fatalities at wind farms (Brinkman et al. 2006).

Fauna Impact Considerations

- Presence of Species of Special Concern (SSC/Listed species) in the general area.

- The presence of Endangered or SSC on a given site.

Flora Impact Considerations

- Presence of Species of Special Concern (SSC/Listed species) in the general area.

- Sensitive/endangered biomes or land types that are under pressure on a given site.

Hydrology Impact Considerations

- Water Use Licence Applications (WULA) requirements for access roads/powerline servitudes.
- Cement batching plants water abstraction requirements requiring a WULA.
- Watercourse alteration/siltation/pollution potential.
- Presence of wetlands/surface water or sensitive aquatic features.

Heritage Impact Considerations

- Proximity to known heritage resources.
- Confirmed heritage resources requiring South African Heritage Resources Agency (SAHRA) permitting.
- Heritage resources that define the areas sense of place.
- Heritage resources that significantly add to the local economy.

Road Access and Powerline Servitudes

- Presence of existing roads.
- Presence of existing powerline infrastructure.
- Need for new access roads for facility construction/access to powerline infrastructure.
- Possible impacts on sensitive habitats resulting from the construction of the above.

Potential Safety Impact Considerations

- Proximity to airfields that may be in conflict with CAA regulations.
- Construction phase heavy motor vehicle (HMV) traffic leading to safety impacts.

Approach taken during the Pre-feasibility Phase

The approach to the pre-feasibility/screening assessment is based on recent sustainability appraisals and risk assessments that have been conducted by CES for numerous infrastructure developments. This methodology has been used in a number of pre-feasibility level assessments, and was argued by CES to provide the necessary information to facilitate decisions relating to the respective proposed project sites.

CES developed a matrix containing a list of all 14 proposed wind farms and identified key impact categories. All impact categories for each site were then scored based on the expected significance of the impact. High scores would indicate potentially high impact with a maximum score indicating a potential fatal flaw.

The overall environmental risk profile per project and individual impacts were then tabulated in terms of low, moderate or high and very high for each of the above criteria. This served to highlight the higher risk profiles associated with sites subject to these higher significance ratings. It is the combination of weighted aggregate scores for environmental significance criteria and mitigation potential that inform the overall risk rating for each site.

Once CES identified and assessed the ecological and social significance of the impacts associated with each of the site alternatives under consideration, the mitigation potential of each was then identified and the degree of difficulty interpreted in terms of effectiveness, practicality, and cost effectiveness. For this reason, CES used both an Impact Assessment and a Risk Assessment scale to identify significant environmental impacts and project related risks.

For each of the 14 sites, CES also identified at a desktop level; Vegetation Types; Mammal Species; Bird species and Bat species and prepared maps for vegetation types and sensitive sites for birds and possible impact spheres.

A summary of environmental impact significance ratings for each of the proposed wind farm sites was then prepared as well as a summary of the overall environmental risk ratings for proposed wind farm sites.

Findings/ Conclusions of Pre-feasibility / Screening Study

A number of the 14 sites were red flagged for potential environmental issues of significant concern, with only two sites being potentially fatally flawed. Two further sites were identified to hold the most potential for resulting in cumulative impacts. These sites were thus excluded from G7's list of priority sites while the remaining sites were prioritised in terms of those that held the best potential for success subject to an EIA being completed. The Roggeveld site was selected by G7 as one of five priority sites, and the EIA and other permitting processes were commenced for these five sites. Once landowner agreements had been granted the wind measurement campaign was started with the erection of a temporary 15 m wind monitoring mast and four permanent 60 m wind monitoring masts [(1)].

(1) The 60 m masts do not require approval as part of the EIA process according to the 2010 regulations under which it was built. Should this be required, a land use status that gives the masts the same lifetime as the project will be applied for through the land-use planning authorisation of the wind farm.

The pre-feasibility study concluded that project sites such as Roggeveld (being near a similar potential location 30km to the northeast) are likely to result in impacts of limited significance on their receiving environments due their relative isolation from densely populated areas. It was anticipated that all impacts can be mitigated to an acceptable level – pending final confirmation through specialist study.

4.6.2 *Site Location*

The sites that were selected for proposed wind energy facilities are considered by G7 as highly desirable from a technical perspective, which considers the following factors:

- Wind resource: Analysis of publicly available information, proprietary information and specialist on site analysis of weather data indicated that the site has sufficient wind resource to make a wind energy facility financially viable.

- Site extent: Sufficient land was secured under long-term lease agreements to allow for a minimum number of wind turbines to make the project feasible.

- Grid access: Grid access and the distance to a viable connection point were key considerations in terms of prioritising appropriate sites. Grid access is deemed favourable for this site due to the existence of an Eskom line traversing the site.

- Land suitability: The current land use of the site is an important consideration in site selection in terms of limiting disruption to existing land use practices. Agricultural land was preferred as the majority of farming practices can continue in parallel to the operation of the wind farm once the construction and commissioning of the project is complete. Sites that facilitate easy construction conditions (relatively flat, limited watercourse crossings, lack of major rock outcrops) are also favoured during site selection.

- Proximity to aerodromes: The proximity to aerodromes and possible interactions with these facilities was considered as part of site selection.

- Landowner support: The selection of sites where the land owners are supportive of the development of renewable energy is essential for ensuring the success of the project.

- Environmental and social high-level screening: As discussed in *Section 4.5.1* above, CES was contracted by G7 to conduct a pre-feasibility assessment for a number of potential wind energy facility locations throughout South Africa. A preliminary desktop assessment was conducted to provide a preliminary assessment of the environmental risks and potential fatal flaws associated with proposed wind farm site alternatives countrywide.

The consideration of the above criteria resulted in the selection of the preferred site. No further site location alternatives will be considered in the EIA process, which will consider preferred infrastructure locations on the site and layout alternatives, with possible revised locations and site layouts informed by the EIA process (see below), as well as the No-Go alternative.

G7 is in the process of initiating the LUPO process for the site and the outcome of the EIA process would feed into the LUPO process. The proposed project would be operational for approximately 25 years, and to ERM's knowledge contracts have been signed with the relevant landowners and agreements in place allowing farmers to continue with farming activities.

