APPENDIX C: Ecological Impact Assessment for the proposed Kipeto Transmission Line Project, Kenya

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1 EXECUTIVE SUMMARY

This report begins by developing the scope of the ecological impact assessment; under which, important biodiversity issues are covered. These include various terrestrial habitat types, aquatic systems, movements of wild herbivores across the landscape, scrutiny of species of conservation importance, and potential impact of electric and magnetic fields on biodiversity. Baseline review covers existing environmental information on the study area existing in secondary data sources or generated from intermediate data sources.

A review of the ecological impact assessment, of the proposed Electric Power Transmission Line project activities was carried out in accordance to the IFC EHS guideline for electric and Power Transmission and Distribution. A field study was conducted to determine areas that would be affected adversely by the project activities. The potential impacts on ecological system in Kipeto-Isinya area were reviewed in accordance to IFC documents: Performance Standard and EHS guidelines. While, the Kurrent Technology Ltd EIA study risk matrix was used to analyze impacts. Cumulative impacts from existing similar projects and other activities were assessed on both habitats and movements of animals.

The Kipeto-Isinya landscape is diverse and characterized by different habitats complementing support for the wild herbivores and local communities. The diversity of plant species is high in the south eastern area of the proposed transmission line. There are mixed habitats and species. The upper areas have more grassland, which are easily affected by by harsh climatic conditions such as drought.

The main impacts that were identified and resolved for purpose of assessment were the potential alteration of terrestrial plant through the destruction of plants and the introduction of alien invasive plant species; temporary obstruction of movement of wild-herbivores; potential poaching for bushmeat; potential exposure to wild herbivores and; potential alteration of aquatic habitats. The Kurrent 2012 risk assessment matrix was used to determine potential risks that the project would pose in the environment. The risk matrix has a score of up to 100. According to the risk assessment matrix, when an impact score is more than 30 (-ve) then recommendation is made. After the assessment was undertaken, impacts that were given special attention due to exceeding the threshold were alteration of terrestrial plants (-36), introduction of alien invasive plant species (-48), alteration of aquatic habitat (-32), temporary obstruction of wild herbivores (-32).

The impacts recommended for mitigation include the avoidance of the destruction of habitats and a change in the behavior of personnel. A detailed environmental management plan is proposed at the end to guide on issues to be addressed and assignment of responsibility on monitoring development.

2 INTRODUCTION

2.1 Scoping

The electric and power transmission project is a business activities described in the Performance Standard 1 paragraph 4 as having potential to generate risks and impacts in the entire life cycle of the project. Hence, the project was subjected to environment impact assessment.

The electric and power transmission (EPT) and distribution comprises the power generation facility, transmission line and substation located within electricity grid. It involves bulk transfer of electricity energy from generating power plants to electrical substations. Most transmission lines use high-voltage three-phase alternating current (AC). Development of EPT is associated with adverse effects on environment manifested in the construction of Right-of-Way, maintenance of ROW, and the electric and magnetic fields. Due to this, guidelines have been developed in order to control activities which can have negative impacts on the environment and human beings. The IFC Environment, Health and Safety guideline on the Electric and Power Transmission highlights potential impacts on terrestrial and aquatic systems?.

Ecological Impact Assessment was undertaken along the proposed Power Transmission line route with a spatial extent to the North 1.71^0 S and 1.77^0 S to the South; 36.83^0 E to the East and 36.69^0 to the West. The proposed power line runs from Kipeto area through to Isinya in Kajiado County where power substation exist. The length of the proposed power line is approximately 16.5 km and runs South East from Kipeto to Isinya. It has a right of way (ROW) of 60 m width i.e. power line being the centerline. This covers an approximated area of 1 km^2. Baseline review was confined within 1 km buffer either side; this was meant for characterizing the area.

Associated activities with the development of the Power Transmission Line that assessment of impact on biodiversity will be based on include: construction of Right-of-Way; maintenance of ROW. Environmental issues were assessed in accordance to IFC notes on environmental, health, and safety guidelines on electric power transmission and distribution. Issues include the terrestrial habitat alteration, aquatic habitat alteration; Electric and magnetic fields and Hazardous materials.

Scoping was enhanced by field reconnaissance. Relevant and specific biodiversity issues that were identified included the:

- Isolations of terrestrial habitats such as woodland/bushlands, riverine habitats and rock outcrop habitats
- Movements of wild herbivores in the area
- Potential existence of species of conservation importance/interest internationally and locally
- Potential Electric and Magnetic Fields on biodiversity

Field biodiversity study was strategized to establishing baseline information or the current status of biodiversity in the areas proposed power passes. Taxa that were focused on included the flora (all life forms) and fauna (especially mammals and reptiles).Potential impacts of the proposed project activities were described in relation above biodiversity issues identified above.

3 BASELINE INFORMATION

3.1 Project Location

The proposed Power Transmission Line is situated in Kajiado County, which is located in the south of the Rift Valley and it borders to south-west the Republic of Tanzania, Taita-Taveta County to the south-east, Machakos and Makueni County to the east, Nairobi to the North-East, Kiambu District to the North and Narok County to the West (Fig. 1). The county lies between longitudes 36^0 5' and 37^0 5' East and between latitude 1^0 0' and 3^0 0' South. The proposed project location lies between Kipeto area and Isinya Power Sub-Station. Defined extent of the proposed Kipeto Power Transmission Line is to the North 1.71^0 S and 1.77^0 S to the South; 36.83^0 E to the East and 36.69^0 to the West.

