



# **APPENDIX I**

## **Transport Assessment Study for a Proposed 100MW Wind Energy Project, Kajiado District, Kenya**

Report Prepared for

**Kipeto Energy Limited**

**March 2012**

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# 1 Introduction

This report sets out the scope and methodology to be employed by the project proponent in relation to the assessment of the likely transportation and road infrastructure impacts associated with the transportation of the proposed 67 no. wind turbines Kipeto Wind Farm development which is to be located in the Kajiado district of the Rift Province, Kenya. The access arrangements will vary over the 3 phases of the Proposed Development: construction, operation and decommissioning. Construction and decommissioning are both short-term phases (approximately 12 months each) whilst operation will cover the majority of the lifetime of the proposed development (approximately 25 years).

The potential impact on transport and road infrastructure to the wind farm has been taken into consideration at the design stage. The methodology deployed in this report is intended to:

- Quantify the likely traffic movements generated by the proposed wind farm; and
- Assess the likely impact of the proposed development on transport infrastructure and the receiving environment during construction, operational and decommissioning phases

A preliminary desk top study and site visit was carried out to assess on site access conditions. It is likely that the turbines will be uploaded at Mombasa port and transported by road from Mombasa to Nairobi via the A104. The turbines will then travel via the A104 to the site at Kipeto. A desktop transport study on the proposed transport route of the turbines to the site was carried out by Galetch Energy Developments Ltd (GED). This study was carried out in accordance with GE standard specifications using desktop swept path analysis and standard wind farm access impact assessment methodology. A drive through reconnaissance of the proposed route was carried out by GED in January 2012 to assess the route and determine its suitability as the proposed transport route.

This report has been coordinated by Catherine Keogan of Galetch Energy Developments Limited in accordance with best practice standard Wind Farm Access and Transport Impact Assessment and reviewed by Sanjay Gandhi of Kurrent Technologies Limited.

## 2 Receiving Environment

### 2.1 Location & Local Road Network

The project area is located north-west of Kajiado town which is located on the main Athi River to Namanga highway on the A109. The site is predominantly used for agricultural purposes. Access to the site is most likely to come from the existing farm access roads which connect to Kajiado.

Existing roads on site consist of informal tracks which are of poor quality and offer very limited accessibility during the rainy season.

## 2.2 Characteristics of the Proposed Development

The proposed development in summary consists of:

- 67 no. turbines and associated development such as underground cables
- Access tracks and hardstanding areas
- Permanent Anemometers Masts
- Sub Station
- Associated site development works

## 2.3 Description of Wind Turbine Components

The wind turbines will be brought to site by the turbine supplier. Turbine units which must be transported to the site consist of:

- the tower (in segments)
- the nacelle
- the three rotor blades
- other components required such as generators and transformers.

The individual components are defined as abnormal loads in terms of the Traffic Act by virtue of the dimensional limitations (abnormal length of blades) and load limitations (nacelle). Additionally, components of various specialized construction and lifting equipment are required on site to erect the wind turbines and need to be transported to site. Along with the specialized lifting equipment/cranes, the normal civil engineering construction equipment will need to be brought to the site for the civil works (e.g. excavators, trucks, graders, compaction equipment, cement trucks, etc.).

The components required for the establishment of the sub-station (including transformers) will also be transported to site as required.

The dimensional requirements of the vehicles/loads used during the construction phase (length/ height) may require alterations to the existing road infrastructure (e.g. widening on corners), accommodation of street furniture (e.g. street lighting, traffic signals, telephone lines, etc.) and protection and upgrade of road related structures (e.g. bridges, culverts, etc.) which may be susceptible to abnormal loading.

The equipment will be transported to the site using appropriate national roads and dedicated access/haul road to the site itself.

### 3 Methodology

The analysis of the potential effects of the Kipeto Wind Farm upon access routes is carried out by desk based research, on-site surveying and through consultation.

Desk-based research, to establish:

- Activities that may potentially give rise to significant effects;
- Views from relevant consultees;
- Public access to and within the Development Site;
- Current site usage;

The Ministry of Roads and/or the Kenya National Highways Authority was consulted during the ESIA process.