4.6.3 Site Layout Alternatives

The turbine layout and project component design was subjected to a number of iterations based on technical aspects of the project such as detailed site specific wind data and construction conditions, and the environmental and socio- economic considerations as well as specialist input and sensitivity ratings for the site that were explored during the EIA process.

An original layout (Layout Alternative 1 shown in *Figure 4.4*) provided by G7 and based on limited data was used as the basis for the initial specialist assessment. After field surveys and workshops by the EIA team particular areas posing additional environmental and social constraints or specific unsuitable turbine locations were identified and fed back to the G7 technical team. Areas considered unsuitable by the environmental specialists were excluded where possible based on potential impacts to vegetation, birds, bats, ecology, noise sensitive receptors and visual considerations. *Figures 4.5* and *4.6* indicate Layout Alternative 1 on the Ecological, Bird and Bat Sensitivity maps. The technical team then generated a revised 'buildable areas map' based on these environmental and social constraints as well as additional technical constraints and from there developed a revised turbine layout design, Site Layout Alternative 2 (*Figure 4.5*) taking these constraints into consideration. The two alternative layouts are summarised below in *Table 4.3.*

Table 4.3 Alternative Layouts Considered in this Assessment

Description	**No. of turbines**	**Turbine Type**	**Turbine Max. Hub Height**	**Total Output capacity (MW)**	**Reason**
Site Layout Alternative 1 *Figure 4.4*	250	3MW	100m	750	Initial buffers and technical constraints.

Description	No. of turbines	Turbine Type	Turbine Max. Hub Height	Total Output capacity (MW)	Reason
Site Layout Alternative 2 *Figure 4.5*	250	3MW	100m	684	Additional buffers and sensitive areas considering inputs from the public and environmental and social constraints.

Technical criteria and buffer zones considered in deriving at the final site layout (Layout Alternative 2) included:

- Slopes of less than 8 degrees in the immediate vicinity of the turbines;
- Where possible, avoiding areas which are very rocky or uneven in order to minimise earthworks and thus real and potential environmental impact;
- Inland water body buffer of 100m;
- House or buildings buffer of 500m;
- River buffer of 200m;
- Buffer along public roads of 200m; and
- Buffer along existing Eskom grid infrastructure of 125 m for turbines.

The coordinates of the turbines in the preferred and final layout are given in *Table 4.4*. In future, the precise coordinates of the individual wind turbines given here may undergo further minor refinement of no more than 20 m for geotechnical reasons, described in *Section 4.5.2*.

4.4 Turbine coordinates of Site Layout Alternative 2 (preferred/final)

Turbine number	Phase	Latitude	Longitude
WTG 1	Phase 1	20° 30' 20.06" E	32° 52' 51.94" S
WTG 2	Phase 1	20° 30' 22.68" E	32° 52' 59.89" S
WTG 3	Phase 1	20° 30' 25.77" E	32° 53' 7.25" S
WTG 4	Phase 1	20° 30' 26.09" E	32° 53' 14.95" S
WTG 5	Phase 1	20° 30' 25.00" E	32° 53' 23.04" S
WTG 6	Phase 1	20° 30' 19.69" E	32° 53' 29.56" S
WTG 7	Phase 1	20° 30' 15.74" E	32° 53' 36.60" S
WTG 8	Phase 1	20° 30' 13.03" E	32° 53' 44.24" S
WTG 9	Phase 1	20° 30' 10.37" E	32° 53' 52.10" S
WTG 10	Phase 1	20° 30' 2.26" E	32° 54' 2.08" S
WTG 11	Phase 1	20° 30' 5.90" E	32° 54' 10.34" S
WTG 12	Phase 1	20° 30' 9.16" E	32° 54' 17.64" S
WTG 13	Phase 1	20° 30' 18.79" E	32° 54' 26.53" S
WTG 14	Phase 1	20° 30' 23.71" E	32° 54' 34.17" S
WTG 15	Phase 1	20° 30' 29.57" E	32° 54' 41.25" S
WTG 16	Phase 1	20° 30' 34.61" E	32° 54' 49.05" S
WTG 17	Phase 1	20° 30' 31.64" E	32° 54' 56.10" S
WTG 18	Phase 1	20° 30' 32.89" E	32° 55' 4.11" S
WTG 19	Phase 1	20° 30' 34.22" E	32° 55' 11.81" S
WTG 20	Phase 1	20° 30' 32.72" E	32° 55' 19.72" S
WTG 21	Phase 1	20° 30' 30.01" E	32° 55' 27.04" S
WTG 22	Phase 1	20° 30' 44.82" E	32° 55' 35.72" S
WTG 23	Phase 1	20° 30' 49.77" E	32° 55' 28.44" S
WTG 24	Phase 1	20° 30' 55.60" E	32° 55' 22.37" S
WTG 25	Phase 1	20° 31' 2.15" E	32° 55' 15.89" S