Figure 1: Project location showing counties neighboring Kajiado County

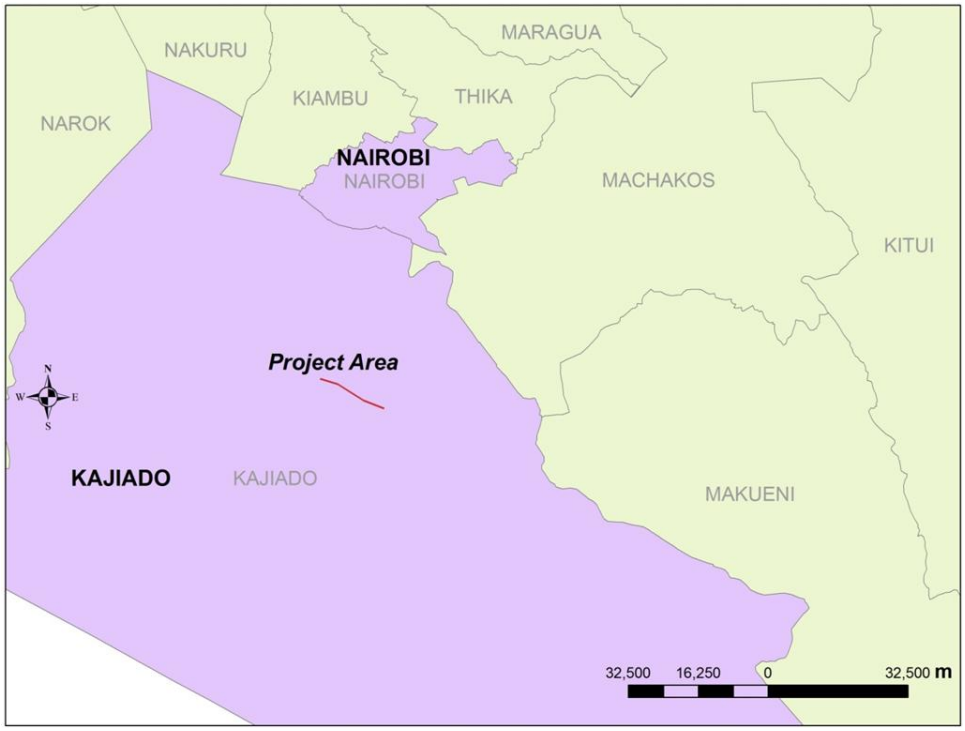
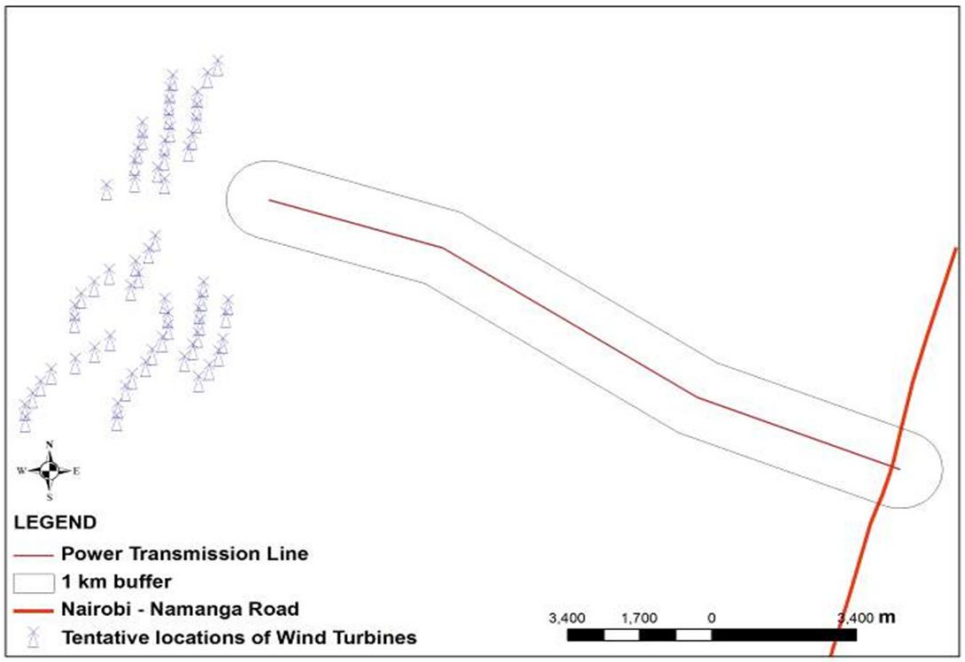


Figure 2: Project area with 1 km buffer showing transmission line and turbine locations



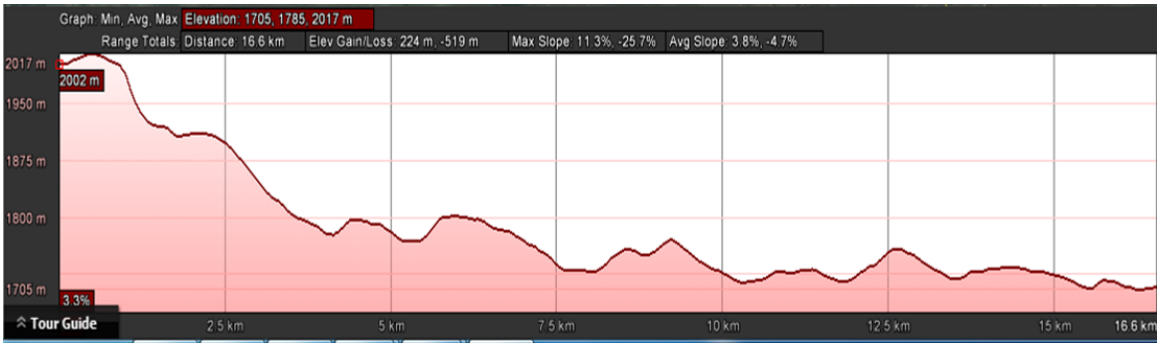
3.2 Topography and drainage

Topography of Kajiado County is characterized by undulating plains and few volcanic hills. The plains are dissected by several valleys. The land rises from 500 m a.s.l. around Lake Magadi to about 2500 m m a.s.l. in the Ngong Hills area. Generally, topography of Kajiado District can be divided into four different ecozones; The Rift Valley, Athi Kapiti Plains, Central Broken Ground and the Amboseli Plains. Kipeto occur in the Athi Kapiti Plains, which consist of open rolling land. Two major tributaries emerge from Ngong Hills, these include Mbagathi and Kiserian, which are permanent water features. The Kipeto area where the transmission line starts has altitude ranging between 1760 – 2000 m a.s.l.

There are valleys, which form the drainage system that radiate to the north east and south east from the undulating higher altitude landscapes. These drainage systems are largely seasonal streams.

The elevation of the propose transmission line ranges from 1705 to 2018 m a.s.l.

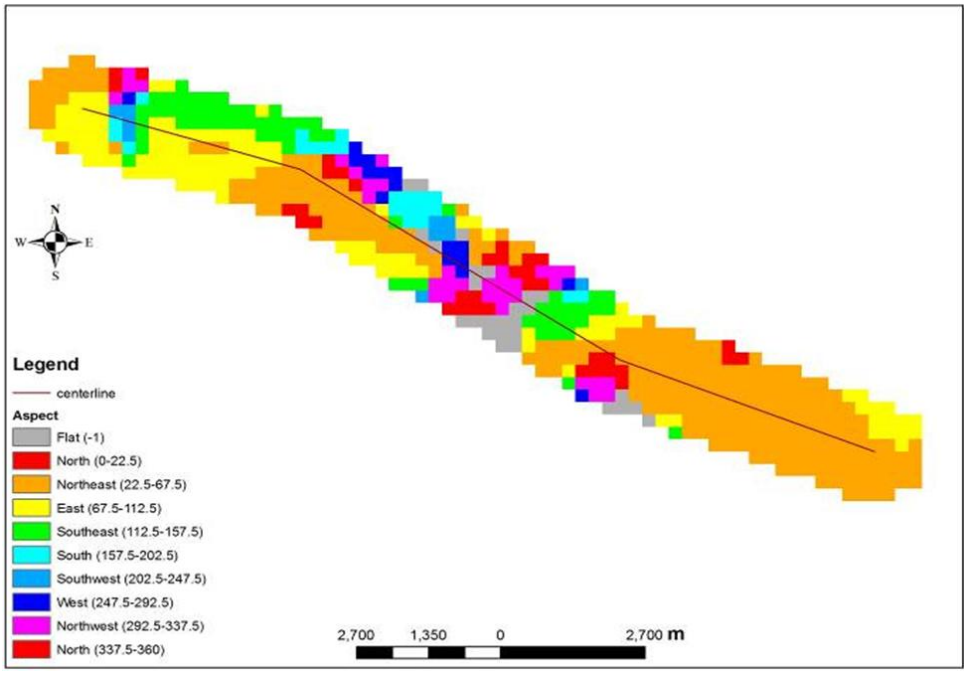
Figure 3: Figure 3. Cross-section gradient from Kipeto (on the left) to Isinya (on the right)



Generally, the landscape through which the power transmission line passes undulates but arises from high elevation and drops to relatively low elevation (Fig. 3). Approximately 45 % of the delineated area slopes towards north east; 15 % slopes towards East, 10 % runs towards South East, the rest runs