An assessment was carried out as part of the ESIA to include the likely number of construction traffic movements and the capacity of local roads to accommodate those movements. This was completed with reference to recognized best practice guidelines and in close consultation with The Ministry of Roads and/or Kenya National Highways Authority.

Once the proposed wind farm is operational, the number of traffic movements to the site would be significantly reduced to regular visits by a small maintenance van.

A desktop based Swept Path Software Analysis was carried out on the proposed transport route from Mombasa to the site at Kipeto via Nairobi and Kajiado. The purpose of this study was to identify pinch points and other constraints using vehicles fitted with rear axle steering which would typically be used for transportation of such turbines. The road edge location was estimated from geo-referenced Google earth imagery.

The methodology above was employed to predict the likely impact of the proposed wind farm on roads and transportation infrastructure and where appropriate identify mitigating measures.

Prior to construction surveying detailed route survey will be carried out in conjunction with a structural engineer to assess the route suitability for the road transportation of the turbine components to the site and the suitability of the proposed access points to the proposed site according to GE internationally approved standards.

#### 3.1 Desk Based Results

##### 3.1.1 Development Activities and Potential Effects

Potential impacts on access are detailed below, grouped by the 3 phases of the Proposed Development.

**Construction:**

- Safeguarding around work areas;
- Construction traffic;

- Other road users

**Operation:**

- Safeguarding around work areas;
- Maintenance traffic;
- Noise – this is addressed in a separate chapter of the ESIA;
- Other public safety restrictions;

**Decommissioning:**

- Safeguarding around work areas;
- Traffic.

### **3.2 Site Visit**

Engineer Protas Murunga (Norcken International Limited) visited the project area on 16<sup>th</sup> October, 2011, to undertake an initial assessment of the project area and proposed locations of development illustrated in the map below.

**Figure 1: Local Access to the Proposed Site**



All the sites are located on ridges and therefore access roads to these sites will have to be newly constructed.

The A104 is owned by the Kenya National Highways Authority (KeNHA) and is in generally good condition. All "E" Class roads belong to the Kenya Rural Roads Authority (KeRRA).

The legal framework for undertaking improvement works on 'E'-Class rural roads under the Kenya Roads Act (2007) and all rural roads are the responsibility of KeRRA. Any improvement works being undertaken on these roads are subject to approval by KeRRA.

#### ***Access Roads Linking the Site to Classified Roads***

The tasks involved in the development of these access roads are:

- i) Topographic survey;
- ii) Alignment design (both vertical and horizontal);
- iii) Alignment soils investigations;
- iv) Design of suitable pavement to carry envisaged loads on roads and hardstanding Areas;
- v) Drainage investigations and drainage design;

- vi) Land acquisition (since this is private land);
- vii) Procurement of a Contractor to undertake construction;
- viii) Supervision of works in progress;
- ix) Handing over of completed works and preparation of a maintenance plan;

### 3.3 Views of Relevant Consultees

Much information for this assessment was gained through consultation. A meeting was held with KeRRA on the 3<sup>rd</sup> of November 2011.

It was agreed that a Public Private Partnership will be set up involving Kipeto and KeRRA. This would include:-

- Description of design standards needed on the route for the transportation and access of the site
- Supervision of work to be done on the route
- Agreement on maintenance of the developed roads
- Decisions on which parties will take up which roles in this agreement.

This agreement will highlight three main areas, namely:- **planning, construction and maintenance.**

The main highway from the port to Kajiado will be most affected and disrupted during transportation of the equipment. The loads have to be within the allowable legal limits. Thus the weight, height and width of the load need to be known and the National Highway Authority needs to be informed.

- It may be necessary to circumvent some bridges.
- Maximum height of the load should be 5.4m
- With a wide load, movement is legally limited to daytime with escorts.

The route survey experts are to inform the team of what structures are on the route and where to find them (bridges, tunnels etc.)