WTG 26	Phase 1	20° 30' 24.55" E	32° 55' 34.36" S
WTG 27	Phase 1	20° 30' 16.83" E	32° 55' 37.74" S
WTG 28	Phase 1	20° 30' 19.39" E	32° 55' 45.88" S
WTG 29	Phase 1	20° 30' 23.57" E	32° 55' 52.30" S
WTG 30	Phase 1	20° 30' 25.31" E	32° 56' 0.17" S
WTG 31	Phase 1	20° 30' 21.19" E	32° 56' 7.58" S
WTG 32	Phase 1	20° 30' 16.63" E	32° 56' 14.55" S
WTG33	Phase 1	20° 30' 9.77" E	32° 56' 20.63" S
WTG 34	Phase 1	20° 30' 2.02" E	32° 56' 25.01" S
WTG 35	Phase 1	20° 29' 53.46" E	32° 56' 28.18" S
WTG 36	Phase 1	20° 32' 0.81" E	32° 56' 4.35" S
WTG 37	Phase 1	20° 32' 9.48" E	32° 56' 1.67" S
WTG 38	Phase 1	20° 32' 13.39" E	32° 55' 54.38" S
WTG 39	Phase 1	20° 32' 15.90" E	32° 55' 48.20" S
WTG 40	Phase 1	20° 32' 25.27" E	32° 55' 48.68" S
WTG 41	Phase 1	20° 32' 34.25" E	32° 55' 46.85" S
WTG 42	Phase 1	20° 32' 42.07" E	32° 55' 42.50" S
WTG 43	Phase 1	20° 32' 47.39" E	32° 55' 34.81" S
WTG 44	Phase 1	20° 30' 43.30" E	32° 54' 43.27" S
WTG 45	Phase 1	20° 30' 51.59" E	32° 54' 39.47" S
WTG 46	Phase 1	20° 30' 58.98" E	32° 54' 34.62" S
WTG 47	Phase 1	20° 31' 5.97" E	32° 54' 29.51" S
WTG 48	Phase 1	20° 31' 11.06" E	32° 54' 23.09" S
WTG 49	Phase 1	20° 31' 19.38" E	32° 54' 19.52" S
WTG 50	Phase 1	20° 31' 25.98" E	32° 54' 13.92" S
WTG 51	Phase 1	20° 31' 33.48" E	32° 54' 9.07" S
WTG 52	Phase 1	20° 31' 42.86" E	32° 54' 8.48" S
WTG 53	Phase 1	20° 31' 52.14" E	32° 54' 8.01" S
WTG 54	Phase 1	20° 32' 1.60" E	32° 54' 7.85" S
WTG 55	Phase 1	20° 32' 10.88" E	32° 54' 7.48" S
WTG 56	Phase 1	20° 32' 19.06" E	32° 54' 3.65" S
WTG 57	Phase 1	20° 32' 27.45" E	32° 54' 0.42" S
WTG 58	Phase 1	20° 32' 36.50" E	32° 53' 58.31" S
WTG 59	Phase 1	20° 32' 45.42" E	32° 53' 56.04" S
WTG 60	Phase 1	20° 32' 54.35" E	32° 53' 53.88" S
WTG 61	Phase 1	20° 33' 3.37" E	32° 53' 52.34" S
WTG 62	Phase 1	20° 33' 12.21" E	32° 53' 50.16" S
WTG 63	Phase 1	20° 33' 20.99" E	32° 53' 47.65" S
WTG 64	Phase 1	20° 31' 35.08" E	32° 54' 1.11" S
WTG 65	Phase 1	20° 31' 35.22" E	32° 53' 53.17" S
WTG 66	Phase 1	20° 31' 37.04" E	32° 53' 45.52" S
WTG 67	Phase 1	20° 31' 41.55" E	32° 53' 38.72" S
WTG 68	Phase 1	20° 31' 45.07" E	32° 53' 31.42" S
WTG 69	Phase 1	20° 31' 48.39" E	32° 53' 24.08" S
WTG 70	Phase 1	20° 31' 52.88" E	32° 53' 17.24" S
WTG 71	Phase 1	20° 31' 59.83" E	32° 53' 11.89" S
WTG 72	Phase 1	20° 32' 6.35" E	32° 53' 6.36" S
WTG 73	Phase 1	20° 32' 12.24" E	32° 53' 0.25" S
WTG 74	Phase 1	20° 32' 19.15" E	32° 52' 55.09" S
WTG 75	Phase 1	20° 32' 26.61" E	32° 52' 50.34" S
WTG 76	Phase 1	20° 32' 29.23" E	32° 52' 42.91" S
WTG 77	Phase 1	20° 32' 31.08" E	32° 52' 35.13" S
WTG 78	Phase 1	20° 32' 40.72" E	32° 52' 25.32" S
WTG 79	Phase 1	20° 32' 35.33" E	32° 52' 17.47" S
WTG 80	Phase 1	20° 32' 32.14" E	32° 52' 9.97" S
WTG 81	Phase 1	20° 32' 29.80" E	32° 52' 2.33" S
WTG 82	Phase 1	20° 32' 29.06" E	32° 51' 54.49" S
WTG 83	Phase 1	20° 32' 27.28" E	32° 51' 46.88" S
WTG 84	Phase 1	20° 32' 26.76" E	32° 51' 38.99" S
WTG 85	Phase 1	20° 32' 27.79" E	32° 51' 31.22" S

WTG 86	Phase 1	20° 32' 30.13" E	32° 51' 23.64" S
WTG 87	Phase 1	20° 32' 31.33" E	32° 51' 15.86" S
WTG 88	Phase 1	20° 32' 32.40" E	32° 51' 6.96" S
WTG 89	Phase 1	20° 32' 34.59" E	32° 50' 59.31" S
WTG 90	Phase 1	20° 32' 32.50" E	32° 50' 51.69" S
WTG 91	Phase 1	20° 32' 35.74" E	32° 50' 44.41" S
WTG 92	Phase 1	20° 32' 33.73" E	32° 50' 36.74" S
WTG 93	Phase 1	20° 32' 36.98" E	32° 50' 29.43" S
Possible WTG1	Phase 1	20° 31' 8.09" E	32° 56' 43.60" S
Possible WTG 2	Phase 1	20° 31' 3.38" E	32° 56' 50.27" S
Possible WTG 3	Phase 1	20° 30' 54.18" E	32° 56' 48.84" S