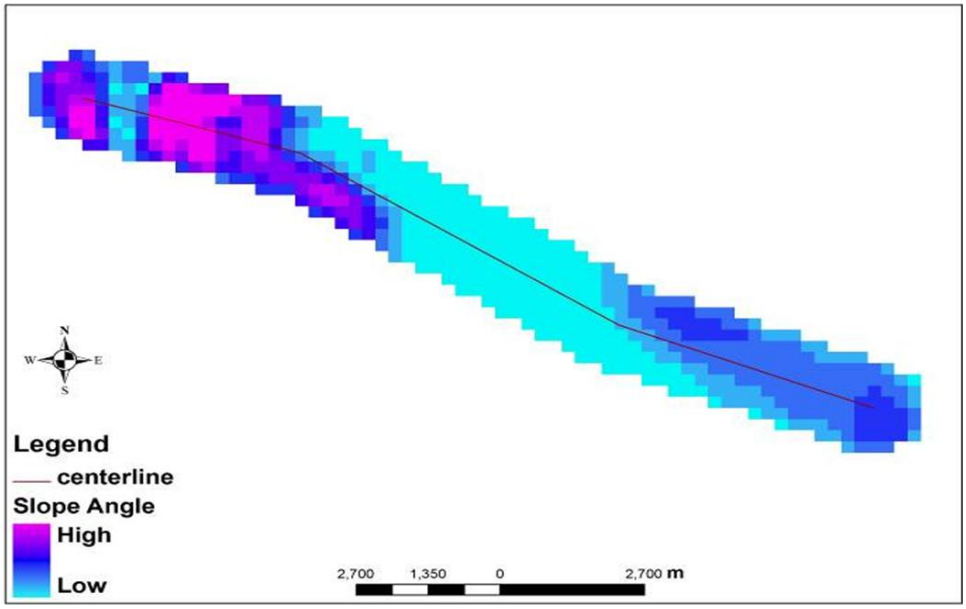
westerly, north and south (Fig. 4). This indicates over 70 % of the drainage within delineated area flows easterly direction (i.e. east, north east or south east).

Figure 4: Project area showing surface of landscape facing east, west, north, south and flat. It describes roughly the direction the landscape is inclined



The area within the project buffer area has middle area with low slope gradient. These are relatively flat areas (very low slope angle). Most of areas in the northwest has relatively high slope angles (Fig. 5). drainage water flows faster in the north western areas than in the middle areas and south eastern.

Figure 5: Project area showing slope angle, basically gradient variations of landscape



Areas with high flow length in figure 6 indicates drainage waters flow for a long distance before they reach outlet to the subsequent larger sub-basin or basin. Only less than 20 % of the areas have high flow length. This indicates there are several sub-catchments in the area which can be observed by numerous small drainage channels forming distributary-like patterns.

Within the delineated buffer area, the basin flow is high in the south east of the area (Fig. 7). This is an area where runoff does not flow but tends to collect and stay for long periods. The north western side has low basin flow because water does not stay there for longperiods. It has high slope angles.

Figure 8. below shows flow accumulation indicatings areas where drainage accumulates from the numerous small distributary-like channels (Fig. 9).

Figure 6: Project area showing the flow length, the distance the drainage water travels to outlet from one sub-basin

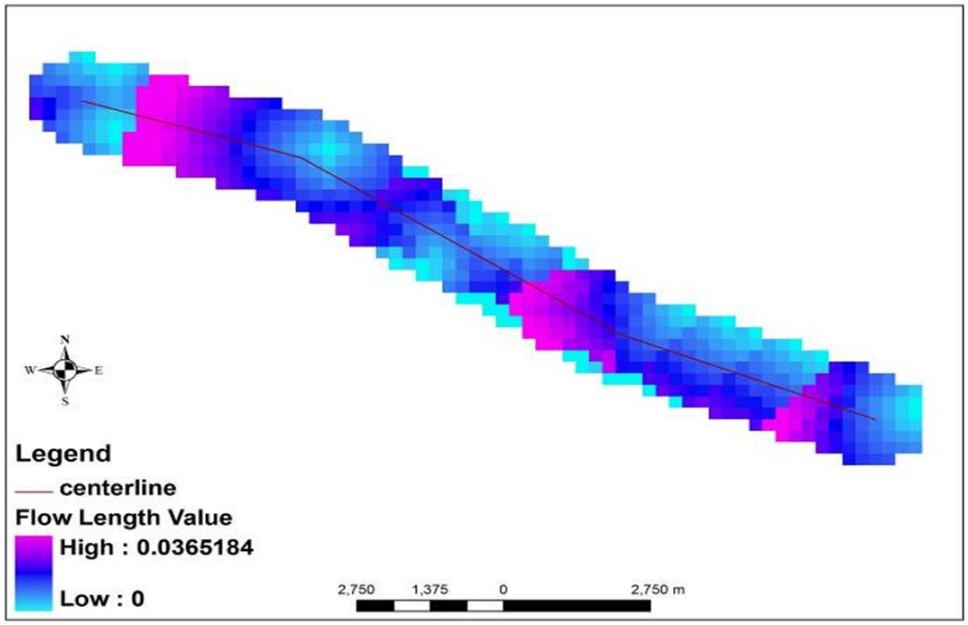


Figure 7: Project area showing basin flow values, indicating areas which retain drainage water longer than the others