1. Processes required- a brief/ addendum of the following will be made available to the relevant parties:
  - Information on dimensions of the equipment
  - Timelines
  - Standards required
  - Any other information deemed necessary for planning purposes
2. Demarcation- it was noted that no land demarcation of any sort had been done in the area and an equipped planning team (physical planners) would be required. This is to avoid any disputes or interruptions during the construction phase of the routes. Planning permit applications will also need to be prepared.

## 4 Potential Transportation Impacts

There are a number of existing access routes leading to the proposed project area but it is anticipated that all access to the proposed wind farm will come from the Athi River – Namanga highway A109.

Both construction traffic and operational traffic would access the proposed site from Kajiado before making use of existing tracks leading to the project area. New purpose built tracks to each wind turbine would also be required. Construction access tracks would be downsized as appropriate on completion of construction activities.

The main traffic impacts would be during construction, both in the delivery of materials to site as well as turbine components and specialist construction equipment. Some of these deliveries would be made by long/slow moving vehicles. The number of vehicle movements during construction would depend largely on the arrangements made by the contractor, and details cannot be provided with any certainty at this stage.

In terms of construction traffic movements, it is expected that the local road network would have sufficient capacity once it has been reinforced. The likely number of construction traffic movements has been estimated as part of the ESIA and the capacity of the local road network to accommodate this confirmed with Kenya National Highways Authority.

### On-Site Surveying

The site and the potential access points into the proposed development site will be surveyed prior to construction by a GE approved engineer to establish the best possible route with the least upgrading or disturbance to existing access routes and traffic using the area. An initial site visit and a desk top analysis has indicated that the optimum route is from the port of Mombasa to the site. See section 6 of this report for more details.

## 5 Predicted Impacts

Given the nature of the proposed development, it is inevitable that some access restrictions will have to be put in place to safeguard the public and commercial users of the site and allow reasonable progress during construction, operation and decommissioning. These restrictions will be dictated by standard Health, Safety and Welfare issues.

This section analyses the impact of any access restrictions on the receptor groups. Restrictions during construction and decommissioning will be similar and so will be dealt with together.

It is also inevitable that there will also be an impact on local and regional transport roads during the transportation of turbine components. These impacts are dealt with comprehensively in Section 6 of this report.

The construction of the access tracks and hard standings on the site are required to provide access for the construction, operation and maintenance of the wind turbines and all associated equipment. The predicted impacts of this construction on various receptor groups are also addressed in this section.

## 5.1 Site Access Specification

In terms of accessing the site it is proposed to construct internal access tracks off the local roads to transport the turbines to their final location.

Within the site itself, access tracks are proposed to be constructed which are circa 5m in width. Tracks that are not required during the operational phase will be reinstated wherever possible. It is likely however that the majority of the tracks will be required during the operational phase for maintenance purposes.

Tracks shall be similar in appearance to normal agricultural tracks but with a slightly wider typical running width of approximately 5m. Additional excavated strips will be required alongside the tracks to accommodate drainage and the cable trenches. Track variations shall be made to accommodate turning facilities for long loads and passing places for general traffic, as required. Hard standing areas shall be established adjacent to each turbine to facilitate the crane operations for erection. Sufficient quantities of suitable material are available locally for building these access facilities.

Topsoil removed during construction operations will be used to reinstate the margins of all excavations and formations as far as is practicable, to minimise visual impact on the surrounding landscape.

## 5.2 Construction Traffic

The project requires the transportation to the site of large turbine components under escort, together with associated electrical equipment, construction plant and general site traffic. Access tracks for the proposed wind farm will be constructed. The turbines will be accessed from access points off the local routes during the construction, operational and decommissioning phase of the wind farm. The proposed access points will comply with Kajiado Council requirements for visibility and road safety. The route for construction traffic, particularly the large turbine components, to reach the site entrance is likely to be from Mombasa. The proposed transportation routes both national and local are illustrated in Section 6 Transport Survey.