"WTG 1"	Phase 2	20° 30' 33.07" E	32° 50' 24.84" S
"WTG 2"	Phase 2	20° 32' 37.62" E	32° 50' 23.25" S
"WTG 3"	Phase 2	20° 30' 39.20" E	32° 50' 15.68" S
"WTG 4"	Phase 2	20° 32' 39.10" E	32° 50' 12.76" S
"WTG 5"	Phase 2	20° 30' 42.40" E	32° 50' 5.46" S
"WTG 6"	Phase 2	20° 30' 41.66" E	32° 49' 54.85" S
"WTG 7"	Phase 2	20° 30' 38.41" E	32° 49' 44.57" S
"WTG 8"	Phase 2	20° 30' 31.77" E	32° 49' 35.77" S
"WTG 9"	Phase 2	20° 30' 33.83" E	32° 49' 25.51" S
"WTG 10"	Phase 2	20° 30' 38.65" E	32° 49' 15.58" S
"WTG 11"	Phase 2	20° 30' 42.93" E	32° 49' 5.73" S
"WTG 12"	Phase 2	20° 30' 37.32" E	32° 48' 56.29" S
"WTG 13"	Phase 2	20° 30' 30.05" E	32° 48' 47.70" S
"WTG 14"	Phase 2	20° 30' 22.77" E	32° 48' 38.91" S
"WTG 15"	Phase 2	20° 30' 17.34" E	32° 48' 29.48" S
"WTG 16"	Phase 2	20° 30' 9.89" E	32° 48' 20.92" S
"WTG 17"	Phase 2	20° 30' 3.44" E	32° 48' 11.57" S
"WTG 18"	Phase 2	20° 30' 12.42" E	32° 48' 4.29" S
"WTG 19"	Phase 2	20° 30' 21.27" E	32° 47' 56.84" S
"WTG 20"	Phase 2	20° 30' 22.31" E	32° 47' 46.41" S
"WTG 21"	Phase 2	20° 30' 30.28" E	32° 47' 38.37" S
"WTG 22"	Phase 2	20° 30' 31.51" E	32° 47' 27.79" S
"WTG 23"	Phase 2	20° 30' 35.29" E	32° 47' 17.58" S
"WTG 24"	Phase 2	20° 30' 37.17" E	32° 47' 7.08" S
"WTG 25"	Phase 2	20° 30' 31.93" E	32° 46' 57.60" S
"WTG 26"	Phase 2	20° 30' 27.01" E	32° 46' 47.77" S
"WTG 27"	Phase 2	20° 30' 19.42" E	32° 46' 39.35" S
"WTG 28"	Phase 2	20° 30' 15.45" E	32° 46' 29.47" S
"WTG 29"	Phase 2	20° 30' 17.54" E	32° 46' 18.87" S
"WTG 30"	Phase 2	20° 30' 19.63" E	32° 46' 8.26" S

"WTG 1"	Phase 3	20° 31' 30.75" E	33° 3' 54.34" S
"WTG 2"	Phase 3	20° 31' 31.99" E	33° 3' 43.83" S
"WTG 3"	Phase 3	20° 31' 28.39" E	33° 3' 33.78" S
"WTG 4"	Phase 3	20° 31' 22.60" E	33° 3' 24.58" S
"WTG 5"	Phase 3	20° 31' 20.28" E	33° 3' 14.34" S
"WTG 6"	Phase 3	20° 29' 8.44" E	33° 3' 8.72" S
"WTG 7"	Phase 3	20° 31' 30.58" E	33° 3' 8.57" S
"WTG 8"	Phase 3	20° 30' 1.85" E	33° 3' 6.69" S
"WTG 9"	Phase 3	20° 29' 4.05" E	33° 2' 58.91" S
"WTG 10"	Phase 3	20° 31' 33.14" E	33° 2' 58.35" S
"WTG 11"	Phase 3	20° 30' 5.00" E	33° 2' 56.22" S
"WTG 12"	Phase 3	20° 31' 41.98" E	33° 2' 51.00" S
"WTG 13"	Phase 3	20° 28' 56.78" E	33° 2' 49.87" S
"WTG 14"	Phase 3	20° 30' 6.99" E	33° 2' 45.72" S

"WTG 15"	Phase 3	20° 31' 51.17" E	33° 2' 43.79" S
"WTG 16"	Phase 3	20° 29' 0.11" E	33° 2' 39.84" S
"WTG 17"	Phase 3	20° 30' 6.68" E	33° 2' 35.33" S
"WTG 18"	Phase 3	20° 31' 50.85" E	33° 2' 33.18" S
"WTG 19"	Phase 3	20° 29' 1.38" E	33° 2' 29.41" S
"WTG 20"	Phase 3	20° 30' 12.09" E	33° 2' 25.70" S
"WTG 21"	Phase 3	20° 31' 47.52" E	33° 2' 23.13" S
"WTG 22"	Phase 3	20° 28' 59.23" E	33° 2' 18.87" S
"WTG 23"	Phase 3	20° 30' 13.81" E	33° 2' 15.25" S
"WTG 24"	Phase 3	20° 31' 45.01" E	33° 2' 12.80" S
"WTG 25"	Phase 3	20° 28' 54.81" E	33° 2' 9.13" S
"WTG 26"	Phase 3	20° 30' 16.78" E	33° 2' 4.83" S
"WTG 27"	Phase 3	20° 31' 53.99" E	33° 2' 5.16" S
"WTG 28"	Phase 3	20° 28' 49.22" E	33° 1' 59.75" S
"WTG 29"	Phase 3	20° 32' 0.36" E	33° 1' 56.02" S
"WTG 30"	Phase 3	20° 30' 13.28" E	33° 1' 54.74" S
"WTG 31"	Phase 3	20° 32' 12.28" E	33° 1' 52.47" S
"WTG 32"	Phase 3	20° 28' 43.74" E	33° 1' 50.10" S
"WTG 33"	Phase 3	20° 30' 6.02" E	33° 1' 46.27" S
"WTG 34"	Phase 3	20° 32' 19.91" E	33° 1' 44.23" S
"WTG 35"	Phase 3	20° 28' 38.38" E	33° 1' 40.48" S
"WTG 36"	Phase 3	20° 32' 28.78" E	33° 1' 36.94" S
"WTG 37"	Phase 3	20° 30' 7.97" E	33° 1' 35.91" S
"WTG 38"	Phase 3	20° 28' 35.20" E	33° 1' 30.05" S
"WTG 39"	Phase 3	20° 32' 24.31" E	33° 1' 26.71" S
"WTG 40"	Phase 3	20° 30' 10.35" E	33° 1' 25.57" S
"WTG 41"	Phase 3	20° 28' 25.71" E	33° 1' 23.40" S
"WTG 42"	Phase 3	20° 32' 19.49" E	33° 1' 16.98" S
"WTG 43"	Phase 3	20° 30' 6.15" E	33° 1' 15.40" S
"WTG 44"	Phase 3	20° 28' 21.68" E	33° 1' 13.58" S
"WTG 45"	Phase 3	20° 28' 30.59" E	33° 1' 6.10" S
"WTG 46"	Phase 3	20° 30' 0.03" E	33° 1' 6.29" S
"WTG 47"	Phase 3	20° 32' 23.04" E	33° 1' 6.83" S
"WTG 48"	Phase 3	20° 32' 30.39" E	33° 0' 58.17" S
"WTG 49"	Phase 3	20° 29' 53.85" E	33° 0' 56.85" S
"WTG 50"	Phase 3	20° 28' 28.74" E	33° 0' 55.66" S
"WTG 51"	Phase 3	20° 32' 21.51" E	33° 0' 50.79" S
"WTG 52"	Phase 3	20° 29' 53.57" E	33° 0' 46.26" S
"WTG 53"	Phase 3	20° 28' 31.34" E	33° 0' 45.45" S
"WTG 54"	Phase 3	20° 28' 21.59" E	33° 0' 39.08" S
"WTG 55"	Phase 3	20° 29' 57.63" E	33° 0' 36.45" S
"WTG 56"	Phase 3	20° 28' 17.22" E	33° 0' 29.04" S
"WTG 57"	Phase 3	20° 30' 2.10" E	33° 0' 26.76" S
"WTG 58"	Phase 3	20° 28' 20.17" E	33° 0' 18.57" S
"WTG 59"	Phase 3	20° 30' 7.92" E	33° 0' 17.59" S
"WTG 60"	Phase 3	20° 28' 26.50" E	33° 0' 9.62" S
"WTG 61"	Phase 3	20° 30' 15.15" E	33° 0' 8.94" S
"WTG 62"	Phase 3	20° 30' 25.14" E	33° 0' 2.74" S
"WTG 63"	Phase 3	20° 28' 26.62" E	32° 59' 59.20" S
"WTG 64"	Phase 3	20° 30' 35.70" E	32° 59' 57.29" S
"WTG 65"	Phase 3	20° 31' 34.05" E	32° 59' 49.93" S
"WTG 66"	Phase 3	20° 28' 26.57" E	32° 59' 48.78" S
"WTG 67"	Phase 3	20° 30' 31.64" E	32° 59' 48.47" S
"WTG 68"	Phase 3	20° 31' 21.99" E	32° 59' 47.57" S
"WTG 69"	Phase 3	20° 30' 44.22" E	32° 59' 47.02" S
"WTG 70"	Phase 3	20° 31' 9.56" E	32° 59' 46.73" S
"WTG 71"	Phase 3	20° 30' 56.97" E	32° 59' 46.37" S
"WTG 72"	Phase 3	20° 30' 19.36" E	32° 59' 45.42" S
"WTG 73"	Phase 3	20° 29' 42.42" E	32° 59' 43.50" S
"WTG 74"	Phase 3	20° 29' 54.86" E	32° 59' 42.98" S