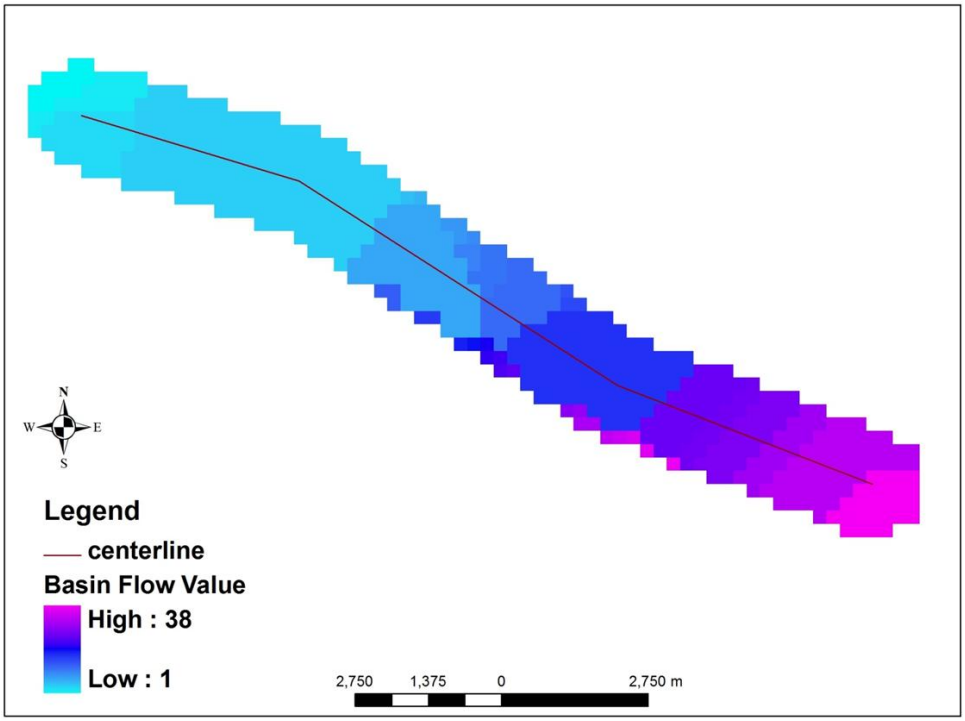
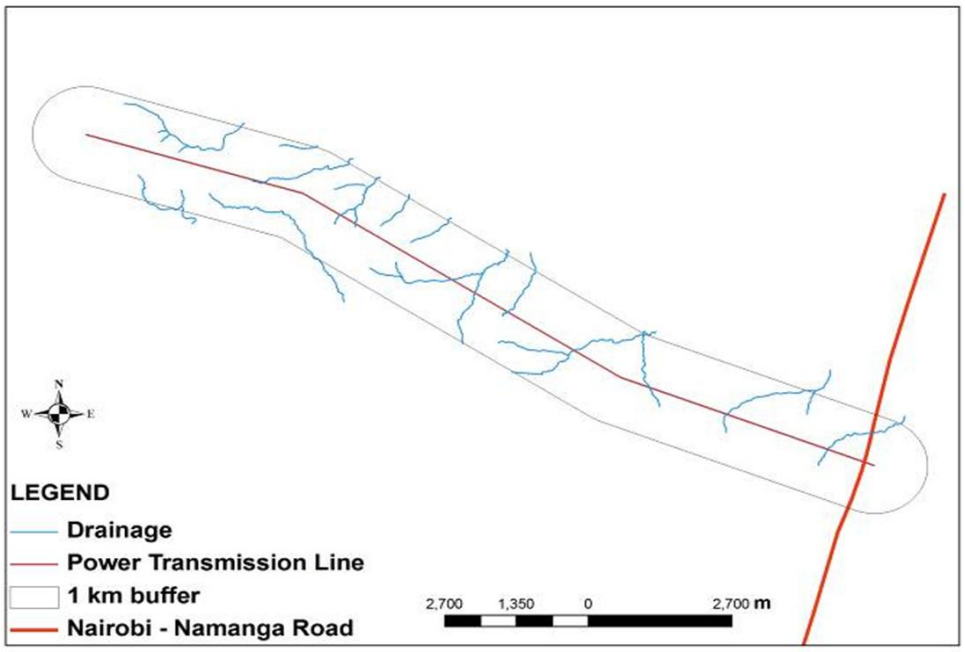


Figure 8: Project area at 1 km buffer showing drainage patterns



4 METHODOLOGY

4.1 Ecological field study

4.1.1 Plant survey

The survey sites were based on the refined reconnaissance identified sites. A transect of 1 km was used for recording existing species within the ROW. The presence and absence of species on sites were recorded to determine their distribution in the area. Detailed photograph were taken of species that were not identified in the field for later identification. Identification was done using the Kenya trees, shrubs and Lianas (Beentje 1994).

4.1.2 Aquatic survey

The aquatic system is not prominent in the area during the dry season. However, water still occurs in some pools. Sweep net was used in the pools to determine aquatic species occurring in the pools that occurred within the ROW.

4.1.3 Mammal survey

Physical observation was used to record mammal species. Proxies were used for identification of species where it was not observed. These included types of droppings (scatters) in the landscape. This involved walking along the 1 km transect across the area through established transects. A camera was used to capture the animal photographs and droppings. Verbal accounts on existing mammals were sought from pastoralists met along the proposed power line.

4.1.4 Herpetofauna survey

Special search on specific areas was conducted. This included search on rocks, under stones, on tree stems, shrubs and herbs. Stony areas were targeted in the morning when the sun just hit the ground to observe species busking. Also stones were rolled over to look for individuals hiding.

4.2 Species of conservation importance

These species enlisted in the ***IUCN red list data*** **of threatened species.** IUCN red list of threatened species online database was used to determine the conservation status of the species. Scientific names of observed species were run on the IUCN red list database to confirm conservation status of the species. The results of this analysis are shown on various sections of taxa.

4.3 Methodology for assessing impacts

Performance Standard 1 paragraph 7 emphasizes the process of identifying environmental risks and impacts. The type, scale and location of the project guided the scope of the impact identification. The direct and indirect project-related impacts on biodiversity and ecosystem services and residual impacts were considered during the assessment of impacts in accordance to Performance Standard 6 paragraph 6.

According to IFC the power transmission project potentially has impact on environment by altering terrestrial and aquatic habitats. Impacts are possible during construction and the maintenance of Right-of-Way. In addition, the electric and magnetic fields could have potential impact on mammals depending on the level of exposure. The project is, therefore, envisaged to pose a potential threat to

existing biodiversity, which consists of flora and fauna, and associated ecological processes. After conducting field observations, impact assessment was confined within the scope of the study on terrestrial plants, wildlife (mammals) and their behaviours across the landscape, ecological processes (migration, watercourses, ecological services (pastoral).

An Ecological Risk Assessment Matrix developed by Kurrent Technologies Ltd in 2012 was used to assess impacts of the project on biodiversity. The **extent of** impact can be limited to the project site and to specific activity at particular period, or affect areas beyond the project site. **Duration** in which the impact takes place is also considered in the evaluation of the impact. The period can be specific to the period of certain activities or could be related to the occupancy period of the project development. Thus, in terms of duration an impact can be viewed as a short, medium, long term impact or permanent. Impact can affect biodiversity partially or completely. For instance only small part of habitat, ecological processes or small population of species can be destroyed by the impact. Thus, **magnitude** of an impact was evaluated as proportion of the environmental entity affected. The probability of the impact to happen was derived from the frequency of the activity and frequency of impacts. The four characteristics described above were used to synthesise significance of the impact. See below the scale of risk assessment matrix.

Table 1: An ecological Risk Assessment Matrix developed by Kurrent Technologies Ltd.

EXTENT

Localized (At localized scale and a few hectares in extent)	1
Study area (The proposed site and its immediate environs)	2
Regional (District and provincial 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

Figure 9: Method used to determine the environmental risk

		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 2: Method used to determine significance of impacts

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

Table 3: Confidence of assessment table

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

4.4 Identification of Risks and Impacts

The process of identifying risks and impacts was undertaken in accordance to IFC Performance Standard 1. The IFC Performance Standard 1 underscores the importance of managing environmental and social risks and impacts throughout the life of a project. The stipulations of IFC Performance Standard 1 were considered in the implementation of IFC Performance Standard 6. The risks and impacts identification process accrued basis on Performance Standard 1 paragraph 7. Here, the direct and indirect project-related impacts on biodiversity and ecosystem services and any significant residual impacts were considered. These include relevant threats to biodiversity and ecosystem services, especially focusing on habitat loss, degradation and fragmentation, invasive alien species, overexploitation, hydrological changes, nutrient loading, and pollution.

4.5 Mitigations

Mitigation measures against the project are derived from the IFC Performance Standard 1 paragraph 14, 15 on adoption of mitigation hierarchy and avoidance or where not possible, minimize, and where residual impacts remain, compensation/offset of risks and impacts to the environment. The main objectives of mitigations are to achieve IFC PS6 i.e. to protect and conserve biodiversity, maintain benefits from ecosystem services and sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

The approach used for environmental risk assessment was adopted from Kurrent 2012 risk assessment matrix. When an impact scores above 30, the decision on whether project should be developed in an area would be made. In this case effective mitigation measures would influence decision to proceed with the project. In consideration of mitigation threshold set in Kurrent 2012, impacts that score less than 30 but are induced by behaviours of personnel are strongly recommended for further mitigation.

