APPENDIX A: Avifauna Impact Assessment Study for the proposed Kipeto Transmission Line Project, Kenya

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Acronyms

AEWA	African Eurasian Migratory Waterbird Agreement
CMS	Convention on Migratory Species
EIA	Environmental Impact Assessment
IUCN	The International Union for Conservation of Nature
NEMA	National Environmental Management Authority
SEA	Strategic Environmental Assessment
SNH	Scottish National Heritage
UNEP	United Nations Environmental Program
VP	Vantage Point

1 Executive Summary

This report is an ornithological impact assessment of the proposed 220kV transmission line project proposed by Kipeto Energy Limited (KEL) as the proponent. The study aims to define the baseline environment and potential ornithological impacts associated with the project in order to develop mitigation measures that aim to minimize the negative impacts of the project while optimizing the positive impacts. Cumulative effects on the wind farm, transmission line and associated infrastructure are also assessed both at a local and national scale.

This study has been conducted to satisfy the Kenyan Environmental Management and Co-ordination Act 1999, which is the legislation that governs EIA studies in Kenya. The study further aims to satisfy the requirements of applicable avifauna related treaties and conventions and the procedures of the World Bank Group.

The ornithological impact assessment of the transmission line comprised discussions and consultations with the proponent and stakeholders; initial site reconnaissance; desk study and literature review; preparation of data collection instruments; field visits for consultations and observations; data analysis and report writing.

Bird surveys were carried out along the proposed 17km transmission line. Additional studies were also conducted on the wind farm site to relate how the different actions will impact on bird species cumulatively. The key activities undertaken during the ornithological assessment of the proposed 220kV transmission line are:

- Identifying sensitive bird habitats along the transmission line corridor;
- Identifying key bird species that would be affected by the transmission line while establishing their distribution;
- Generate baseline data that will be used to monitor and evaluate the mitigation measures to be implemented during the project cycle;
- Assessing the anticipated impacts of the project on birds, with particular emphasis on the various phases of the project (i.e. construction, operation and maintenance)
- Recommend practical measures for mitigation of adverse impacts and enhancement of positive ones;
- Identify actions and species that would be impacted upon cumulatively by other reasonably foreseeable wind power projects; and

A semi-quantitative impact assessment methodology was undertaken to determine the significance of potential avifaunal impacts resulting from the transmission line project. Bird collision was established as the most significant impact with the overhead conductors without mitigation. Electrocution was also identified as potential impact with high significance but with relevant mitigation on the design of the support structures, the probability would be low. No fatal flaws were identified which could prevent the project from proceeding.

There has been a substantial increased interest in wind farm developments globally. Most of the areas proposed for wind energy are also important areas for birds especially raptors and water birds. Whilst renewable energy development is crucial to the region’s growth and to combating climate change, the impacts for soaring birds—including collision and electrocution with power lines and wind turbines—is considerable. The scale of energy development is huge, with over five million kilometers of transmission lines planned globally between 2010 and 2015. The Rift Valley/Red Sea region provides some of the best wind resources in the world. It is important to follow precautionary approaches that ensure potential cumulative impacts are considered and avoided where possible in accordance with existing environmental protection in EMCA and the 2012 International Finance Corporation’s Performance Standards on Environmental and Social Sustainability. It should however be noted that not all the proposed wind farms presently under consideration are operational. However this assessment will consider that all potential wind farms will become operational in a reasonably foreseeable time frame.

The cumulative impact assessment in this report focused on known proposed wind farms in Kenya. The proposed projects would have the potential to impact on avifauna in a cumulative manner. Each project is expected to have additional potential impacts depending on the size, location and the interactions with different bird species.

The cumulative impacts assessment also focused on key vulnerable bird groups that include migrating raptors and breeding birds. The key cumulative effects identified were direct mortality through collision from wind turbines, transmission lines and barrier effect resulting from wind farms. Results from cumulative effects assessment indicate minimal residual impacts on birds with effective implementation of mitigation measures. A comprehensive post monitoring plan will reduce any anticipated impacts.

2 Introduction

An Environmental Impact Assessment (EIA) is a legal requirement in Kenya for all development projects. The Environmental Management and Coordination Act, 1999 (EMCA) is the legislation that governs EIA studies in Kenya. This project falls under the Second Schedule that lists the type of projects that are required to undergo EIA studies in accordance with section 58 (1-4) of the Act. Projects under the Second Schedule comprise those considered to pose potentially negative environmental impacts. Kenyan law has made provisions for the establishment of the National Environment Management Authority (NEMA), which has the statutory mandate to supervise and coordinate all environmental activities.

The approach to this ornithology study was structured in order to cover relevant requirements under the EMCA. This study is also based on Safeguard Policies and procedures recommended by the International Finance Corporation's Performance Standards on Environmental and Social Sustainability (International Finance Corporation 2012) as stipulated in Guidance Note 6 on Biodiversity Conservation and Sustainable Management of Living Natural Resources. It involved largely an understanding of the project background, the preliminary designs and the implementation plan. In addition, baseline information was obtained through physical investigation of the site, desktop study as well as literature review of previous work in the proposed project site.

The environmental assessment process provides insights to ascertain the applicability of safeguard policies to specific projects. This is especially the case for the policies on natural habitats that are typically considered within the environmental impact assessment (EIA). The breadth, depth, and type of analysis of the EA process depend on the nature, scale, and potential environmental impact of the proposed project. The requirements of the policy aim to ensure sustainable project implementation. Most of the requirements of this safeguard policy have been responded to in this report by evaluating the impact of the project and recommending appropriate mitigating strategies.

Issues associated with bird collisions and electrocution has received growing attention on wind power projects. Many species of migratory birds' especially large species fall victim to transmission lines, conductors or poles of electricity power grids. Bird collisions and electrocution is a conservation issue and can also lead to disruption of power thus posing a concern for electricity distribution on a broader scale.

In order to address the current uncertainty as to the extent of the problem of power line related bird mortality in the African-Eurasian region, the secretariats of the Convention on the Conservation of Migratory Species of Wild Animals (UNEP/CMS) and the Agreement on the Conservation of African- Eurasian Migratory Water birds (UNEP/AEWA) commissioned a review covering all aspects of the conflict between migratory birds and electricity power grids, and guidelines for mitigating and avoiding this conflict within the African-Eurasian region (Prinsen *et al*, 2011).

The guidelines provide an overview of the nature, scale and impact of the collision and electrocution problem of birds including an overview of the aspects involved and gaps in the knowledge on the extent of bird fatalities with the AEWA range states. The guidelines include the state of art mitigation measures and recommends solutions and appropriate actions both technical as well as legislative and suggestions for research and potential mitigation measures.

Several measures have been recommended in the CMS 'Guidelines on how to avoid or mitigate impact of electricity power grids on migratory birds in the African-Eurasian region' (Prinsen *et al*., 2011). To ensure avian safe electricity transmission and distribution facilities, the following measures are recommended:

- Put existing and new low to high voltage power lines underground in as far as technically and financially feasible, but especially in areas of high relevance to birds;
- Develop and support strategic long-term planning of nationwide electricity grid networks, applying appropriate strategic environmental assessment (SEA) and environmental impact assessment (EIA) procedures to carefully consider location in the planning process, incorporating all available information on presence of protected areas, key bird areas and susceptible bird species, including important bird flight routes;
- Use state-of-the-art technical standards for bird safety for new and retrofitted power lines;
- Substitute upright insulators on cross-arms with hanging insulators or put the latest generation of insulating caps on the upright insulators;
- Place the power lines (conductors) below the cross-arms, use insulating chains at least 70 cm in length, insulation of power lines at least on 70 cm of both sides of the cross-arm, insulation of all other energized parts which are closer than 70 cm to a possible perch, installation of bird-friendly perching and/or nesting devices,
- Installation of clearly visible large high contrast (*i.e.* Black and white) markers and/or moving and reflecting bird flight diverters in energized conductors and ground wires.
- Existing power lines should be examined on their risks for bird electrocution and collision using standardized protocols.

Only few international treaties have paid attention to the problem of power lines and bird collisions and electrocution. On the national level, the problem of power lines and bird collision and electrocution is almost entirely dealt with through the provisions within SEA and EIA procedures.

A number of conventions and agreements exist to deal with the problem of protection of birds for instance, the Ramsar Convention and CMS. The Ramsar convention requests a number of global actions on conservation, research, sustainable management of water birds in all flyways. Many of the required actions, if applied, could also be beneficial for the problem of migratory birds and power lines. The conventions at the same time emphasize sustainable use, local community involvement and the integration of migratory species aspects into other aspects of society such as national planning and development cooperation that certainly applies to power line construction and bird problems. The conventions and treaties represents strong moral obligations hence are good instruments to remind countries on the obligations to which they are a Party.

The involvement of NGOs dealing with conservation is key in advocating for bird conservation. BirdLife International suggests a number of practical mitigation measures and suggests what further research and monitoring should be undertaken. This is supported by all National BirdLife partners in this case Nature Kenya; who are always key stakeholders when it comes to joint efforts on the national level with the electricity companies and governments agencies to reduce the killing of birds by power lines.

3 Methodology

In predicting the impacts of the proposed transmission line on birds, a combination of scientific field methods and desktop assessment were carried out to provide a general picture of the species in the area and to assess the level of bird activity at different points within the proposed site.

An extensive literature review on similar projects was undertaken; bird surveys were undertaken using standard methods at the proposed site to understand bird habitat interaction and distribution in relation to the proposed wind facility. The potential impacts of the proposed facility were described and quantified against standardised criteria. Surveys were undertaken along the 17km transmission line route that runs from the proposed substation next to the wind farm in Kipeto to the substation at Isinya to join the main KPLC grid.

Vantage point (VP) watches

The survey methods involved vantage point watches and transect surveys. This is based on the recommended survey methodologies under Scottish Natural Heritage (SNH, 2005), *Bird survey methods for use in assessing the impacts of onshore wind farms on bird communities*), adapted to suit to the conditions at the project site. The same methods have been employed in similar projects in Kenya (Lake Turkana Wind Project and Ngong Hills). Following this, the survey methods focused on:

- *Population surveys for all species*
- *Identifying key species vulnerable to wind energy projects*
- *Bird movements at various vantage points in areas proposed for wind turbines*
- *Determine Behavioral aspects of key species especially those that would be impacted upon by the project e.g. breeding, including nest observations etc*
- *Identifying the distribution of the species vis-a-vis the potential locations for the wind turbines*

Diurnal Vantage Point Surveys was carried out to estimate spatial and temporal use of the site by resident and migrant raptors and other diurnal passerines. Sampling intensity was designed to document raptor movement throughout the proposed development area.