In terms of vehicle movements during the construction stage of the proposed development the number of abnormal loads required to transport the parts of the turbines along with cranes has been calculated based on standard industry practice. Traffic management measures will be agreed with relevant government bodies in relation to these abnormal loads prior to commencement.

It is estimated that a number of HGV trips and commercial vehicle trips will occur during the construction phase of the development. It has been assumed that during the construction phase workers will be transported to site by bus. As with any such predictions the figures estimated are very much of an indicative nature and should be read as such. The actual figures shall be very much determined by Site Management and Project Programming. Also any future planning conditions imposed on the project could alter these predicted figures.

In terms of vehicle movements during the construction stage of the proposed development it is estimated that approximately 810 round trips of abnormal loads will be required to transport the parts of the turbines along with cranes. Traffic

management measures will be agreed with relevant government bodies in relation to these abnormal loads prior to commencement.

**Table 1: Outline of Predicted Traffic Movements**

Task Description	Load Details		
	Abnormal	HGV	Van/Bus
Turbine Delivery	810	210	3,580
Civil Works	2	16,230	280
Site Electrics and Buildings	5	150	2,930
Site Staff	0	0	480
<b>Total</b>	<b>815</b>	<b>16,590</b>	<b>7,270</b>

It is anticipated that the construction phase of the project is approximately 12 months of work.

## 5.3 Receptors

### 5.3.1 Farmers

It may be necessary to limit access around the locations of turbines for personnel and livestock at times during construction. It may be more practicable to exclude livestock from this area for the duration of the construction period. This will be achieved utilising additional fencing in liaison with the farmer. Given the other areas available for grazing, the impact is deemed *minor/significant*. Except during short periods of maintenance on turbines access restrictions are not envisaged. Impact is deemed *not significant*.

### 5.3.2 Infrastructure

All existing on-site infrastructure will be mapped prior to the commencement of construction. Any issues during construction/decommissioning to infrastructure will be managed by the Site Manager. Any restrictions will be of a short duration (in relation to the construction period). Impact is deemed *not significant*.

### 5.3.3 Public Receptor Groups

During construction and decommissioning, restrictions will have to be put in place to safeguard the public from certain construction activities and machinery. These restrictions will prevent unauthorised access to the site during these phases for Health and Safety reasons. Restrictions will only be put in place where necessary and their duration and extent will be kept to a minimum. However, given the widespread nature of construction activities, there is potential for impacts to occur, albeit of a temporary nature and as such it has been deemed *minor significant*.

During operation, temporary restrictions may be placed from time to time while maintenance activities are performed but these will be localised and short lived. Even so, there is potential for impacts to occur and as such it has been deemed *not significant*.

## **6 Transport Study**

### **6.1 Introduction**

The report consists of an assessment of the route suitability for the road transportation of the GE 1.6MW wind turbines, nacelles, blades and their associated tower sections, consistent with 50m blades to the Kipeto Wind Farm site.

### **6.2 Technical information on Transport Vehicles and Load**

Please see Appendix I GE 1.6 100 Technical Documentation WTGS.

The proponent shall engage a transport and logistics companies with the capability of transporting the turbine components from the port at Mombasa to the site. Maximum axle load limit and the gross weight limit for the Kenyan roads is 8 tons. Suitable axle numbers shall be used to achieve the correct legal loading once the actual trucks to be used are identified.

The Tower flange diameter is 4.62m which should not pose any difficulties traversing the route to site as components of height equal to 5.85 metres have been transported along this route.

Prior to the arrival of the vessel, a minimum of two hydraulic mobile cranes of suitable capacity for handling the wind turbine components shall be commissioned. The cranes will be equipped with various certified soft sling belts and other lifting gear necessary to handle the wind turbine equipment.

Direct delivery of all wind turbine components shall be taken by the transport contractor from the vessel which shall be moved to a safe and secure hard standing area within the port, using the cranes.

The vehicles will then proceed to on the A109 from Mombasa to Nairobi. At Athi river the transport shall proceed to Kajiado along the A104 before proceeding to the site. It is not anticipated that there will be extraordinary challenges along the route to Kajiado with regard to: turning radii for the trailers; heights of the cargo; and weights of the cargo being transported as longer and heavier components have been transported successfully through the East African Region.