4.6 Assessments of Cumulative impacts

Cumulative impacts were considered to be impacts from any existing projects or activities around the area. Each activities/project identified around the area were analysed for their actual or potential impacts they exert on habitats and movement of wild herbivores.

The projects are assumed to be exerting impacts in space that add on to or magnify impacts from existing projects. Theoretically, projects or activities exert great impact onsite but this is considered to attenuate with distance (Fig. 10). In this analysis impact value near the site (within 5km distance) is considered to be 1. Generally, attenuation of impact value follows geometric progression that is dependent on distance. Geometric progression designed for this project is 5, 10, 20, 40 etc. Thus, on site, attenuated impact value is = Impact value (1) divide by the distance class. The impact would increasingly be significantly negligible depending on the size and distance from the project site. Similar project types that are located far away are considered to increase intensity of impact value of the proposed project but not directly affecting ecological environment. Through this, impact value on-site of the proposed project is adjusted to consider intensity (impact value) from other projects. In order to calculate accumulated impact value, GIS technique was used to generate buffer at specific distance class until the farthest project site is covered. Impact value attribute was generated under which the value was calculated as indicated above for all sites with similar project (wind power and transmission lines). These layers were added up in GIS (ArcGIS) and the average sum added to the estimated values from attenuation.

This concept is theoretically developed in order to show impact of project in a ***scenario that there is no variable ecological environment or none exist***. This concept is used together with any developed scales of risk assessment matrix to determine accumulated impact at any distance classes from project site. For instance, in the case for Kurrent Technologies Ltd Risk Assessment Matrix, accumulated impact at any distance would be multiplied by the maximum value of risk. Thus risk value for the wind power within a distance of 5 km would be 20 (0.2 x 100), i.e. under scenario indicated above. However, the Kurrent Technology looks at impact of the activities under variable ecological environment. It therefore, takes into account the extent, magnitude, duration and probability of impact. Now for example, if there is one similar project near Kipeto within 5 km then, cumulated impact value exerted by the project on Kipeto will be 20. The total risk on the ecological environment variable will be equal to the risk value estimated by Kurrent Technology Risk Matrix plus the accumulated value exerted by the nearest project. This interaction is demonstrated by model below (Fig. 11).

Activities that are within the vicinity of proposed project already exerts impact on ecological environment; for instance fencing in the area already restricts movements of wild herbivores and reduces their grazing areas in some areas. The accumulated impact of the activities are considered in an impact scenario model of the proposed project assessed using the Kurrent Technologies Ltd Risk Assessment Matrix.

Figure 10: Impact value of a project attenuating at a geometric progression with distance

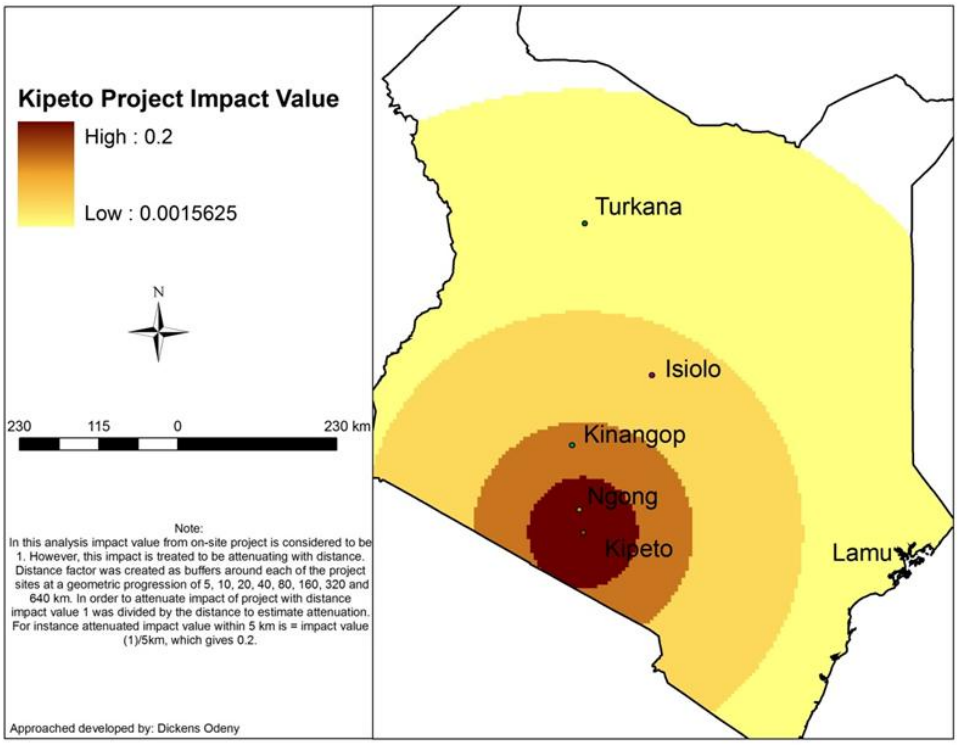
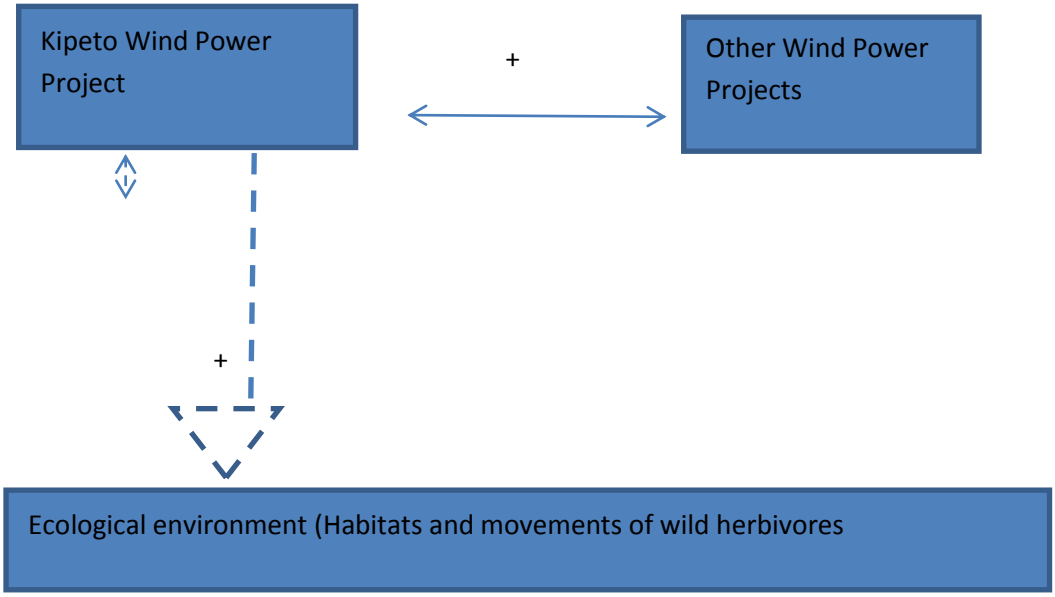


Figure 11: : Spatial Interaction model of projects and activities within the vicinity



5 FIELD OBSERVATION (RESULTS)

5.1 Habitats observed

5.1.1 Grassland

Grasslands are predominant in the upper parts of the project area. Some areas have mixed herbaceous plants which are opportunistic and a few are invasive species (Fig. 12). Grasses are normally tall during peak wet seasons. Herbivores disperse to the vast grasslands during wet season to effectively use the landscape. On the other hand, they are safe from predators.