Ten vantage points were selected along the transmission line. The survey points were selected to provide good visibility in all directions while surveying different habitats, topographic features, and portions of the study area without overlap. VP watches were carried out to assess the likelihood of collision with the transmission line (overlooking the proposed site to assess the usage of the site by overflying birds.

Factors that guided choice of VP included;

- Site coverage - to achieve full coverage of the defined area for the proposed wind farm
- Area visibility-also to achieve maximum visibility with the habitats.
- Landscape and habitat distribution – this was to ensure that all micro-habitats (woodland, grasslands) and landscapes (ridges etc.) were covered within the sampling design to cover all species.

The vantage point (VP) watches entailed recording birds over a set area of the potential transmission line at representative number of locations The orientation of each VP covered a 360° field of view. The VP locations were chosen as a sample to give good spatial coverage across the site to cover regular bird-flight lines and potential migratory movement.

Bird surveys had previously been carried out for the proposed 100MW KEL wind farm over a 2 year period between 2011 and 2013. An additional bird survey was conducted in the month of April 2013 to capture the breeding season for local birds and migration of migrants back to the breeding grounds. Additional surveys on the transmission line are planned for the future to capture birds coming to winter in Africa that use Kipeto for passage. The survey was divided into two sessions when birds are most active (Pomeroy 1980); in the morning from 0730hrs to 1030hrs and evening from 1500hrs to 1830hrs. Each VP was observed twice with each visit allocated 3hours repeated to cover every session. In total each point was visited for six hours. A total of 60hrs was spent conducting observations along predetermined points on the transmission line. In addition to the VP surveys, observations of all birds made during the course of moving around the site were also recorded along the proposed transmission line running from Kipeto to Isinya. The following parameters were recorded for each bird observed and entered onto standard recording data forms.

- Species name and number
- Duration of Survey (Time start and end)
- Time species observed
- Flight Height above ground for flying birds and their flight behavior (flight in a single direction, circling and hovering)
- Activity of species
- Bird movements
- Behavior (i.e. Perched, flying, roosting or foraging)
- Distance from observer.

Activities such as foraging, roosting and nesting sites were noted and mapped using a GPS. This provided important data to determine where most impacts would occur and to guide in the location of the transmission line.

The identified impacts on birds were assessed according to the Impact Assessment Methodology (Table 2).

4 Field Observations

4.1 Description of Affected Environment and bird micro-habitats

The landscape within the proposed transmission line is mainly characterized by wooded grassland and rock outcrops that opens up to dwarf *Acacia drepanolobium* habitat towards the proposed grid station at Isinya. It is expected that limited vegetation will be removed, since the construction phase will require the making of a permanent access road, which will be needed to provide access for the construction and operational phase activities respectively.

The proposed power line falls within pastoral landscape with associated grasslands and scattered acacia woodlands. According to the above considerations, the majority of this habitat is regarded as suitable terrestrial bird species for foraging, roosting and as passage for migrating birds. It must be emphasized that birds will, by virtue of their mobility, utilize almost any areas in the landscape from time to time.

The scattered acacia woodlands in the study area support the majority of and a mixed diversity of avifaunal species found in the study area. Unique species found within the woodland include wheaters, pipits, larks etc. The disturbance associated with clearing of woodland and grassland for the power line servitude will potentially impact on such species. Acacia encroached grasslands tend to occur towards the southern reaches of the proposed route. Species at risk to power line collisions in this area include a host of raptor species, such as Lesser Kestrels, Verreaux's Eagle etc observed at the time of the survey.

Cultivated land represents a significant feeding area for many bird species in any landscape due to readily accessible food for birds and other predators; the crop or pasture plants cultivated are often eaten by birds, or attract insects which are in turn eaten by birds; during the dry season cultivated lands often represent the only green or attractive food sources in an otherwise dry landscape. Cultivated lands are scattered throughout this study area. Relevant bird species that will be attracted to these areas include most importantly the Hornbill, Raven species and possibly Storks. However this should not pose significant threat as it's not a widely practiced activity.

Man-made water pans and natural depressions occur in close proximity in the area of the proposed transmission line. These form suitable habitat for duck species and drinking points for other birds. These were mainly observed along the stream. At certain times of the year, they are characterized by slow flowing water and tall emergent vegetation, and provide habitat for water birds.

4.2 Bird species observed along the Transmission Line

A total of 63 species were recorded (see **Appendix 1** for a full list of species-both observed and expected) along the proposed transmission line during the current survey. Most species recorded during the current survey were also observed during the 2011/2012 ESIA study for impacts of wind farms on birds. Of these species, none is classified as endangered in the IUCN Red List of threatened Species. Lesser Kestrel was the key migrating raptor recorded.

From existing literature records and results of previous surveys more birds are expected to utilize the site for foraging or passage to feeding or roosting sites, it is considered more practical to direct risk assessments and mitigation efforts towards species that have a high biological significance, in order to achieve maximum results with the available resources at hand (Van Rooyen 2008). Bird behavior cannot be reduced to formulas that will hold true under all circumstances. By virtue of their mobility, they are able to adapt and relocate rapidly, changing the location of predicted impacts. Based on the experience gained from previous bird assessment at the proposed wind farm in Kipeto from the 2 year site study the team is confident in the predictions that the same bird species recorded would utilize the same area proposed for the transmission line.

The habitat along the transmission line provide suitable habitats for grassland bird species including pipits, wheatears, Larks etc. most of which breed on the ground. Raptors including Kestrels, Kites and eagles were also recorded. These are key targets for monitoring with respect to the impacts of the proposed development. Bird movements are possible between these habitats within the proposed development site during different times of the year. The routing of the transmission line could increase this collision risk, particularly near wooded areas or rock outcrops that form cliffs. Storks and herons have also been identified as groups prone to collisions with overhead lines (Jenkins *et al*. 2010), and this risk is increased when lines run through suitable habitats like cliffs.

4.3 Potential Avifaunal Impacts of Transmission line

Power lines pose a threat to avian populations. Mortalities from collisions with power lines and electrocutions on poles are documented (Jalkotzy *et al.* 1997). Electrocution and collision are one of the main mortality factors among the medium-sized and large birds observed such as Storks, Eagles, Vultures, other Raptors, Owls, Ravens and Bustards. The main types of risk to birds that would result from the development of the proposed power line are discussed below.

4.3.1 Risks of electrocution

Electrocution of birds is caused when a bird bridges the gap between either a live phase or an earth component (phase-earth electrocution) or two live phases (phase-phase electrocutions) (Harness and Wilson 2001). Several species of large birds suffer losses to electrocution. This would mainly affect birds associated with the site; and electrocutions on power supply structures by raptors and other medium sized birds on passage.

Birds sitting on power poles and /or conducting cables could cause short circuits between energized wires or short to ground especially for numerous medium sized birds and large birds using the power poles as perching, roosting and even nesting sites. Birds are able to cause electrical faults (short circuits on power lines through bird pollution). A flashover occurs when an insulator string gets coated with pollutant, which compromises the insulation properties of the string. When the pollutant is wetted, the coating becomes conductive, insulation breakdown occurs and a flashover results. Nests may also cause faults through nest material protruding and constituting an air gap intrusion. Crows in particular often incorporate wire and other conductive material into their nests.

Power lines pose a number of threats to a variety of birds (Table 1) especially those migrating, in large flocks and large birds with limited maneuverability. Raptor species potentially at risk in the (greater) study area may include Tawny Eagle, Lesser Kestrels, and White-backed Vulture. Birds of prey are vulnerable to mortality due to overhead lines, (Van Rooyen 2008, 2010). Vultures are at risk on power line structures in terms of both collisions and electrocutions (Van Rooyen 2010) due to their far-ranging nomadic habits and their colonial nature. They are gregarious and often attempt to perch together on one structure. Bird species including ducks and herons are more likely to die of power line collisions than from electrocutions (Janss and Ferrer 1998) others include storks and corvids due to their morphology and behavior. These birds are most at risk of electrocution due to their relatively wide wingspans and tendency to use poles as nesting platforms and perches from which they survey for prey (Lehmann 2001).

4.3.2 Risk of collision

Collisions are a significant threat posed by overhead lines to birds (van Rooyen 2004). Those that would be mostly impacted are bustards, storks, cranes and various species of ducks observed. These species are mostly heavy-bodied birds with limited maneuverability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001).

Collision with power lines is a lesser-known problem than electrocution and is harder to detect because it can occur at any point along the transmission line, the bird collides with the earth wire, which is less visible. Collision risk is influenced by the topography of surrounding terrain and the proximity of lines and pylons to nests and other areas used frequently by local species.

Potential impact through collision is anticipated to occur along river valleys that are mostly utilized by birds especially during the dry season. In most cases the impact of collision leads to immediate death or fatal injuries.

4.3.3 Disturbance and habitat destruction

Habitat destruction is expected during the construction phase and maintenance of power lines and substations, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, the clearing of power line servitudes and construction of substations. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through modification of habitat.

Reduction in availability of quality habitats for breeding birds and foraging areas is most likely to occur during the construction phase. These activities should thus be timed to take place outside the breeding season. On the other hand, transmission lines have proven to be partially beneficial to many birds, including the larger species such as Martial Eagles *Polemaetus bellicosus*, Tawny Eagles *Aquila rapax*, African White-backed Vultures *Gyps africanus*, and even occasionally Verreaux's Eagles *Aquila verreauxii* by providing safe nesting and roosting sites in areas where suitable natural alternatives are scarce (van Rooyen 2004). Although this provision of nesting and roosting substrate can be beneficial, it could also simply place these birds at greater risk of collision with the power lines.

Raptor and Corvid populations may benefit from the presence of power poles (Steenhof *et al*. 1993).Both Pied Crow and Ravens are ubiquitous and nest freely on human-made structures, often using pieces of scrap wire which can cause shorts.