"WTG 75"	Phase 3	20° 30' 7.28" E	32° 59' 42.38" S
"WTG 76"	Phase 3	20° 27' 25.77" E	32° 59' 6.29" S
"WTG 77"	Phase 3	20° 27' 35.25" E	32° 58' 59.38" S
"WTG 78"	Phase 3	20° 27' 44.68" E	32° 58' 52.63" S
"WTG 79"	Phase 3	20° 27' 57.04" E	32° 58' 52.40" S
"WTG 80"	Phase 3	20° 28' 57.93" E	32° 58' 52.40" S
"WTG 81"	Phase 3	20° 28' 45.58" E	32° 58' 51.43" S
"WTG 82"	Phase 3	20° 28' 9.32" E	32° 58' 49.73" S
"WTG 83"	Phase 3	20° 29' 9.73" E	32° 58' 49.30" S
"WTG 84"	Phase 3	20° 28' 21.63" E	32° 58' 47.72" S
"WTG 85"	Phase 3	20° 28' 36.33" E	32° 58' 44.96" S
"WTG 86"	Phase 3	20° 28' 43.05" E	32° 58' 35.92" S
"WTG 87"	Phase 3	20° 28' 53.07" E	32° 58' 29.72" S
"WTG 88"	Phase 3	20° 29' 4.60" E	32° 58' 24.91" S
"WTG 89"	Phase 3	20° 29' 5.61" E	32° 58' 14.55" S
"WTG 90"	Phase 3	20° 30' 43.91" E	32° 58' 8.46" S
"WTG 91"	Phase 3	20° 28' 58.47" E	32° 58' 6.05" S
"WTG 92"	Phase 3	20° 30' 55.13" E	32° 58' 4.25" S
"WTG 93"	Phase 3	20° 30' 33.92" E	32° 58' 2.09" S
"WTG 94"	Phase 3	20° 29' 4.38" E	32° 57' 56.87" S
"WTG 95"	Phase 3	20° 26' 47.37" E	32° 57' 53.84" S
"WTG 96"	Phase 3	20° 30' 25.31" E	32° 57' 54.21" S
"WTG 97"	Phase 3	20° 29' 16.14" E	32° 57' 53.50" S
"WTG 98"	Phase 3	20° 26' 58.01" E	32° 57' 47.99" S
"WTG 99"	Phase 3	20° 30' 16.66" E	32° 57' 46.35" S
"WTG 100"	Phase 3	20° 31' 59.05" E	32° 57' 46.06" S
"WTG 101"	Phase 3	20° 32' 11.28" E	32° 57' 44.68" S
"WTG 102"	Phase 3	20° 32' 35.89" E	32° 57' 43.86" S
"WTG 103"	Phase 3	20° 29' 16.74" E	32° 57' 43.08" S
"WTG 104"	Phase 3	20° 31' 47.07" E	32° 57' 43.18" S
"WTG 105"	Phase 3	20° 32' 23.52" E	32° 57' 43.29" S
"WTG 106"	Phase 3	20° 27' 7.83" E	32° 57' 41.59" S
"WTG 107"	Phase 3	20° 30' 6.20" E	32° 57' 39.72" S
"WTG 108"	Phase 3	20° 27' 17.92" E	32° 57' 35.54" S
"WTG 109"	Phase 3	20° 29' 24.94" E	32° 57' 34.91" S
"WTG 110"	Phase 3	20° 29' 55.74" E	32° 57' 33.09" S
"WTG 111"	Phase 3	20° 29' 43.07" E	32° 57' 31.04" S
"WTG 112"	Phase 3	20° 27' 28.02" E	32° 57' 29.49" S
"WTG 113"	Phase 3	20° 29' 31.88" E	32° 57' 25.85" S
"WTG 114"	Phase 3	20° 27' 38.11" E	32° 57' 23.44" S
"WTG 115"	Phase 3	20° 27' 49.23" E	32° 57' 18.40" S
"WTG 116"	Phase 3	20° 29' 36.30" E	32° 57' 16.32" S
"WTG 117"	Phase 3	20° 27' 56.20" E	32° 57' 9.45" S
"WTG 118"	Phase 3	20° 28' 47.20" E	32° 56' 59.15" S
"WTG 119"	Phase 3	20° 27' 57.67" E	32° 56' 58.93" S
"WTG 120"	Phase 3	20° 28' 10.00" E	32° 56' 58.51" S
"WTG 121"	Phase 3	20° 28' 59.96" E	32° 56' 58.45" S
"WTG 122"	Phase 3	20° 28' 34.79" E	32° 56' 58.32" S
"WTG 123"	Phase 3	20° 28' 22.33" E	32° 56' 58.08" S
"WTG 124"	Phase 3	20° 29' 12.36" E	32° 56' 55.79" S
"WTG 125"	Phase 3	20° 29' 23.32" E	32° 56' 50.48" S
"WTG 126"	Phase 3	20° 29' 31.28" E	32° 56' 42.45" S
"WTG 127"	Phase 3	20° 29' 41.80" E	32° 56' 36.73" S