Grassland is highly susceptible to the dynamics of climate. They are prone to wild fires that are caused by lightning or arsonists. They dry up leaving the landscape without any protection to potential erosion by animals and runoffs. Erosions are eminent in gentle valleys in the area and this was observed to be caused by lack of surface cover to protect from erosivity of runoffs (Fig. 13).

Figure 12: Grassland area in the upper area of the power transmission line showing mixed herbs

Figure 13: An erosion occurring with a subtle valley in grassland areas

5.1.2 Rock outcrops

Rock outcrops occur mostly in the upper area of the proposed power transmission line in Kipeto area (Fig. 14). These are part of volcanic rocks that protrude in the area. Volcanic rocks has a lot of nutrients locked; however, this nutrients are tapped by lichens that also trap moisture from the cold winds from Mount Kilimanjaro area, which makes Kipeto very cold at night. Lichens have contributed to the breakdown of the massive rock availing nutrients to the environment when they die (Fig 15).

Some succulent plants are observed growing on rock crevices and on soils which collect on small depressions (Fig. 16 & 17). The Aloe sp. (Fig. 18) is very conspicuous in the outcrop area; some grows on the crevices and others on soils near the rocks.

The rock outcrops are massive areas that have created important habitats for some animal species such as the lizards and geckos, rock hyrax (Fig. 19) and birds (swallows found on overhanging rocks)

“Soil pans” occur within the rock outcrop areas. These pans provide suitable habitats for some trees and habitat for moles where they burrow in the soils.

Figure 14: Project area showing distribution of rock outcrop areas

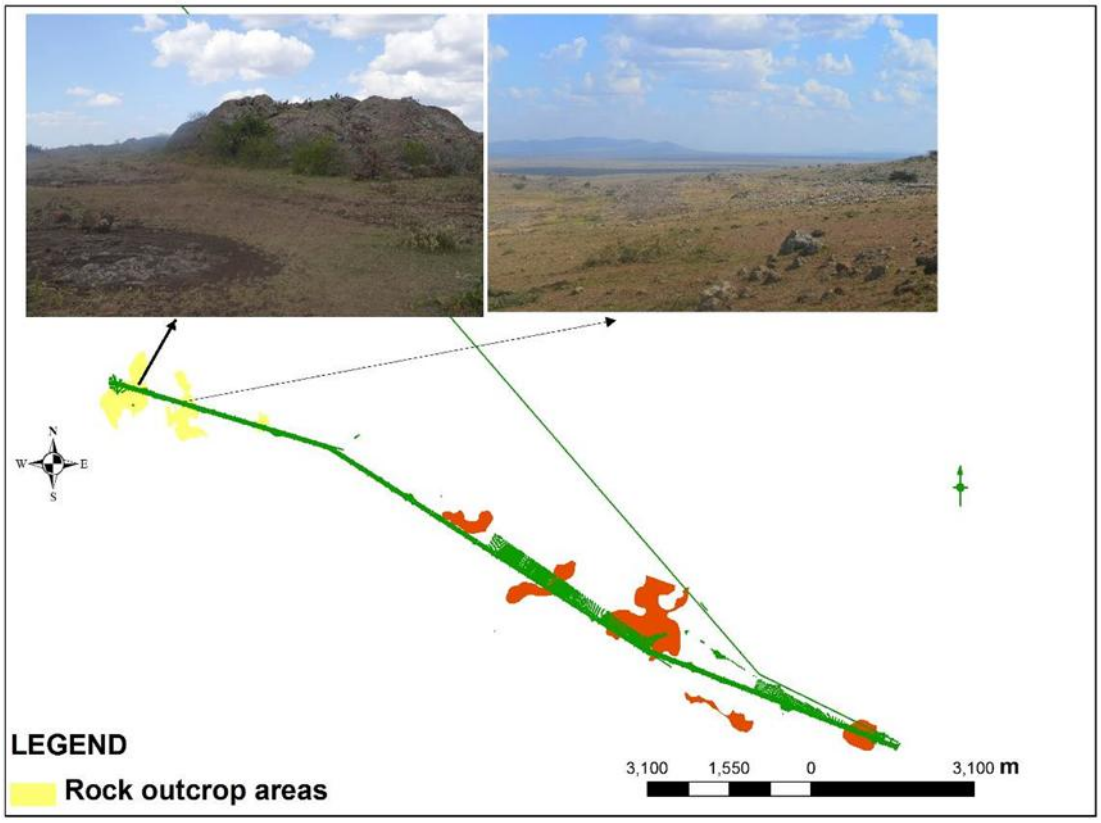


Figure 15: Lichens attached on rocks

Figure 16: Trees (Erythrina abyssinica) growing on soil pans within rock outcrops

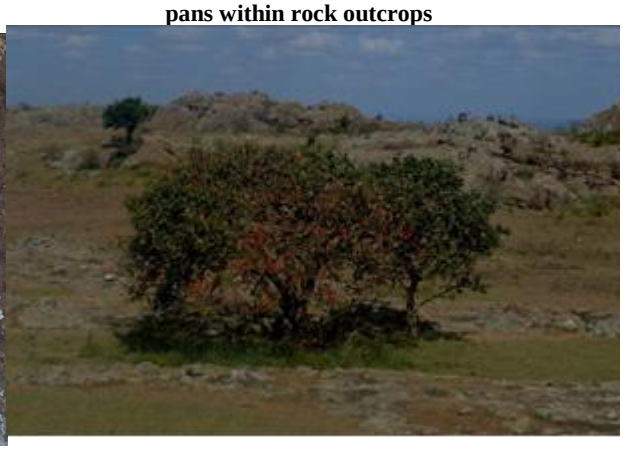


Figure 17: Succulent herbs growing on rock crevices

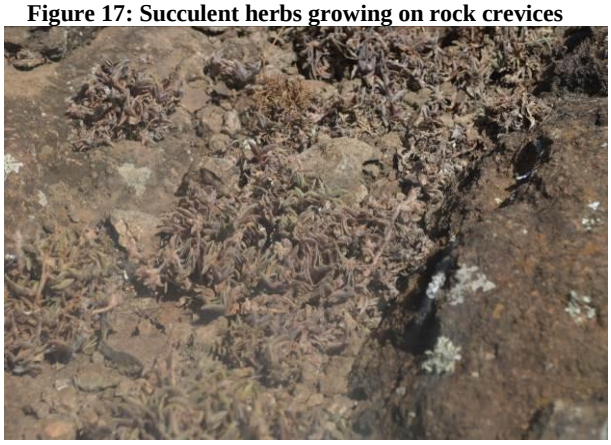
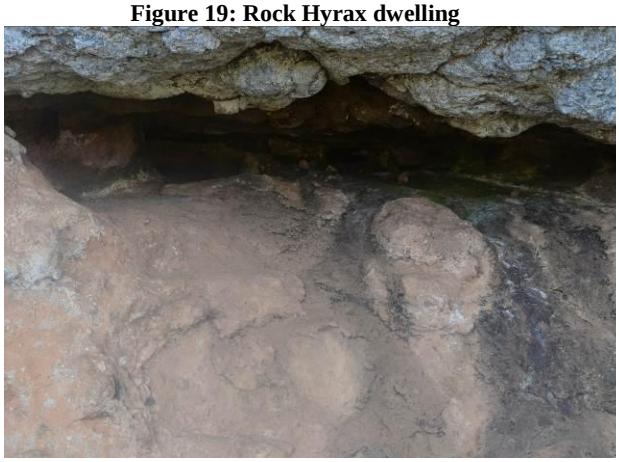


Figure 18: Aloe species growing on rock crevices

Figure 19: Rock Hyrax dwelling



5.1.3 Bush lands

Bushes were prominent in the lower areas of the proposed power line. Bushes are normally comprised of the *Acacia drepanolobium*, *Acacia mellifera* (Fig. 20-23). These are generally woody species but short (less than 3 m tall), with canopy (branches) spreading to the ground. The species sometimes occur as singles of clusters forming bushy shapes. Grasses are reserved around the bushes that provide forage to wild herbivores and livestock. Most of the wild herbivores noted were observed in bushy areas including accounts on occurrence. Livestock grazing was also prominent in the area than upper area that had dry grasses.