Table 1: Bird Families and Impacts of Power lines

Bird family	Electrocution	Collision
Ducks *(Acaridae)*		√
Herons *(Ardeidae)*	√	√
Storks *(Ciconidae)*	√	√
Ibises *(Threskiornidae)*	√	√
Raptors (*Acciptriformes & Falconiformes*)	√	√
Sandgrouses*(Pterociididae)*		√
Pigeons & Doves *(Columbidae)*	√	√
Bustards *(Otidae)*		√
Cuckoos*(Cuculidae)*		√
Owls *(Strigiformes)*	√	√
Nightjars *(Caprimulgidae)*		√
Swifts *(Apopidae)*	√	√
Hoopoes *(Upupidae)*	√	√
Kingfisher *(Alcedinidae)*	√	√
Bee eaters *(Meropidae)*	√	√
Rollers *(Oraciidae)*	√	√
Woodpeckers *(Picidae)*	√	√
Ravens & Crows *(Corvidae)*	√	√
Medium sized & small Passerines *(Passeriformes)*	√	√

5 Impact Assessment Methodology

The following section provides an assessment of the likely impacts on avifauna and has been assessed according to the Impact Assessment Methodology in Table 2 and 3. This qualitative assessment was also used to assess cumulative effects of wind farms on birds.

Table 2: Kurrent Technologies Ltd. EIA Study Risk Matrix

EXTENT	
Localized (At localized scale and a few hectares in extent)	**1**
Study area (The proposed site and its immediate environs)	**2**
Regional (County level)	**3**
National (Country)	**4**
International (Beyond Kenya)	**5**

MAGNITUDE	
Small and will have no effect on the environment	**0**
Minor and will not result in an impact on the processes	**2**
Low and will cause a slight impact on the processes	**4**
Moderate and will result in process continuing but in a modified way	**6**
High (processes are altered to the extent that they temporarily cease)	**8**
Very high and results in complete destruction of patterns and permanent cessation of the processes	**10**

DURATION	
Very short (0 – 1 Years)	**1**
Short (1 – 5 Years)	**2**
Medium term (5 – 15 years)	**3**
Long term (>15 years)	**4**
Permanent	**5**

PROBABILITY	
Highly improbable (<20% chance of occurring)	**1**
Improbable (20 – 40% chance of occurring)	**2**
Probable (40% - 70% chance of occurring)	**3**
Highly probable (>70% - 90% chance of occurring)	**4**
Definite (>90% chance of occurring)	**5**

Risk = (Extent+Duration+Magnitude) x Probability

		CONSEQUENCE (Extent+Duration+Magnitude)																			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
PROBABILITY	**1**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
	3	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	4	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
	5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100

Table 3: Method used to determine the environmental risk

Low	<30	Where this impact would not have a direct influence on the decision to develop in the area
Medium	30-60	Where the impact could influence the decision to develop in the area unless it is effectively mitigated
High	>60	Where the impact must have an influence on the decision process to develop in the area

Confidence of assessment

The degree of confidence in predictions based on available information, Kurrent Technologies Ltd. judgment and/or specialist knowledge	Low
	Medium
	High

5.1 Risk of bird collisions with transmission line

This was identified as the most significant impact on avifauna that would result from the project. This impact was assessed as Medium prior to mitigation due to the abundance of medium size winged species and raptors that are present in the area which are vulnerable to collisions. The transmission line passes through riverine habitat, valleys and grasslands which are all sensitive areas from an avifauna perspective.

The open patches of grassland however would attract species such as storks which could be at risk of collisions however these patches of grassland are small and any impact should be negligible

Unmitigated Impact : Risk of bird collisions with transmission line	
Magnitude of Impact	6
Geographic Extent	2
Duration of Impact	4
Probability	3
Confidence of Assessment	Medium
Risk	-36(Medium)
Comment/Mitigation	

- Line marking to increase the visibility of the line. There are three general types of line marking devices: aerial marker spheres, spirals, and suspended devices
- Managing surrounding land to influence bird use.
- Consider line placement that takes migratory patterns and high bird-use areas into account.
- All sections of line crossing rivers and the adjacent Riparian habitat should be fitted with Bird Flappers on the earth wire.
- If practical, consider line orientation that considers biological and environmental factors

such as bird flight paths, prevailing winds, and topographical features	
Mitigated Impact : Risk of bird collisions with transmission line	
Magnitude of Impact	4
Geographic Extent	2
Duration of Impact	4
Probability	2
Confidence of Assessment	Medium
Result	-20(Low)

5.2 Risk of Habitat Destruction

Sections of natural habitat will be destroyed during the construction phase for clearing of servitudes, creation of access roads and for clearing of the substation site. Clearing these areas will have an impact in terms of loss of habitat for woodland avifauna. The areas for the building of the proposed substations are open grassy fields which are being utilized for grazing by cattle and goats. From an avifaunal perspective these are not sensitive and as such the impact of the construction on the avifauna will be low.

Disturbance will occur during the construction and intermittently in the maintenance phase. If best practices are followed and this can be kept to a minimum, the impact will be low on avifauna. Sensitive areas include the valleys and open grasslands and care should be taken in these areas as not to disturb avifauna nesting in and around these areas. There will be minimal threat since densities of bird population are low and there also exist similar habitats in close proximity.

Unmitigated Impact : Habitat Destruction	
Magnitude of Impact	6
Geographic Extent	2
Duration of Impact	4
Probability	2
Confidence of Assessment	High
Risk	-24(Low)
Comment/Mitigation	
• Destruction of grassland during construction and operation should be kept to a minimum. • No destruction of riparian habitats and water pans during construction and operation should be allowed • The activities of the construction and operations staff must be restricted to the servitude and immediate surrounds. • Under no circumstances must birds be exposed to more disturbance than is inevitably brought about by construction and operations activities. • Care should be taken in sensitive areas such as grassland, wetland and valleys not to	

create more disturbance than is necessary. Machinery and vehicle access to these areas should be carefully controlled and maintenance and construction activities must be restricted to the servitude where practical	
Mitigated Impact : Habitat Destruction	
Magnitude of Impact	2
Geographic Extent	1
Duration of Impact	4
Probability	1
Confidence of Assessment	High
Result	-7(Low)

5.3 Risk of Bird Electrocution on poles

The bird species at the greatest risk of electrocution would be the vultures but even this species should be safe with the proposed design. After applying the impact assessment methodology, the assessment shows a low significance, (since species could be killed) and remains low after mitigation. The use of a Steel or Concrete Monopole Structure with sufficient clearance would minimize electrocution risks to avifauna.

Unmitigated Impact: Electrocution of birds on poles	
Magnitude of Impact	6
Geographic Extent	2
Duration of Impact	4
Probability	2
Confidence of Assessment	High
Risk	-24(Low)
Comment/Mitigation	
• Provide artificial bird safe perches and nesting platforms placed at a safe distance from the energized parts • Cross-arms, insulators and other parts of the power lines can be constructed so that there is no space for birds to perch where they can be proximate to energized wires. • All terminal structures (transformers) should be constructed with sufficient insulation on jumper wires and surge arrestors	
Mitigated Impact : Habitat Loss	
Magnitude of Impact	2
Geographic Extent	1
Duration of Impact	1
Probability	1

Confidence of Assessment	High
Result	-4 (Low)

6 Cumulative Effects on Avifauna

Cumulative effects are changes to the environment that are caused by an action in combination with other past, present and future actions (Hegmann*et al.* 1999).

The Kipeto wind energy project is situated adjacent the Great Rift Valley area, where a number of similar projects have been proposed including Ngong Hills which is currently operational, Kinangop Wind Park and Lake Turkana wind project. Others include Lamu. Isiolo, and Malindi (Table 4, Figure1).

Wind farm developments have both negative and positive impacts on natural resources and social environment within a project area. The previous project (KEL 100MW wind farm) assessed the impacts associated with the Kipeto wind farm largely in isolation. It is important to assess cumulative impacts associated with a proposed transmission line. The Kipeto Wind Energy Project will also include the construction of a new on-site substation and a transmission line, which will evacuate power to the Kenyan national electricity grid. The Project also includes roads that provide access to the turbines for ongoing maintenance

Wind energy projects have unique physical, construction and operational characteristics. As such the proposed projects will present unique cause and effect relationships with the environment and avifauna. The nature of cumulative effects of Kipeto combined with other proposed developments will be determined by the potential interaction of multiple wind projects both at a local and national scale. The cumulative effect assessment therefore examines the potential cumulative effects among existing and proposed wind energy projects within the broader landscape. It is well established that activities such as overhead power lines, communication towers, have higher mortality impacts on avian populations than do wind turbines (Erickson et al., 2005 Drewitt and Langston, 2008). However the impacts of associate wind facilities combined with impacts from wind farms have been less studied.

Table 4: Planned additions of new wind energy generation sources (2011-2015)

Developer	Project	Status of EIA	Turbines (Number)	Estimated Commissioning Date
KenGen	Ngong Hills	Wind	20	???
Independent Power Producer (IPP)	Lake Turkana	Wind	300	December 2014
IPP	Aeolus Kinangop	Wind	60	November 2013
IPP	Kipeto 2	Wind	63	???
KenGen	Isiolo	Wind	???	???
Electrowinds	Lamu	Wind	???	???
KenGen	Malindi	Wind	???	???

6.1 Approach to cumulative impact Assessment

The process of cumulative impact assessment involved habitat assessment and identification of key species guilds that are potentially vulnerable to the actions that would result from the wind farms and associated proposed facilities. For the purposes of this study, cumulative impacts are taken to be those arising from more than one wind farm of the same type, rather than the accumulation of changes making up one development. In the case of wind farms, cumulative studies concentrate on other wind farms. Nevertheless, given the singular appearance of wind farms and their generally isolated rural locations, the potential for overlap of cumulative impacts with other developments is more limited.

Assessment was done following Scottish Natural Heritage Guidance on the assessment of cumulative impacts (*Guidance: Cumulative Effects of Wind farms, version 2. SNH, 2005*). For the purposes of this study, cumulative impacts are taken to be those arising from more than one wind farm of the same type, rather than the accumulation of changes making up one development. In the case of wind farms, cumulative studies concentrate on other wind farms. Nevertheless, given the singular appearance of wind farms and their generally isolated rural locations, the potential for overlap of cumulative impacts with other developments is more limited

All known proposed wind farms both at a local scale and national scale were therefore considered in the assessment (Figure1 below). Other associated facilities such as transmission lines were also included (Figure 2). The local scale included effects that could arise if the impacts of Kipeto wind energy were combined with the impact of other wind farms and other types of development in the vicinity. At a national scale all the proposed wind farms were considered with an assumption that they were all operational. Since most of wind farms are located along a migration corridor e.g. the great rift valley ; it is anticipated and assumed that all the wind farms will potentially have impact on the same set of birds over a given space and time.