There are a number of bridges along this route that will need to be assessed to ensure they have sufficient structural capability to carry the transport vehicles and turbine components. This assessment will be carried out by Kenya National Highways Authority as part of the abnormal loads permit. Should any bridge along this route be found to be unsuitable, then an alternative route through the river bed shall be investigated. As loads with similar weights have been transported along this route previously, this is not envisaged to be a major problem.

- The proponent shall engage a suitably qualified transport and logistics operator in the region with has the required experience and expertise with regard to managing licenses and permits to transport abnormal / out-of-gauge cargo from the relevant statutory authorities.
- Should the terrain be a challenge anywhere along the route, the proponent shall mobilize required resources cranes, graders, additional prime movers or low-loaders etc to facilitate smooth execution of the assignment.

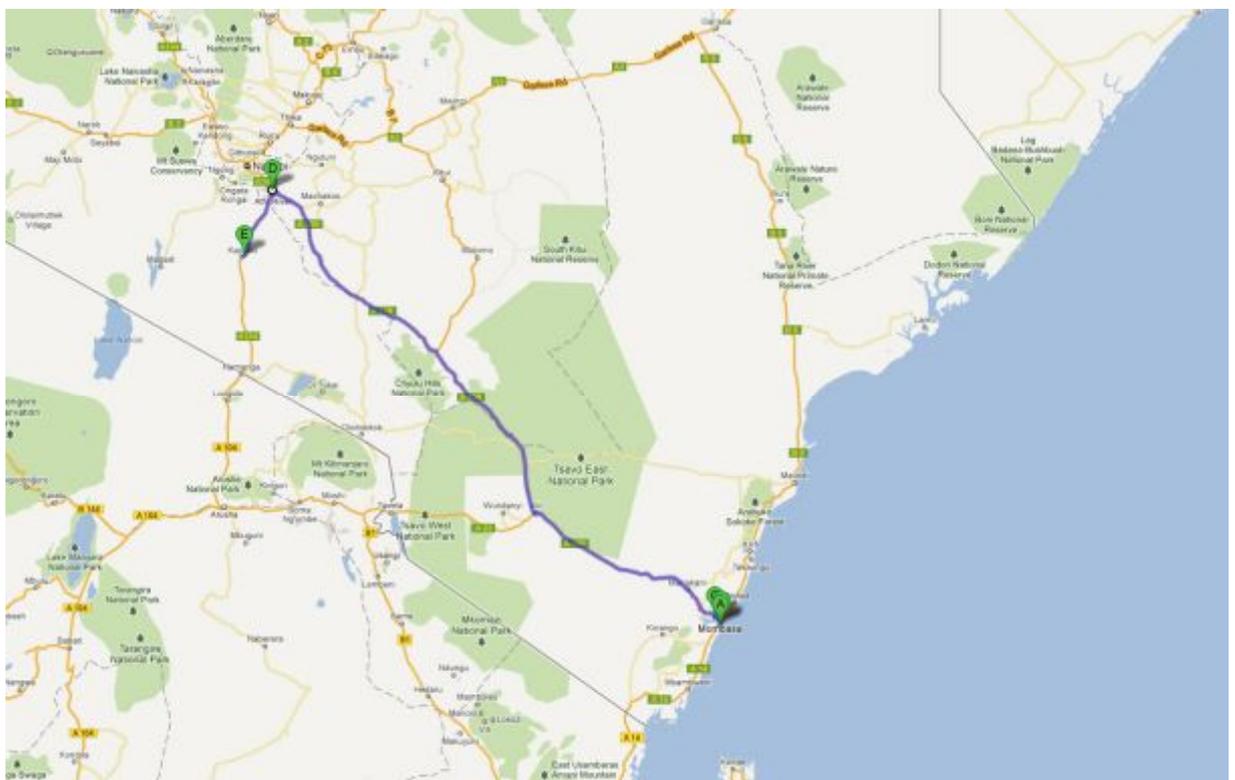
## 6.3 Transport Route

### 6.3.1 Port of Entry

Ultimately the port of landing shall be chosen by the turbine supplier however it is assumed that the port chosen will be Mombasa. Prior to a port been chosen it shall be necessary for a suitably qualified engineer to carry out whatever surveys are necessary along the route to ensure that it shall be suitable for the transportation of the turbine components using the vehicle types available to them.