Technical inputs that may influence the final design of the facility, including the final layout, size, type and number of turbines, would be determined using:

- The intensity of wind turbulence determined from further on-site wind measurements and wind modelling;
- The characteristics of the final turbine model selection, including hub height, rotor diameter and generator size;
- Results of detailed geotechnical surveys, construction design and civil engineering; and
- Detailed wind turbine procurement with short-listed reputable wind turbine manufacturers.

The aim of considering layout alternatives was to balance the technical and financial objectives of maximising the output of the proposed facility with the other critical environmental and social constraints including visual, noise, botanical, fauna, heritage, archaeology, palaeontology and avifauna.

It is reiterated that **Site Layout Alternative 2** *(Figure 4.10)* is the preferred **turbine layout** design applied for in this EIR. The precise coordinates may be subject to minor adjustments once detailed engineering has been completed as mentioned in *Section 4.2.* Any revision of the design would, however, be strictly within the allowable zones prescribed by the sensitivity zoning undertaken in this EIR and through pre-construction monitoring.

Figure 4.9 Alternative layout 1 – map showing project infrastructure

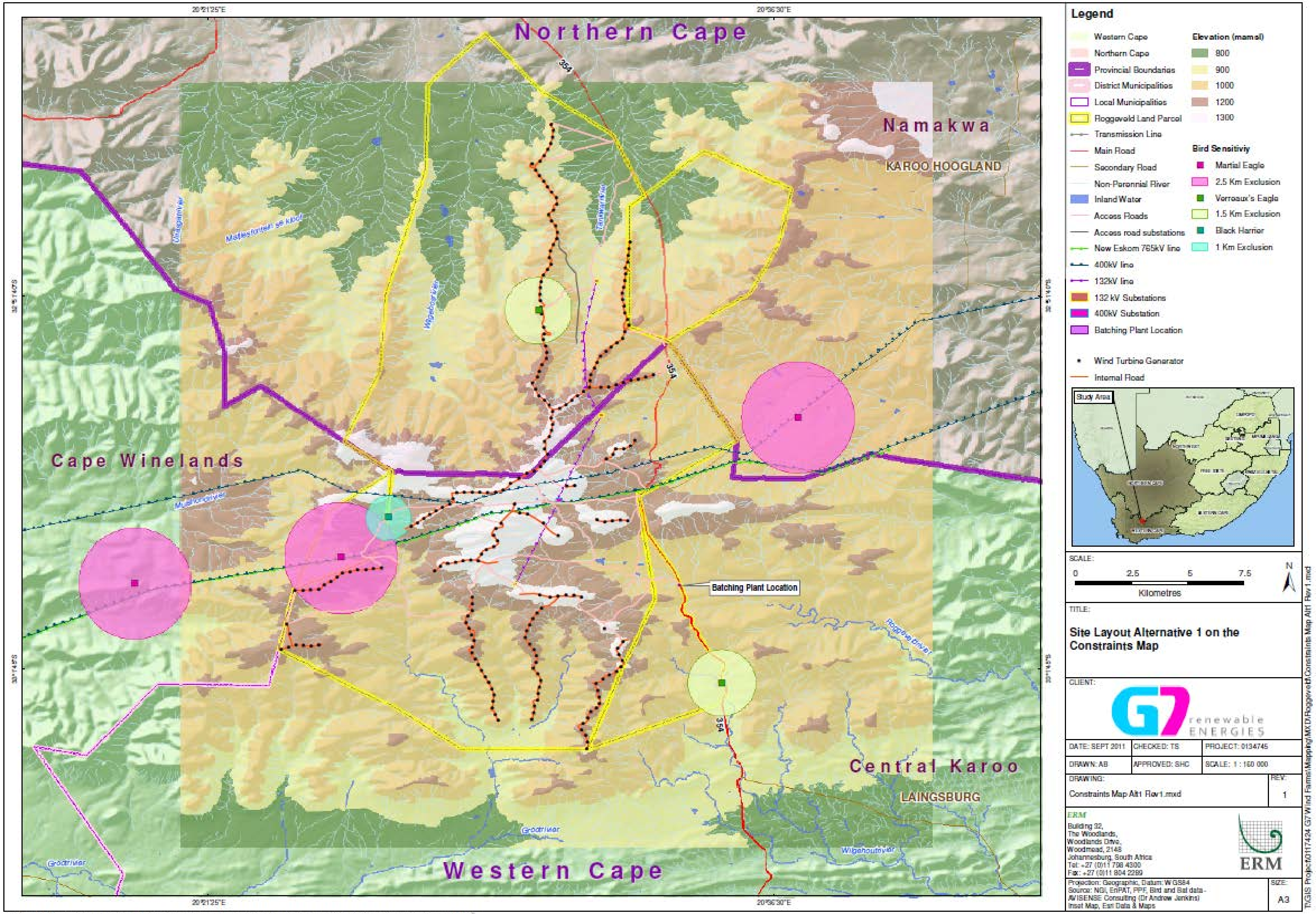
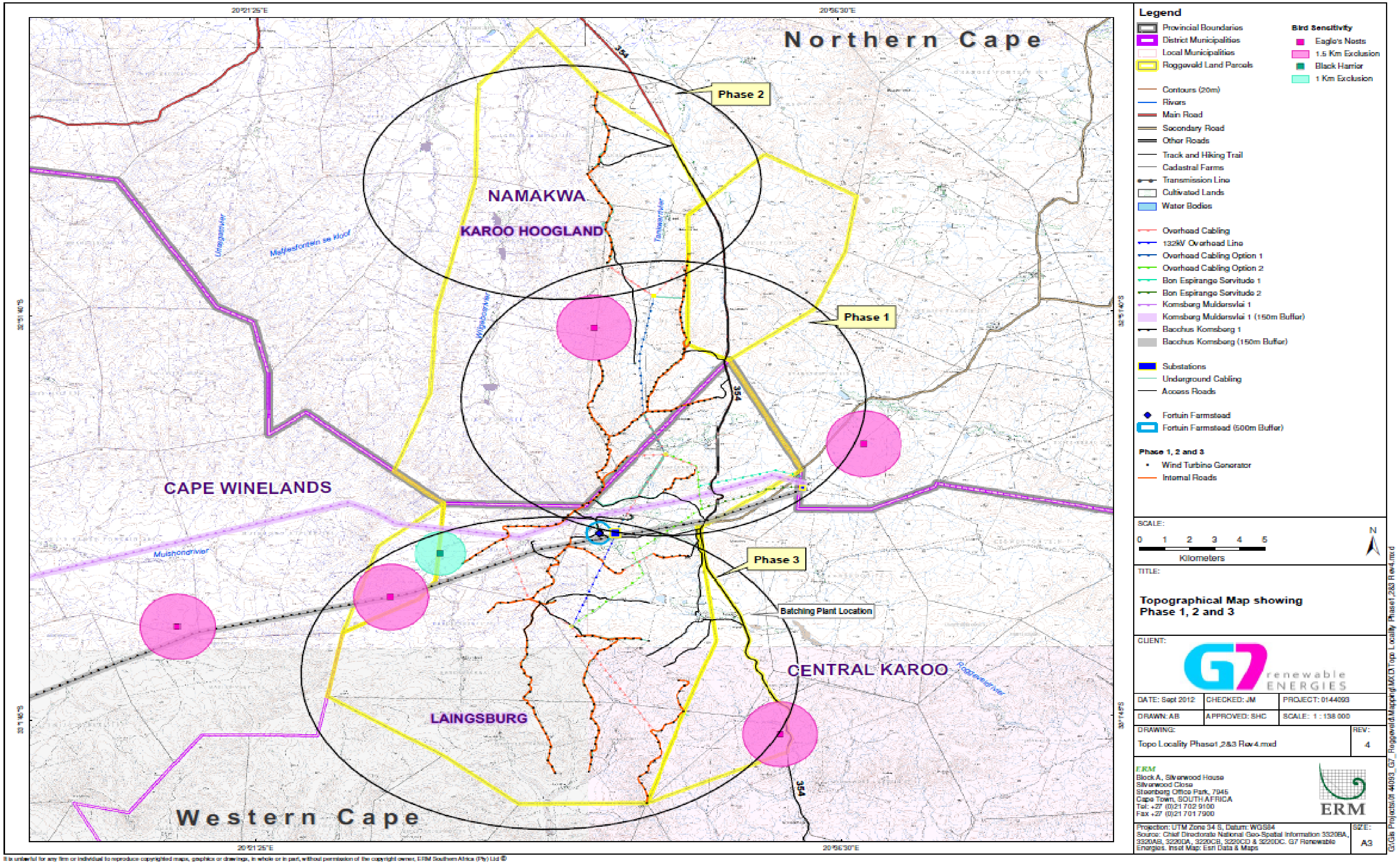


Figure 4.10 Alternative 2 on constraints map



4.6.4 *Grid Connection Alternatives*

The options of the connection of the wind energy facility to Eskom's national grid are subject to on-going discussions between G7 and Eskom. Two grid connection options are being considered.Option 1 which was part of the initial assessment remains part of the application, with minor amendments (i.e. slight change in position). This report now also considers an Option 2 for the Roggeveld grid connection. Eskom is now proposing to have a grid connection hub to which all wind farms in the neighbouring area will connect, i.e. the Komsberg substation. Eskom have advised that they can provide a letter of consent for the property.

4.6.5 *Technology Alternatives*

Wind energy is considered to be the most suitable renewable energy technology for this site, based on the site location, ambient conditions and energy resource availability. A number of different wind turbine models are available with different dimensions and outputs. The Final Layout has a choice of possible turbines, however the preferred turbine supplier has not yet been selected and different turbine models suitable for installation and operation on site will be considered with an output of 1.5-3MW, hub height of up to 100 m and rotor diameter of up to 117 m. For the final choice of supplier, criteria such as suitability to the site high wind conditions, sufficient generation capacity of the chosen model, guarantees, scope of delivery and services, overall experience, accreditation and acceptance by lenders, long term support structure within South Africa, willingness to maximize local content and financial aspects will be taken into consideration.