Key processes and activities that would potentially be affected cumulatively including nesting, foraging, roosting and breeding sites were mapped (Figure 3) to establish their proximity with the wind farm and the associated species behavior and movements around the project area. Migrating birds (mostly raptors) and local breeding birds form the main focus of the cumulative impact Assessment. This group of birds is expected to be impacted more cumulatively within the proposed sites. Bird movements including migratory birds and breeding bird locations were similarly mapped (Figure 3).

The level of information on species movements and distribution in Kipeto is not available for all of the other proposed wind facilities. Therefore, for this study, the cumulative effects on birds are estimated on the basis of impacts measured at the Kipeto Wind farm. In this study these effects are extrapolated in order to represent multiple wind farms at a national scale. We consider two scenarios, the first with multiple wind farms near Kipeto (all comparable in their effects with Kipeto Energy) and the second with multiple wind farms scattered across the country The current assessment focuses on migratory birds (mainly raptor) and breeding birds. The cumulative effects were assessed for a selection of the most relevant and vulnerable bird species.

Figure 1: Image showing cumulative impacts of proposed Wind farms in Kenya

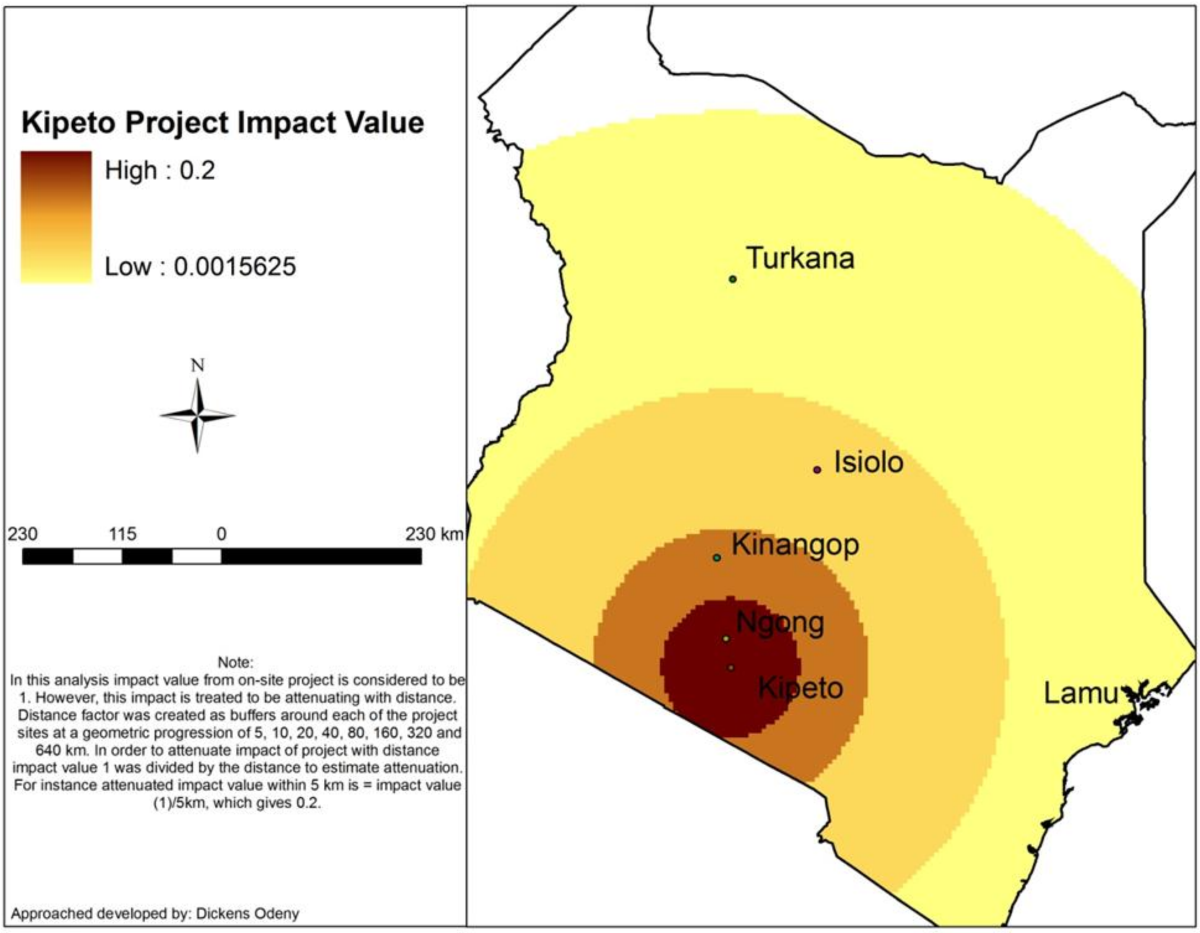


Figure 2: Image showing location of proposed turbines in relation to the substation and transmission line

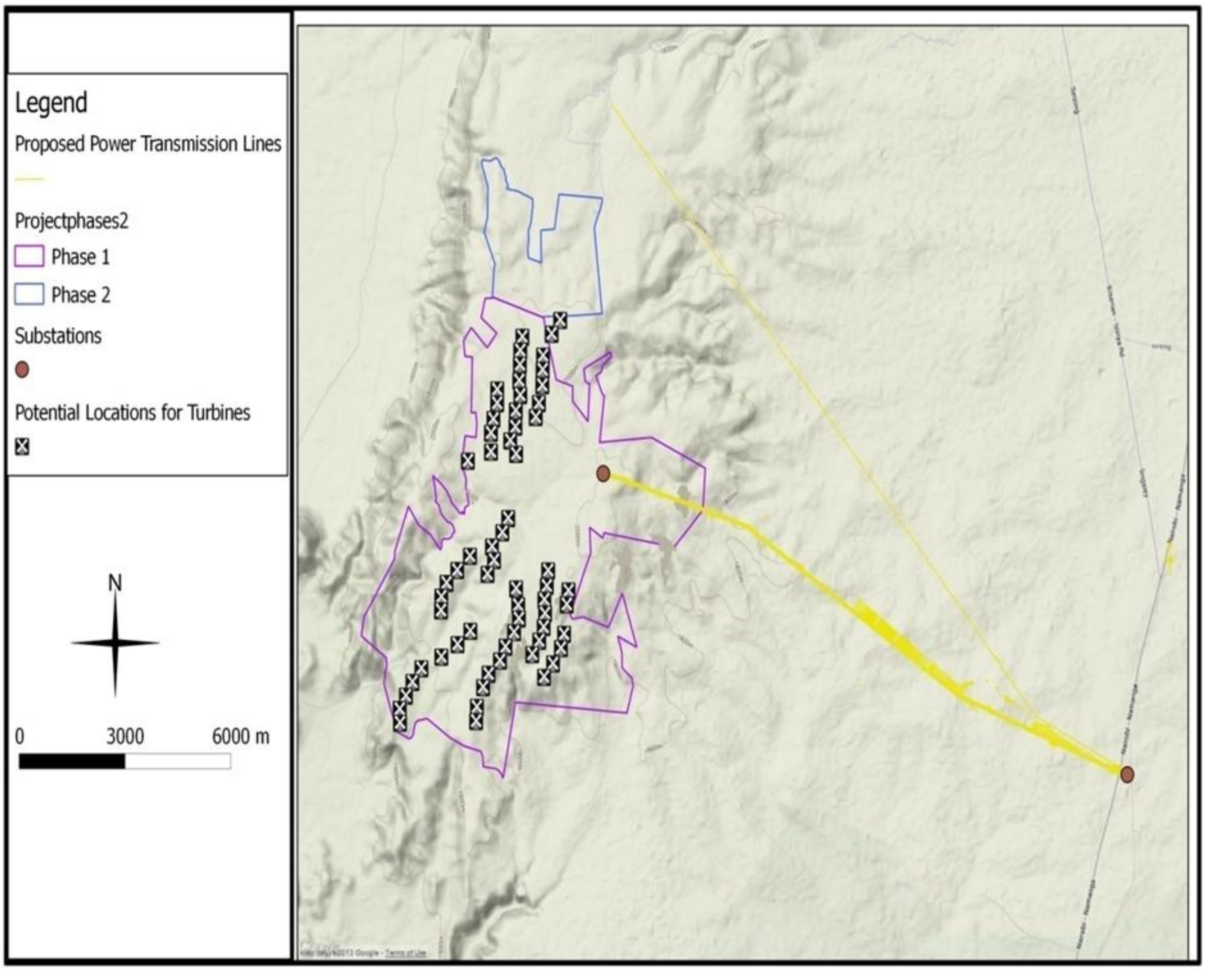
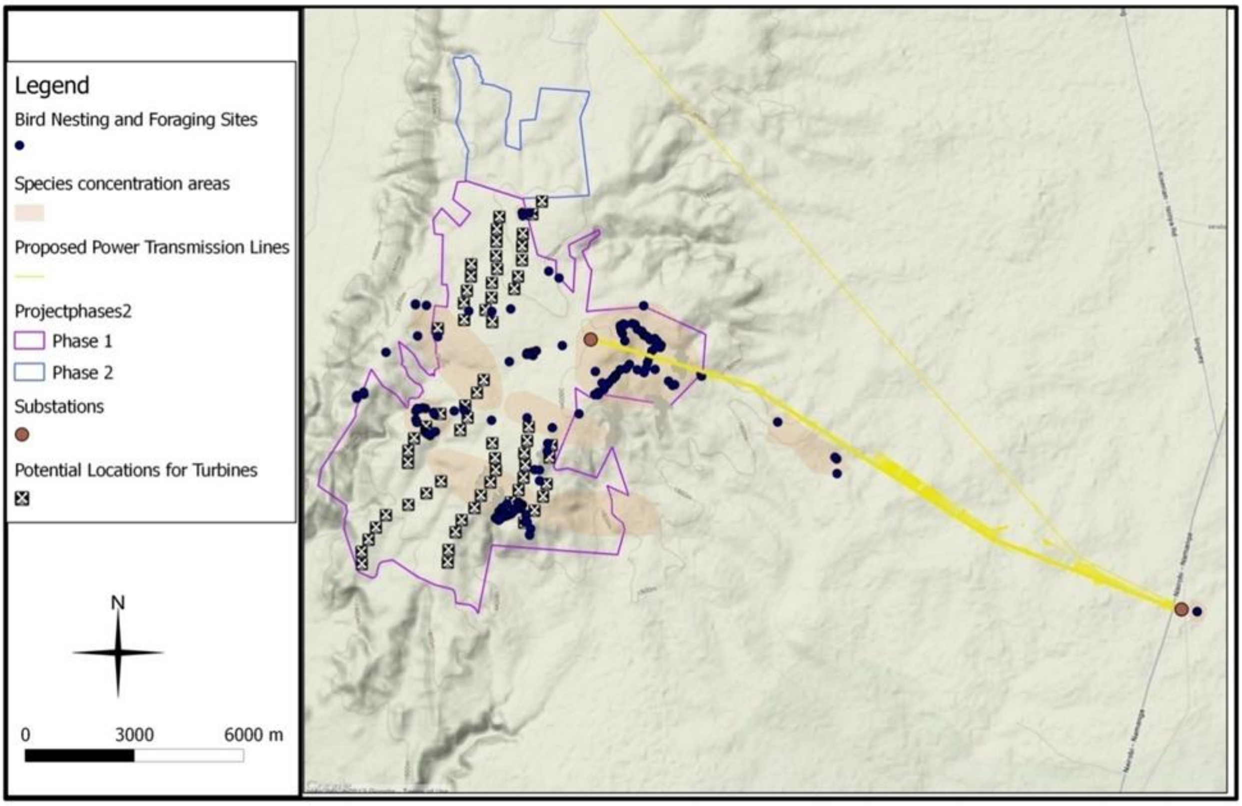