Figure 20: ***Euphorbia candelubrum***

Figure 21: ***Acacia drepanolobium***

Figure 22: ***Acacia sp. 1***

Figure 23: ***Acacia mellifera***

5.1.4 Woodland/shrub land

In this study, this group include the woody plants that have a diameter at breast height less than 10 cm and are less than 4 m high. In addition they stand forming low density with open habitats (Fig. 24-31). These areas support undergrowth such as grasses and herbs. Woodland or shrub lands are restricted to riverine valleys or runoff restricted areas with exception of one located at the foot of the overhanging rocks in Kipeto area. The latter apparently occur at the foot of the rocks receiving water from the rock catchments and remain there for long time.

Birds prefer the trees or shrubs because they are high from the ground providing safety from predators.

Figure 24: Mixed trees and shrub like habitat

Figure 25: *Acacia kirkii*

Figure 26: Scattered Acacia woodland within valleys

Figure 27: *Acacia sp.2*

Figure 28: *Acacia tortilis*

Figure 29: *Acacia seyal*

Figure 30: *Acacia xanthophloea* within a dry river valley

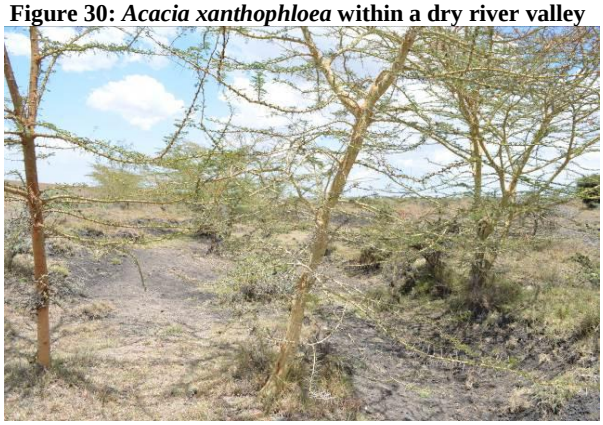


Figure 31: *Acacia tortilis* with bird nest hanging on branches

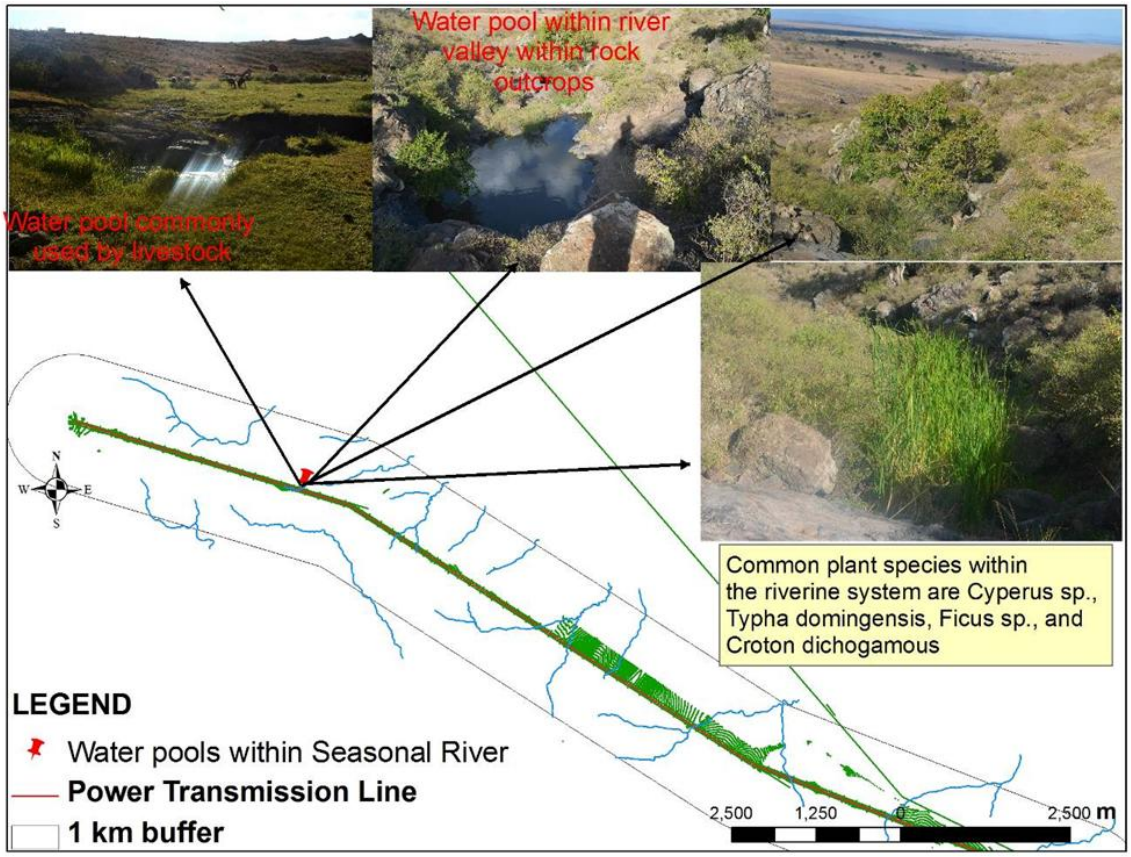
5.1.5 Riverine/Aquatic Habitat

There are established drainage valleys that collect runoffs during rainy seasons. However, none of the drainage valleys have permanent rivers or streams. The map below shows the position of water pools left within a drainage valley. The valley receives run-offs during the rainy season and stores water in the pools which can then be used during the dry season. This water is used by livestock and wild herbivores but more importantly shared during dry seasons. The valley seems to act as ground water storage that seeps out slowly but continuously through to the dry season. Some parts of the valley are dug by the local community to allow ground water seepage to be collected for domestic usage during dry season. This riverine area serves crucial role to the locals and wild herbivores.

The water pools serve aquatic animals such as frogs serving as breeding sites. Frogs and toads lay their eggs when water currents are relatively calm and hatche tadpoles which grow into full adult before the pools are dry. Thus the pools contribute in maintaining life cycles of frogs and toads in the riverine systems. Wetland plants such as *Typha domingensis* and *Cyperus sp.* are important part of riverine and aquatic systems. They stabilize riverine and stream banks creating suitable habitats for insects and birds. The *Cyperus sp.* are good forage for livestock during dry season thus, the system is valued during dry season in providing service to the locals (Fig. 32)

Riverine vegetation which comprises mainly of *Croton dichogamous* and Carissa edulis creates bushland cover type within the valley adjacent to the ROW that form habitats for birds.