The most suitable sea port which can accommodate the landing and handling of turbine components of the size and type of those to be used as part of the Kipeto development is Mombasa, which has direct access onto the National Road Network. Therefore transportation of the components from the port of landing to the development site should not present any significant difficulties.

**Figure 2: Transport Route from Mombasa Port to Kajiado**



**Figure 3: Transport Route from Mombasa Port to Highway, A109**



**Figure 4: Three Alternative routes from the A109 onto the A104**



(Location D on Fig 6.3.1)

## 6.4 Swept Path Analysis

Cormac McPhillips from GED carried out analysis on a GE1.6 100 blade transporter using Swept Path Software Analysis carried out using vehicles fitted with rear axle steering consistent with the vehicle type which would be required to transport such a turbine.

The four locations where swept path analysis was carried out are shown in Fig 6.3.2 and Fig 6.3.3. No other pinch points were observed between Mombasa and Kajiado during the route survey. The swept path analysis was carried out using geo-referenced google earth imagery. A detailed GPS survey will be required to confirm road edge location and to identify any other relevant constraints. The attached pdf shows the swept path of a blade transporter at these locations.

The relevant government and local bodies will be consulted prior to commencement of transport and a detailed route survey will be carried by a suitably qualified engineer.

## **6.5 Kipeto Site Survey**

Deliveries for these turbines shall exit from the highway, A104 at Kajiado. They then travel along the rural road (E407) to the site as shown in Fig 3.2.1. A number of entrances shall be formed off the local public road to allow access to the site.

Along this section of route significant road upgrading will be required in order that the transport vehicles can reach the site. There are three bridges along this route on the E407 that will need to be reconstructed or reinforced to allow access for the turbine components.

Under the Kenya Roads Act (2007) all rural roads are the responsibility of KeRRA. Any improvement works being undertaken on these roads are subject to approval by KeRRA.

The proponent will engage with KeRRA is requested to allow the participation of a Consultant to be hired by GE Energy and to report to both KeRRA and GE Energy on works required.

## **7 Mitigation**

The following mitigation measures are recommended to reduce the potential impacts described above. Mitigation has already occurred at the design stage by incorporating existing local roads into the design of the proposed road network as much as possible.

The principle of the following proposed additional mitigation measures apply equally to the construction, operational and decommissioning phases of the Proposed Development.

- Signage at entrances giving access information;
- A public information / education campaign in advance of commencement of construction will be put in place to provide information on access arrangements
- Restrictions kept to minimum duration and extent;
- Diversions put in place to facilitate continued use where restrictions have to be put in place;
- Construction traffic management – a two way system will be operated on the Kajiado to site road where possible and speed limits appropriate to the conditions will be strictly enforced;
- Provision of a service to manage access and act as a point of contact to the public during the operational phase of the Proposed Development;
- All alterations outlined in the access study to be carried out with consultation of KeRRA/KeNHA/NEMA/Kajiado Council and other relevant bodies.
- No hedgerows or potential breeding habitats to be removed during the breeding season.

- Any damage to local/regional/national roads made good by proponent (including any removal of signage, street furniture etc)

## **8 Residual Impacts**

The mitigation measures, if effectively implemented, will result in residual effects that are deemed *minor positive*.

## **9 Enhancement**

The proponent recognises the potential for enhanced access around the Development Site. Within the context of the Proposed Development, the proponent will seek to collaborate with the land owners and other interested parties to facilitate responsible and safe public access to Development Site areas.

## **10 Appendices**

Appendix 1 Swept Path Analysis

Appendix 2 Technical documentation Wind Turbine Generator Systems 6-100