Figure 3: Image showing bird nesting and foraging sites in relation to proposed wind farm



6.2 Cumulative Assessment on Migrating and Breeding Birds

A total of fourteen raptor species have been so far recorded during the surveys in Kipeto (Table 5). The raptors use the area mainly for foraging and passage during migration. The species in the area are dictated by the nature of habitat and landscapes with passerines being the most abundant. The passerine species present in the area could be broadly categorized into woodland and grassland species. Breeding birds recorded were mainly resident species with nests localized within specific areas independent of other wind farms. The passerines mostly utilized the area for roosting mainly within the valleys. Colonial nesting or roosting species were not recorded

The assessment established that in combination, cumulative effects on migratory and breeding birds from the wind farms could include (i) direct bird mortalities due to collision. The wind farms could also act as (ii) barriers to birds on passage or birds moving to and from their feeding and roosting sites this could result into indirect effects of bird displacement and habitat loss as they would have to avoid the turbines look for alternative foraging areas.

Species of migrating and resident raptors (Table 5) have been identified as those that would mostly be affected by cumulative effects. This is because they move large distances and are therefore likely to be impacted at various scales. Local populations may be affected by different actions at a larger scale. For example, migrating species such as the Lesser Kestrel migrates in a broad front rather than on a specific route. Kipeto wind farm would only affect a restricted portion of the population, and multiple wind farms will affect a different set of birds in turn. Considering only the local population would underestimate the extent of the impact.

The raptor species recorded within the wind farm area were also observed within the area proposed for the transmission. However, the densities of these species were very low. Raptors are top predators, their roles in the ecosystem could be affected cumulatively due to the ecosystem functioning and the trophic relationships between species. Their absence may affect the abundance of their prey and ultimately the composition of the ecosystem (Mills *et al*., 1993). Wind farms can potentially affect a single individual or an entire population of species, depending on the ecology and behavior of the species. For example most raptors are largely sedentary, territorial birds hence wind farm development may only affect the pair whose territory encompasses the wind farm. Raptor species utilizing the area for a specific life stage e.g. breeding, a characteristic that could render them vulnerable to cumulative effects were not observed.

With respect to migratory birds, results of the extensive site investigation have concluded that the Project site supports migratory birds though in low numbers. They utilize the site mainly for foraging on passage during migration twice a year. Knowledge of migratory pattern is only localized in Kipeto. The movements in relation to other proposed wind farms are not well established. They however show a general pattern of movement from west side to eastern site of Kipeto (Figure 4). Based on our assumption that all migrating birds follow the same route along the rift valley then it is anticipated that cumulative impact will act on the population by causing a reduction due to potential mortalities along the migratory corridor and barriers to movement leading to other indirect impacts such as low productivity due to loss of suitable habitats and also the potential to expend more energy while trying to avoid the wind farms..

Migratory birds typically migrate in large flocks (Drewitt and Langston, 2008; Diehl *et al*.,2003; Ewert*et al*., 2006) a single wind project may affect a restricted portion of the population while multiple wind projects may each affect multiple portions of the population. The proposed Project, together with one or more other wind projects, may act cumulatively on migratory birds through (i) Direct Mortality - Birds migrating have a higher probability of mortality as a result of passing through multiple projects; and (ii) Avoidance - The addition of multiple projects will increases a disturbance effect or reduces available habitat, thereby displacing birds to lower quality habitat or reducing fitness levels.

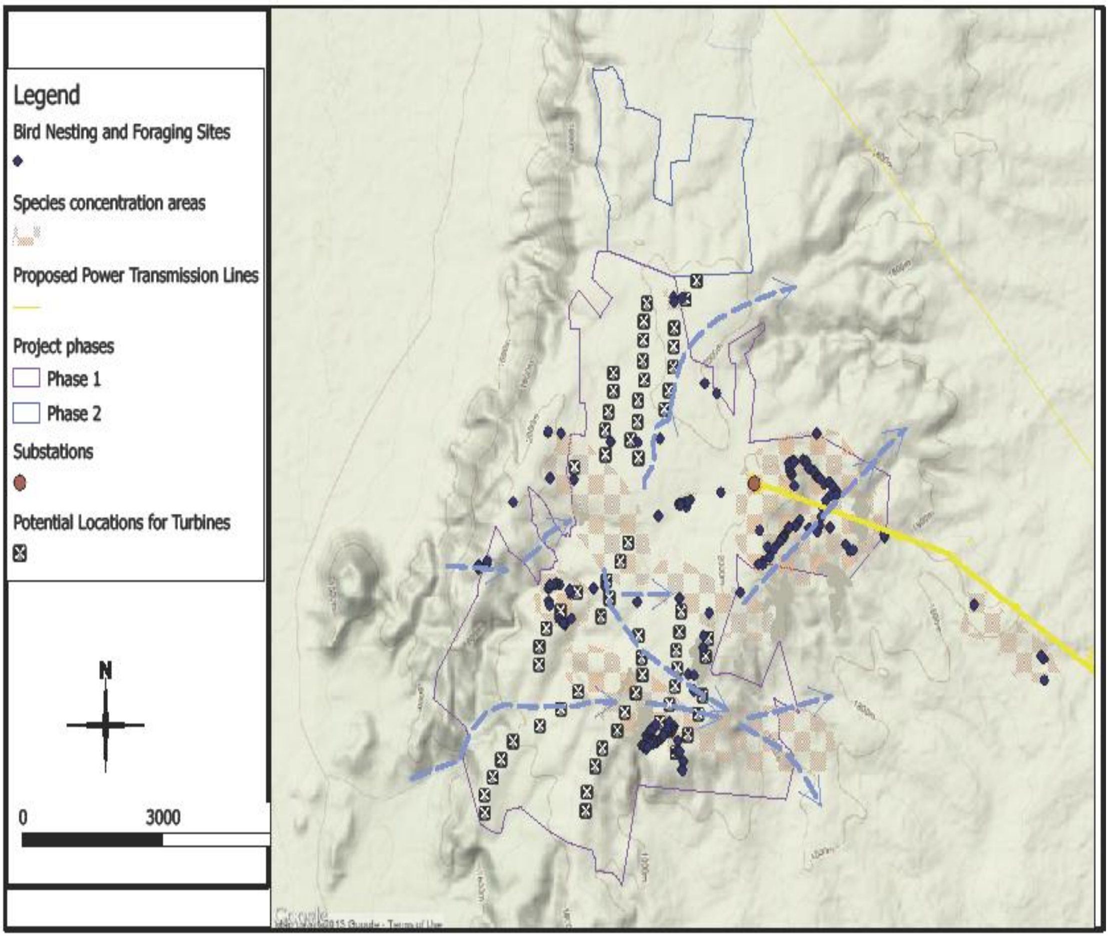
In relation to breeding birds, previous assessment determined that the most abundant breeding bird species located within the Project site were small resident passerine birds. The Project site supports a healthy population of grassland and woodland species and as such, is considered important habitat for the aforementioned species. At present, project site-specific information is limited to the Kipeto Wind Energy project. A similar level of information is not currently available for the other wind projects within the larger proposed wind energy areas. The most common breeding birds that occur on or around the Project site have home ranges that occupy up to approximately 1 ha. When foraging they generally remain within these territories, staying within approximately 500 meters of the nest (Figure 2 above). Given the confined location of their habitats, potential cumulative interactions can be expected to be limited to those between the wind farm area (Kipeto phase 1 and 2 see figure 1above) and not between the wind farm and the transmission line. There are no threatened birds using the area for breeding or roosting.

Table 5: Status of target species of Raptors recorded during the Survey

Species common name	***Scientific name***	***IUCN Status (no. of observations)***
African Harrier Hawk	*Polyboroidestypus*	*Least Concern*
African White-backed Vulture	*Gyps africanus*	*Near-threatened (1)*
Augur Buzzard	*Buteo augur*	*Least Concern*
Black-shouldered Kite	*Elanuscaeruleus*	*Least Concern*
Eurasian Hobby	*Falco subbuteo*	*Least Concern*
Eurasian Honey Buzzard	*Pernisapivorus*	*Least Concern*
Lanner Falcon	*Falco biarmicus*	*Least Concern*
Lesser Kestrel	*Falco naumanni*	*Least Concern*
Martial Eagle	*Polemaetusbellicosus*	*Near-threatened(1)*
Montagu's Harrier	*Circus pygargus*	*Least Concern*
Pallid Harrier	*Circus macrourus*	*Least Concern*
Ruppell's Griffon Vulture	*Gyps ruepellii*	*Near-threatened*
Steppe Eagle	*Aquila nepalensis*	*Least Concern*
Tawny Eagle	*Aquila rapax*	*Least Concern*

Conservation Status of target species recorded on site; *Populations of **African white-backed vulture, Rüppell's Vulture** have declined. These species are listed with an IUCN Red List status of 'near threatened' and the IUCN predicts that populations of the species will continue to decline. **Martial eagle** are listed as 'near threatened', and all the other target species recorded including the bustards are of 'least concern'.*

Figure 4: Image showing Bird Movements within Kipeto in relation to the Wind structures



6.3 Risk Assessment of cumulative effects

The following section provides an assessment of the likely cumulative impacts of wind farms and associated facilities on avifauna and has been assessed according to the Impact Assessment Methodology in Table 2 and 3 above.