4.6.6 *No-Go Alternative*

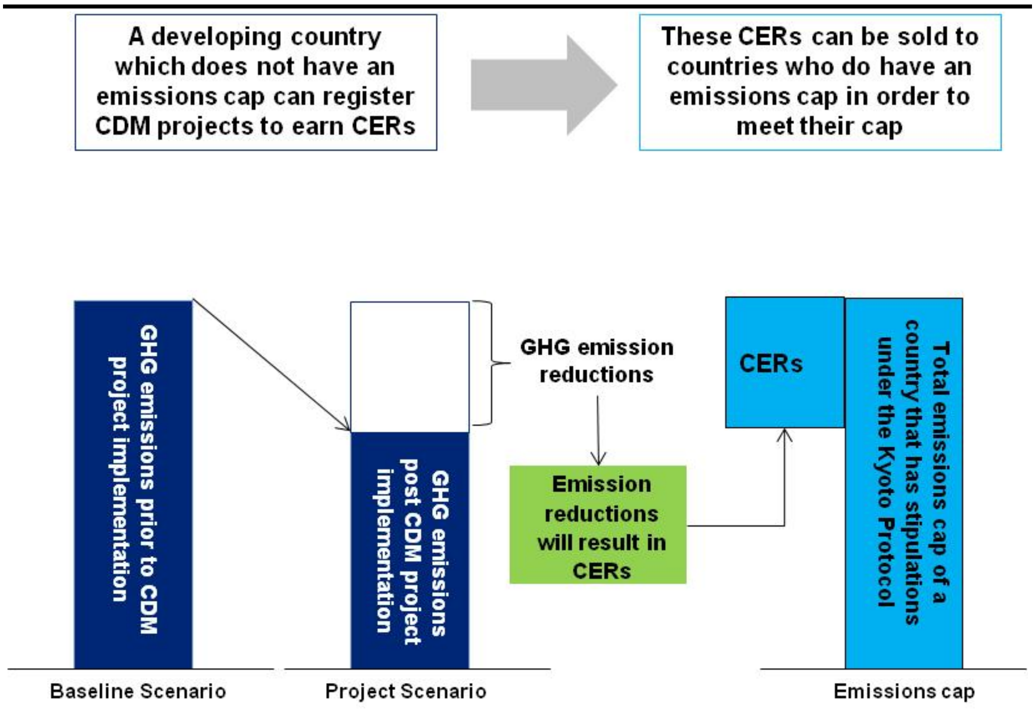
The no-go alternative implies that the proposed project would not be executed. Assuming that the wind energy facility would not be developed at the proposed site, there would be no increase in electricity generation from the facility, no CO_2 (1) offsets associated with the proposed development and no economic benefit to the landowners associated with the potential income generated through the operation of the facility. There would be no job creation, no contribution to meeting South Africa's targets for renewable energy generation and no additional developments and economic benefits to the local community. There would also be no negative or positive environmental and social impacts associated with the development of a wind energy facility, as identified in *Chapters 7-16*.

(1) *Carbon dioxide* is generated amongst others as a by-product of the combustion of fossil fuels. Carbon dioxide is one of the greenhouse gases that contributes to global warming, causing the average surface temperature of the Earth to rise in response, which most scientists agree will cause major adverse effects. Carbon dioxide is also removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle. *Fossil fuels* such as coal, petroleum and natural gas are non-renewable resources as they take millions of years to form. Hence the global movement toward the generation of renewable energy such as wind to help meet increased energy needs.

4.7 *CLEAN DEVELOPMENT MECHANISM REGISTRATION*

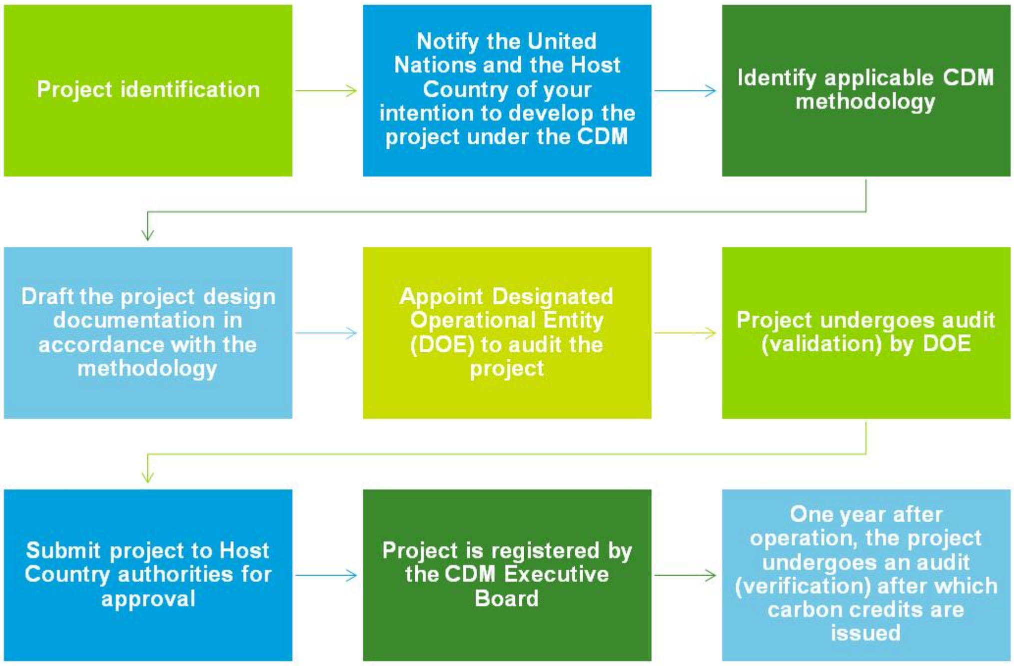
The proposed Roggeveld Wind Farm would generate electricity which would be supplied into the national grid. The electricity generated by this facility would displace grid electricity which is primarily coal-based and, as such, has a high Greenhouse Gas (GHG) emission factor. Part of the project planning includes an application for the project to be registered under the Clean Development Mechanism (CDM) of the Kyoto Protocol. The CDM allows developing countries such as South Africa to implement GHG emission reduction projects and generate carbon credits. These carbon credits are also known as Certified Emission Reductions (CERs). One MWh of electricity generated by the proposed Roggeveld Wind Farm would be approximately equivalent to one carbon credit (one CER). The carbon credits are sold to developed countries to assist in achieving the GHG emission reduction targets committed to under the Kyoto Protocol. This process is illustrated in *Figure 4.11* below.

Figure.4.11 CDM Process Illustration



The project is in the process of preparing an application for registration under the CDM. This CDM registration process is not part of the EIA process and is not being undertaken by ERM. G7 has commissioned Deloitte & Touche as independent CDM consultants to undertake this process. General information on the CDM can be found at www.unfccc.int and for further information on the CDM registration for the Roggeveld Wind Farm please contact Joslin Andrews at Deloitte & Touche (josandrews@deloitte.co.za or +27 (0) 11 806 5952).

Figure 4.12 CDM Project Development



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