6.3.1 Direct Bird Mortality through Collisions

Bird collision with turbines will have a direct impact on population size. Overall, an increase in the number of turbines within the propose site will potentially result in an increase in bird mortality. Each installed turbine has an impact by directly adding to mortality rates (Masden*et al*., 2010). From a conservation perspective, and inherent within the cumulative effects analysis, the critical issue is whether or not this source of mortality insufficiently great to impact populations.

The mortality levels that could be experienced from the cumulative presence of wind projects within the landscape represent a relatively minor component of overall mortality levels that could be incurred both from other human induced actions and from natural causes (i.e. weather, fitness levels). With the implementation of mitigation measures that were already proposed for the wind farm to limit mortality levels within the wind project, additional effects from the transmission line is not expected to have population level effects for individual species. From a local perspective, it is also important to note the relatively small distance between the wind farm, transmission line and the substation (Figure 2 above) would attract similar species. This will therefore not have any cumulative effects on species.

A higher probability of mortality will be expected as a result of birds passing through multiple projects. The majority of potential fatal mortalities are expected to arise from migrating birds. Only a small proportion of the total projected mortality from wind turbines in area is expected to be breeding birds, with majority being woodland species.

Resident breeding birds are expected to have lower collision rates than non-residents, at least partly because they become familiar with the turbines and avoid them (Kingsley and Whittam, 2007).Given the home range for these types of birds observed on the Project site is up to about 1 ha, limited overlap of home ranges with turbines of both phases of Kipeto wind project is expected. As such, the potential for cumulative effects between the two projects is considered to be very low.

Unmitigated cumulative Impact : Collision of birds with turbines and Transmission Lines	
Magnitude of Impact	6
Geographic Extent	1
Duration of Impact	4
Probability	1
Confidence of Assessment	High
Risk	-11(Low)
Comment/Mitigation	
• Reduce impacts with appropriate turbine layout based on micro-siting decisions. • Good macro-siting decisions are essential for choosing an acceptable site or portion of a site. • Once a site is selected, micro-siting efforts can avoid or reduce potential impacts to birds • Mitigations should be considered at a local scale to prevent cumulative impacts	
Mitigated Impact : Collision of birds with turbines and overhead earth	
Magnitude of Impact	2
Geographic Extent	1
Duration of Impact	1
Probability	1
Confidence of Assessment	High
Result	-4 (Low)

6.3.2 Barrier effect on Birds from Wind farms

Wind farms potentially act as a barrier. This may necessitate additional flights to avoid the turbines, hence the bird expend excess energy consequently affecting its breeding success and survival. In this way avoidance response ultimately contributes to reduced population size and consequently changes in population abundance

Birds avoid wind farms by moving away from the wind farm, or gain additional altitude and fly well above turbine height (SNH, 2009 and slow their flight speed when they approach wind turbines (EchoTrack Inc., 2005) thus reduced the risk of collision (EchoTrack Inc., 2005). avoiding windfarm causes displacement from feeding habitat, resulting in effective habitat loss. This avoidance response contributes to reduced population size as a result of lower breeding success due to the expenditure of energy during migration (Masden*et al*., 2010).The cumulative impact of the wind farm will be a When birds are displaced to already occupied or unsuitable habitat this displacement may cause loss of condition amongst these individuals, or even reductions in survival.

The extent to which avoidance is considered an impact depends on the species, size of wind project, spatial arrangement of the turbines, type of movements and the incurred energetic cost (Masden*et al*., 2009). The real effect of any such avoidance has not been measureable. More research is required to further understand the relationship of wind turbines, bird behavior and population dynamics. Some of this information would be gained through the implementation of the Environmental Monitoring Plan for the kipeto wind energy as well as other wind projects.

Unmitigated cumulative Impact : Barrier effect on Birds from Wind farms	
Magnitude of Impact	6
Geographic extent	4
Duration of Impact	4
Probability	3
Confidence of Assessment	High
Risk	-42(Medium)
Comment/Mitigation	
• Layout modification such as creating flight corridors or placing turbines closer together to reduce the project footprint (Drewitt and Langston 2006). • Impacts can be site specific, and may not occur at each site (Goodale and Divoll 2009). Therefore, turbine layout and facility location should be evaluated on a site- specific basis in conjunction with information regarding local and migratory bird species in, around or passing through the proposed site to ensure that any possible barrier effects are minimized or avoided	
Mitigated Impact : Barrier effect on Birds from Wind farms	
Magnitude of Impact	2
Geographic Extent	4
Duration of Impact	4
Probability	2

Confidence of Assessment	High
Result	-20 (Low)

6.4 Cumulative Impacts of Wind Farm Projects at National Level

Cumulative impact is the combined impacts of more than one development proposal or change in the environment within a defined area over a defined period of time. Cumulative impact is a critical consideration in the case of bird impacts of wind farms due to the increasing interest in renewable energy from wind farms and the long term implications of national policy that encourages the development of renewable energy generation.

A single wind farm will have certain effects on birds by means of collision, disturbance and/or barrier effects. Single wind farms might have a minor impact on the reproduction and survival Drewitt& Langston 2006). Numerical impacts are mainly on a local scale by changes in distribution. The greater the effect, in terms of a decrease in reproduction and/or survival, the greater the impact will be on bird population. The construction of multiple wind farms has the potential to reach a threshold above which survival and reproduction could be significantly affected, potentially leading to a decrease in population levels at the wider scale.

The Rift Valley flyway is the second most important flyway for migratory raptors, storks, pelicans and some ibis in the world, with over 1.5 million birds of 37 species (see Table 2, for those recorded in Kipeto), including 5 globally threatened species, using this corridor between their breeding grounds in Europe and West Asia and wintering areas in Africa each year. However, there are great overlaps between the geographical areas identified and earmarked for producing the highest return for wind energy and the known migration routes for soaring birds as both exploit the same resource.

Most of the proposed wind farms in Kenya occur along the rift-valley. Some of the areas identified as potential wind farm site include those areas denoted by Bird Life International as Important Bird Areas (IBAs). These areas and their individual IBA criteria (as determined by Bird Life International), include: areas around Lake Turkana with large congregatory species, migratory land bird concentrations and colonial water bird concentrations and raptors. Kinangop grasslands with its threatened species, the Sharpes long claw is also an IBA site. The upcoming Lamu wind Energy also lies within a habitat important for birds. However, given the relatively large distances between the potential sites (including the distances between turbines and the transmission line) the projects are not likely to interact in a cumulative manner. Most of the habitats and species within the different sites are also different.

Cumulative impacts and benefits on various environmental and social receptors will occur to varying degrees with the development of several renewable energy facilities in Kenya. The degree of significance of these cumulative impacts is difficult to predict without detailed studies based on more comprehensive data on each of the receptor

Mortality rates can be regional and site specific meaning that mortality rates from other regions are not necessarily predictive of rates that will occur. As such, estimating mortality rates for the current Project and other certain and reasonably foreseeable activities is difficult given there are no currently operating wind facilities within the general geographic area. The Ngong hills Wind Farm is the only operating project located within the greater rift valley. The proposed Kipeto Wind Project does not contain habitat types that are found within the other proposed facilities hence this translates to the different species meaning there will be no cumulative effect on species at different sites.

There is a need for strategic planning and cooperation to better understand the cumulative impacts that may result from promoting renewable energy. In order to better understand cumulative impacts, it is helpful to understand location of the various proposed and approved wind farm developments and interaction with associated species at any one time. There is also lack of sufficient data on how different migratory species move within the rift-valley and country as a whole.

6.5 Cumulative Impact Value

The cumulative impact value (Figure 5) has been developed on assumption that (i) impacts on birds are greater closer to the wind turbines and this reduces with increasing distance (ii) the species will not behave or interact in the same manner at a local scale compared to a larger scale.

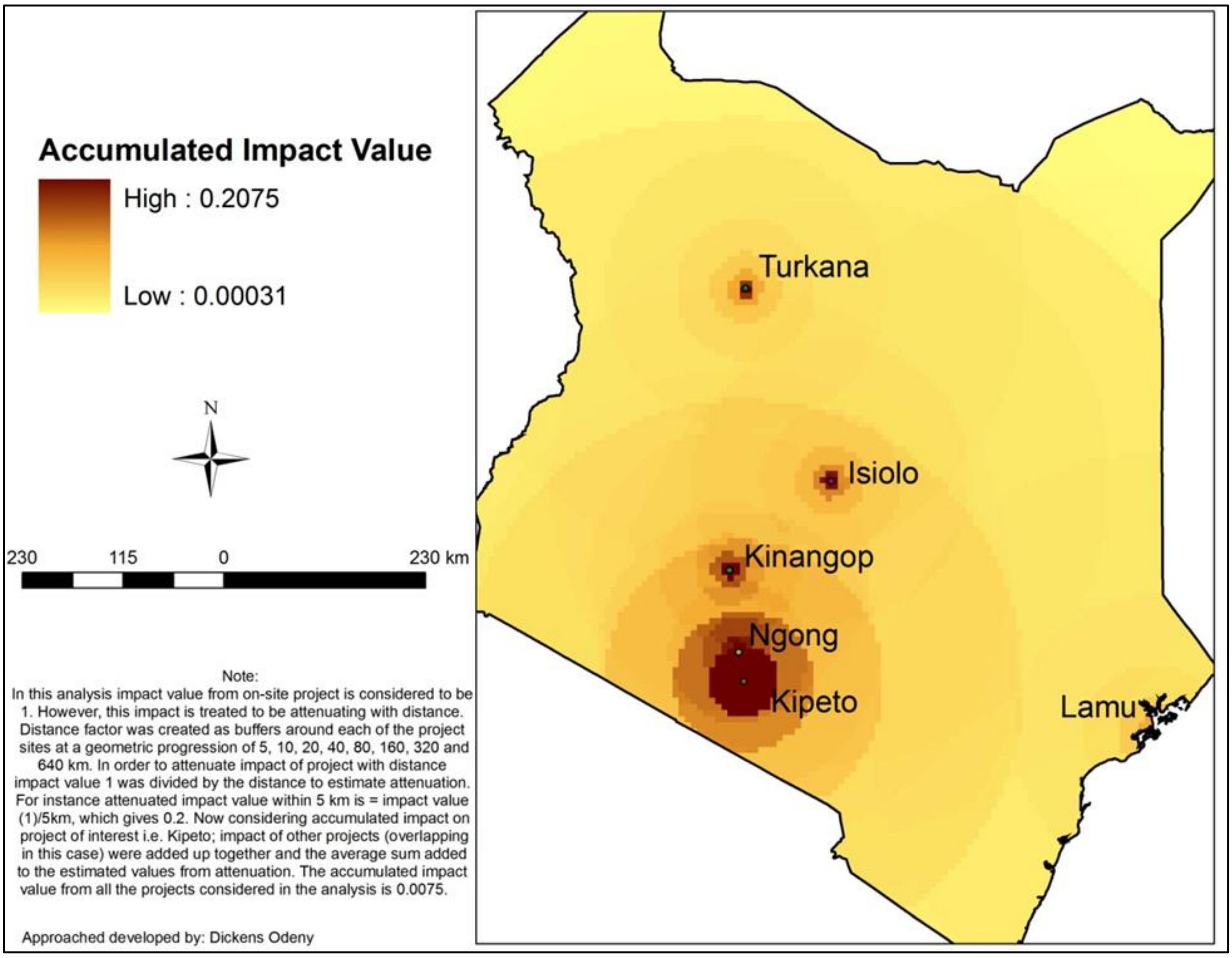
Wind turbine impacts are expected to vary with distance from the current wind farm focus. The impacts on birds will increase close to the turbines; consequently other additional wind farms are expected to act in isolation with respect to breeding birds. However for migratory species, cumulative impact may occur among raptors that migrate long distance, through additional mortality of barrier effect. This would consequently reduce their population.

The distances chosen on the map delineate where additional impacts could generally begin (assuming a level terrain). The actual distances these impacts can occur vary by many miles depending on terrain and weather conditions. The Kipeto wind projects potential contribution to overall disturbance effects, if any, would be correspondingly small given the large distances between other wind projects and the relative number of turbines. With the availability of other suitable habitat in the larger area, it is not expected that the behavior of migratory birds will be adversely affected in a cumulative manner.

However considering other local environmental factors within the area of bird dispersal including land use it is anticipated that the cumulative impacts would attenuate with increasing distance from Kipeto to Turkana (Figure 5). It is expected that habitat features and species change across the gradient, therefore, Kipeto project in conjunction with others in combination will not act cumulatively on these types of birds due to different interacting processes acting within the ecosystems.

Furthermore, with implementation of the mitigation measures described in the 2011/2012 ESIA study, the Project is not expected to have a measureable effect on populations of migratory birds and breeding birds. In addition, given this very small amount of habitat modification relative to the larger area occupied by the wind farms, sufficient habitat suitable for migrating birds will remain available within the area., the amount of habitat loss is not anticipated to significantly increase cumulative effects from that which is already occurring from other actions occurring within the area on focus.

Figure 5: Image showing potential Impact Values of proposed wind farms in relation to Kipeto Wind Farm



7 Some limitations and gaps on cumulative Impact Study

- **Lack of critical data:** For the local breeding birds, it is only possible to make predictions of population at a local scale. On a scale such as at a regional level the calculation of cumulative effects using population is not possible as often relevant data for every individual breeding species are largely unknown. The identification of the effects of past actions is critical to understanding the environmental condition of the area. However there is no standard baseline information to determine the trend of species, but rather the available information describes the current state of the species.
- **Scope of cumulative assessment:** When considering larger spatial scales for cumulative effect analysis it may however be problematic because species often move across international boundaries; it therefore requires cooperation to assess all of the actions that affect these populations. Lack of an international overview on how wind farms are being developed. It is clear that in a wider international context it is desirable to initiate further investigation on the cumulative effects of multiple wind farms within the total distribution range of species, or in case of other migrant species in the entire flyway of a species, as many bird species migrate long distances.
- **Seasonality of species**: Species may not be present in the immediate vicinity of the action year-round yet it may be linked to the action during discrete life stages. An example of this is lesser kestrel’s population migrates through the area of the wind farm twice a year, and therefore actions that affect the population along the flyway may not be fully captured.
- **Uncertainty in cause of fatalities:** If a bird collides with a wind turbine it can either be killed instantaneously or injured. If killed, it will drop to the ground in the vicinity of the turbine, however, if injured the bird may die some distance from the turbine. Hence the cause of death becomes less certain and difficult to verify as the distance from the turbine increases.
- **Change in bird behavior in response to local actions:** Temporal variation is anticipated to occur over the lifetime of the action because the behavior of the species changes in response to the action; birds may initially exhibit avoidance behavior towards wind turbines but over time the response may change.

8 Discussions

The addition of multiple projects increases a disturbance effect, thereby displacing birds to lower quality habitat or reducing fitness levels. Studies of bird densities in grassland habitats have documented localized avoidance behavior in some species (Leddy*et al*., 1999; Johnson *et al*., 2000; Erickson *et al*., 2004). Other studies have shown no avoidance of wind turbines (Shaffer and Johnson, 2008; James 2008) while others show species nesting in higher abundances near turbines (de Lucas *et al*., 2004). Post-construction monitoring of woodland, wetland and grassland breeding birds in Kipeto would provide information on the behavior of these birds in the presence of the wind turbines.

Little is known over barrier effects, although the increased energetic costs of flying around a wind farm or the possibility that birds decide not to utilize the area beyond a wind farm may reduce their reproductive output or in extreme cases reduce survival, however, compared to the direct mortality associated with collisions with turbines the consequences of barrier effects are considered to be negligible. Cumulative impacts are likely to become significant when a number of wind farm developments are located in key habitat types or affect specific bird species considered as of high conservation importance or species considered being vulnerable to wind farms by virtue of their behavior or ecology.

The proposed transmission line area is comprised of the geographical extent within which the terrain and reasonably foreseeable activities could have an effect on birds. The migratory birds would be exposed to cumulative effects in the event that they move within the proposed site and experience an effect from more than one activity i.e. the proposed transmission line and the wind farm. This contrasts with breeding birds, which have relatively compact (1 ha or less) home ranges in proximity to their nests. These biological behaviors have a direct bearing on the potential interaction of these species between the Kipeto Wind Energy and other associated developments in the vicinity. There is a higher likelihood of migratory birds coming into contact with multiple projects than there is with breeding birds as they require extensive home ranges.

Currently the, only wind farm operating in Kenya Is the Ngong Hills Wind farms the wind farm has a maximum of four turbines operating at any one given time. It will therefore be difficult to provide any meaningful data on the actual interactions of birds with other wind farms. There is a potential for cumulative impacts to be significant if all the proposed wind farms become operational hence more research is required to understand the uncertainties. At this stage mitigation of cumulative impacts can be limited to recommending long term monitoring before construction and during the operational phase of wind farms. Mitigating potential effects at the source is the best way to reduce the potential for cumulative environmental change.

9 Conclusions and Recommendations

Significant cumulative impacts that could occur due to the development of wind energy facilities in proximity to each other include an increase in the significance of avifaunal impacts; Clarity on the environmental impact on birds in terms of this and other wind farms proposed for the same area can only be reached once the recommended pre-construction monitoring has been completed across all considered projects and a commitment established for monitoring into the operational phase.

From the current assessment, it is considered that the current proposed developments in Kipeto would not result in a significant or unacceptable level of cumulative impacts when combined with other proposed wind farms. However, any potential significant cumulative impact would be confined at a local scale. The development of proposed wind farms is expected to be in accordance with existing guidelines and legislation. Hence it would be possible to significantly reduce the extent of cumulative impacts on birds.

Protocols for monitoring sensitive species during the sensitive periods i.e. breeding and migration need to be developed for further assessment of impacts during the operation phase. A centralized reporting system is required to report avian mortalities in a standardized fashion. Doing so would provide a wealth of information about avian deaths, and would provide a means for tracking down the worst offenders. Follow-up monitoring: programs are also essential in verifying the accuracy of effect predictions, to reduce uncertainty, and to determine the effectiveness of mitigation. The objective of monitoring would be to track issues as they arise, and to suggest subsequent adaptive management.

This study represents the first attempt to estimate the cumulative effects of multiple wind farms in Kenya. Emphasis should be placed on the fact that for this study, assessment has been done qualitatively using a risk matrix method following precautionary assumptions based on expert knowledge, and observations and available literature. There is little information regarding critical issues e.g. on numbers, trends, life history traits and movements that can be incorporated in the Cumulative effects assessment.

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11 Appendices

Appendix 1:

Table 6: Checklist of species observed and Expected along the proposed transmission line (Am-afro-tropical migrant, PM-Palearctic Migrant, X –Rarities, pm-Partial Migrant)

Species	***Scientific name***	***Status***
Abyssinian Black Wheatear	*Oenanthelugubris*	
Abyssinian Scimitarbill	*Rhinopomastus minor*	
Abyssinian White-eye	*Zosteropsabyssinicus*	
African Citril	*Serinuscitrinelloides*	
African Grey Flycatcher	*Bradornismicrorhynchus*	
African Grey Woodpecker	***Dendropicosgoertae***	
African Harrier-Hawk	*Polyboroidestypus*	
African Hawk Eagle	*Hieraaetusspilogaster*	
African Mourning Dove	*Streptopeliadecipiens*	
African Palm Swift	*Cypsiurusparvus*	
African Paradise Flycatcher	*Terpsiphoneviridis*	**am**
African Pied Wagtail	*Motacillaaguimp*	
African White-backed Vulture	*Gyps africanus*	
Amur Falcon	*Falco amurensis*	
Augur Buzzard	*Buteo augur*	
Banded Parisoma	*Parisomaboehmi*	
Barn Swallow	*Hirundorustica*	**PM**
Bearded Woodpecker	*Thripiasnamaquus*	
Black Crake	*Amaurornisflavirostra*	
Black-headed Heron	*Adreamelanocephala*	
Black-shouldered Kite	*Elanusaxillaris*	
Black-winged plover	*Vanellusmelanopterus*	
Booted Eagle	*Hieraaetuspennatus*	**X, PM**
Brimestone Canary	*Serinussulphuratus*	
Bronze Mannikin	*Lonchuracucullata*	
Bronze Sunbird	*Nectariniakilimensis*	
Brown Snake Eagle	*Circaetuscinereus*	

Species	Scientific name	Status
Brown-crowned Tchagra	*Tchagraaustralis*	
Brubru	*Nilausafer*	
Buff-bellied Warbler	*Phyllolaispulchella*	
Bush Pipit	***Anthuscaffer***	
Cape Robin-Chat	*Cossyphacaffra*	
Capped Wheater	*Oenanthepileata*	
Cardinal Woodpecker	*Denropicosfuscescens*	
Cattle Egret	*Bubulcus ibis*	**am**
Chestnut Sparrow	*Passer eminibey*	
Chestnut Weaver	*Ploceusrubiginosus*	**am**
Chin-Spot Batis	*Batismolitor*	
Cinammon-chested Bee-eater	*Meropsoreobates*	
Cinnamon-breasted Bunting	*Emberizatahapisi*	
Collared Sunbird	*Anthreptescollaris*	
Common Bulbul	*Pycnonotusbarbatus*	
Common Drongo	*Dicrurusadsimilis*	
Common fiscal	*Laniuscollaris*	
Common Kestrel	*Falco tinnunculus*	
Common Rock thrush	*Monticolasaxatilis*	
Common Sandpiper	*Actitishypoleucos*	**PM**
Common Stonechat	*Saxicolatorquata*	
Common Swift	*Apusapus*	
Common Waxbill	*Estrildaastrild*	
Crested Francolin	*Francolinussephaena*	
Crowned plover	*Vanelluscoronatus*	
Diederick cuckoo	*Chrysococcyxcaprius*	
Dusky Nightjar	*Caprimulqusfraenatus*	
Dusky Turtle Dove	*Streptopelialugens*	
Eastern Chanting Goshawk	*Melieraxpoliopterus*	
Egyptian Goose	*Alopochenaegyptiacus*	
Emerald-spotted Wood Dove	*Turturchalcospilos*	
Eurasian Cuckoo	*Cuculuscanorus*	
Eurasian Marsh harrier	*Circus aeruginosus*	**PM**

Species	Scientific name	Status
Eurasian Swift	*Apusapus*	**PM**
Fawn-coloured Lark	*Mirafraafricanoides*	
Fischer's Sparrow-Lark	*Eremopteryxleucopareia*	
Gabar goshawk	*Micronisusgabar*	
Grassland Pipit	*Anthuscinnamomeus*	
Great White Pelican	*Pelecanusonocrotalus*	
Greater Blue-eared Starling	*Lamprotornischalybaeus*	
Greater Honeyguide	*Indicator indicator*	
Grey Cuckooshrike	*Coracinacaesia*	
Grey Heron	*Ardeacinerea*	**am,pm**
Grey-backed Camaroptera	*Camaropterabrachyura*	
Grey-capped Social Weaver	*Pseudonigritaarnaudi*	
Grey-crowned Crane	*Balearicaregulorum*	
Hadada Ibis	*Bostrychiahagedash*	
Hamerkop	*Scopus umbretta*	
Helmeted Guineafowl	*Numidameleagris*	
Hildebrandt's Starling	*Lamprotornishildebrandti*	
Hoopoe	*Upupaepops*	**am,pm**
Hunter's Sunbird	*Nectariniahunteri*	
Isabelline Wheatear	*Oenantheisabellina*	**PM**
Jacobin Cuckoo	*Chrysococcyxklaas*	
Kenya Rufous Sparrow	*Passer rufocinctusrufocinctus*	
Klass's Cuckoo	*Chrysococcyxklaas*	
Knob-billed Duck	*Sarkidiornismelanotos*	**am**
Kori Bustard	*Otis kori*	
Lanner Falcon	*Falco biarmicus*	
Laughing Dove	*Streptopeliasenegalensis*	
Lesser Honeyguide	*Indicator minor*	
Lesser Kestrel	*Ploceusintermedius*	
Lesser Striped Swallow	*Hirundoabyssinica*	
Lilac-breasted Roller	*Coraciascaudata*	**am**
Little Bee-eater	*Meropspusillus*	
Little Rock Thrush	*Monticolarufocinerea*	**X**

Species	Scientific name	Status
Little Sparrowhawk	*Accipiter minullus*	**X**
Little Stint	*Calidrisminuta*	**PM**
Little Swift	*Apusaffinis*	
Long-billed Pipit	*Anthuslongicaudatus*	
Long-tailed Fiscal	*Laniuscabanisi*	
Malachite Sunbird	*Nectariniafamosa*	
Marabou Stork	*Leptoptiloscrumeniferus*	**X**
Martial Eagle	*Polemaetusbellicosus*	
Montagu's Harrier	*Circus pygargus*	
Northern Wheatear	*Oenantheoenanthe*	**PM**
Northern White-crowned Shrike	*Eurocephalusrueppelli*	
Nubian Woodpecker	*Campetheranubica*	
Nyanza Swift	*Apusniansae*	
Pallid Harrier	*Circus macrourus*	
Pearl-spotted Owlet	*Glaucidiumperlatum*	
Pectoral-patch Cisticola	*Cisticolabrunnescens*	
Pied Crow	*Corvusalbus*	
Pied Wheatear	*Oenanthepleschanka*	
Pink-backed Pelican	*Pelecanusrufescens*	
Pin-tailed Whydah	*Viduamacroura*	
Plain Martin	*Ripariapaludicola*	
Plain-backed Pipit	*Anthusleucophrys*	
Purple Grenadier	*Uraeginthusianthinogaster*	
Qualfinch	*Ortygospiza atricollis*	
Rattling Cisiticola	*Cisticolachiniana*	
Red-billed Firefinch	*Lagonostictasenegala*	
Red-billed Hornbill	*Tockuserythrorhynchus*	
Red-billed Oxpecker	*Buphaguserythrorhynchus*	
Red-billed Quelea	*Queleaquelea*	**am**
Red-caped Lark	*Calandrellacinerea*	
Red-cheeked Cordon-bleu	*Uraeginthusbengalus*	
Red-chested Cuckoo	*Cuculussolitarius*	
Red-chested Sunbird	*Nectariniaerythrocerca*	

Species	Scientific name	Status
Red-collared Widowbird	*Euplectesardens*	
Red-eyed Dove	*Streptopeliasemitorquata*	
Red-faced Crombec	*Sylviettawhytii*	
Red-fronted Barbet	*Tricholaemadiadematus*	
Red-fronted Tinkerbird	*Pogoniuluspusillus*	
Red-rumped Swallow	*Hirundodaurica*	
Red-throated Tit	*Parusfringillinus*	
Red-winged Lark	*Mirafrahypermetra*	
Red-winged Starling	*Onychognathusmorio*	
Ring-necked Dove	*Streptopeliacapicola*	
Rock Martin	*Hirundofuligula*	
Rosy-patched Bushshrike	*Rhodophoneuscruentus*	
Rufous Sparrow	***Passer motitensis***	
Rufous-naped Lark	*Mirafraafricana*	
Ruppell's Griffon Vulture	*Gyps rueppellii*	
Scarlet-chested Sunbird	*Nectariniasenegalensis*	
Schalow's Wheatear	*Oenantheschalowi*	
Secretary Bird	*Sagittarius serpentarius*	
Sharpe's Starling	*Cinnyricinclussharpii*	**X**
Singing Bush Lark	*Mirafracantillans*	
Singing Cisticola	*Cisticolacantans*	
Slate-collouredBoubou	*Laniariusfunebris*	
Somali Short-toed Lark	*Calandrellasomalica*	
Southern Grosbeak Canary	*Serinusbuchanani*	
Speckled Mousebird	*Coliusstriatus*	
Speckled Pigeon	*Columba guinea*	
Speke's Weaver	*Ploceusspekei*	
Spot-flanked Barbet	***Tricholaemalacrymosa***	
Spotted Flycatcher	*Muscicapastriata*	**PM**
Spotted Morning Thrush	*Cichladusaguttata*	
Steppe Eagle	*Aquila nipalensis*	
Streaky Seedeater	*Serinusstriolatus*	
Striped Kingfisher	*Halcyon chelicuti*	

Species	Scientific name	Status
Superb Starling	*Lamprotornissuperbus*	
Tawny Eagle	*Aquila rapax*	
Tawny-flanked prinia	*Priniasubflava*	
Temminck's Courser	*Cursoriustemminckii*	
Three-banded Plover	*Charadriustricollaris*	
Three-Streaked Tchagra	*Tchagrajamesi*	
Tree Pipit	*Anthustrivialis*	
Tropical Boubou	*Laniariusaethiopicus*	
Upcher's Warbler	*Hippolaislanguida*	
Variable Sunbird	*Nectariniavenusta*	
Verreaux's Eagle	*Aquila verreauxii*	**X**
Vitelline Masked Weaver	*Ploceusvelatus*	
Von der deckens Hornbill	*Tockusdeckeni*	
Wahlberg's Eagle	*Aquila wahlbergi*	**am**
White-bellied Canary	*Serinusdorsostriatus*	
White-bellied Go-away Bird	*Corythaixoidesleucogaster*	
White-browed Coucal	*Centropussuperciliosus*	
White-browed Scrub Robin	*Cercotrichasleucophrys*	
White-browed Sparrow Weaver	*Plocepassermahali*	
White-eyed Slaty Flycatcher	*Melaenornisfischeri*	
White-headed Barbet	*Lybiusleucocephalus*	
White-rumped Swift	*Apuscaffer*	
Willow Warbler	*Phylloscopustrochilus*	**PM**
Winding Cisticola	*Cisticolagalactotes*	
Woodland Kingfisher	*Halcyon senegalensis*	
Yellow Bishop	*Euplectescapensis*	
Yellow-bellied Eremomela	*Eremomelaicteropygialis*	
Black-bellied Sandgrouse	*Pteroclesorientalis*	
Yellow-billed Stork	*Mycteria ibis*	
Yellow-breasted Apalis	*Apalisflavida*	
Yellow-mantled Widowbird	*Euplectesmacroura*	
Yellow-necked Spurfowl	*Francolinusleucoscepus*	
Yellow-rumped Seedeater	*Serinusreichenowi*	

Species	Scientific name	Status
Yellow-spotted Petronia	*Petroniapyrgita*	
Shaded species are those observed during the Transmission line survey, all others are expected		