Figure 32: Points along transmission line with aquatic system where aquatic plants and animals



5.1.6 Plant Distribution

Thirteen sites were used for conducting plant surveys along the Kipeto-Isinya proposed power transmission line (Fig. 33). A total of 29 species were observed along the proposed power line but with varying distribution of number of species at site. Table () show the species and checked for occurrence at sites.

Figure 33: Survey site where sampling for plant species were conducted

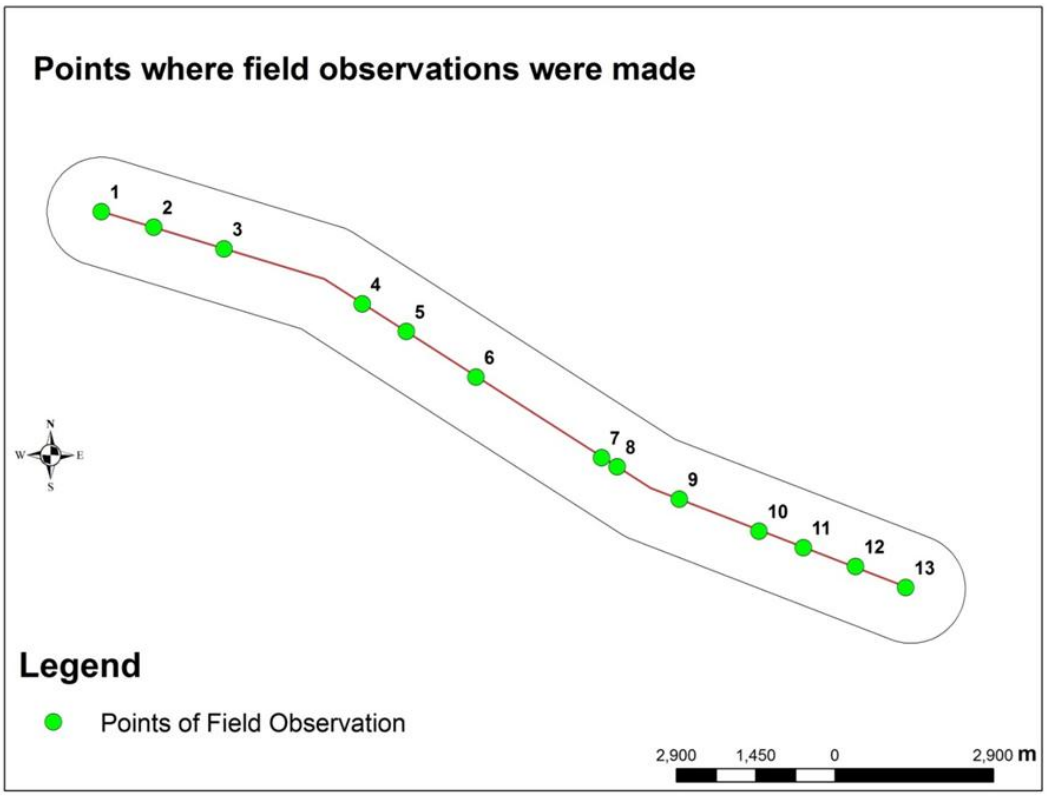


Table 4: Distribution of plant species on sites that were visited along Kipeto – Isinya Power Transmission Line. One (1) means present and zero (0) means absent occurrence

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13
Acacia abyssinica	0	1	0	0	0	0	0	0	0	0	0	0	0
Acacia drepanolobium	0	1	0	1	1	1	0	1	1	1	1	0	1
Acacia kirkii	1	1	0	0	0	0	0	0	0	0	0	0	0
Acacia mellifera	0	0	0	0	1	1	0	1	1	1	1	0	1
Acacia sp.1	0	1	0	0	0	0	0	1	0	0	0	0	0
Acacia sp.2	0	0	0	0	0	0	0	0	0	1	0	0	0
Acacia tortillis	0	0	0	0	0	0	0	0	0	0	0	1	0
Acacia xanthophloea	0	1	0	1	0	1	0	0	0	0	0	1	0
Acalypha sp.	1	0	0	0	0	0	0	0	0	1	0	0	0
Balanites aegyptiaca	0	1	1	0	1	1	1	0	0	0	1	1	1
Carissa edulis	1	1	0	0	0	0	0	0	0	0	0	0	0
Croton dichogamus	0	1	0	1	0	0	0	0	0	0	0	0	0
Cussonia sp.	1	0	0	0	0	0	0	0	0	0	0	0	0
Cyperus sp.1	1	0	0	0	0	0	0	0	0	0	0	0	0
Cyperus sp.2	0	0	0	0	0	0	0	1	0	0	0	0	0
Dodonea	1	0	0	0	0	0	0	0	0	0	0	0	0
Dovyalis sp.1	1	0	0	0	0	0	0	0	0	0	0	0	0
Erythrina abyssinica	1	0	0	0	0	0	0	0	0	0	0	0	0
Euphorbia candelabrum	1	0	0	0	0	0	0	0	0	0	0	0	0
Ficus sp.	1	0	0	0	0	0	0	0	0	0	0	0	0
Grasses (variety)	1	1	1	1	1	1	1	1	1	1	1	1	1
Grewia similis	0	1	0	0	0	0	0	0	0	0	0	0	0

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13
Rhus natalensis	0	1	0	0	0	0	0	0	0	0	0	0	0
Sodom apple	1	1	1	0	0	0	0	0	0	0	0	0	0
Succulent sp.	1	0	0	0	0	0	0	0	0	0	0	0	0
Venonia sp.1	1	0	0	0	0	0	0	0	0	0	0	0	0
Venonia sp.2	1	1	1	0	0	0	1	0	0	0	0	0	0
Venonia sp. 3	1	1	0	0	0	0	0	0	0	0	0	0	0

5.1.7 Developed water resources

Water pans are common water resources developed as a stopgap to water deficiency in the area. Most of the water pans are constructed for livestock but alternatively serve the wild herbivores with drinking water (Fig. 34). Wetland birds were observed near some water pans. The area provides sites where they get food and water for drinking. The presence of Grey Crown Crane near water pan indicates the resource serves important ecological roles (Fig. 35).

Figure 34: Water pan used for drinking livestock and visited by wild animals

Figure 35: Water with the Grey Crown Crane in the background

6 SPECIES OBSERVED

6.1 Fauna Observed

6.1.1 Mammals

The Kipeto-Isinya landscape is characterised by diverse animal species. The conspicuous group is the mammals that are strikingly observable in the landscape. Among the mammals Zebra and Thompson Gazelles are easy to note by just moving along the roads (Fig. 36 & 38). Other mammal species are not widespread in the area but occur specifically in mixed grass and bushy landscapes. The species observed were the Harte-beast and Wild-beast (Fig. 39 & 43). The presence of the African hare could be noticed by the presence of their droppings (scatters) (Fig. 42). Droppings of other mammal species were used for identification. This included the antelope and warthog (Fig. 37).

Other mammal species were noticed with their signs of activities in the sites. These include rodent mole that creates mounds in grass fields, spring hare holes and aardvark holes (Fig. 39 & 40). This group is not easy to see day time; aardvark and spring hare are nocturnals.

Local accounts revealed the areas in the lowland are occasionally visited by Elands and Cheetah. Photos below shows picture of physically observed animals and other physical signs used for identification. See table below to determine distribution of the group by site.

Figure 36: Herds (group) of Zebras grazing

Figure 37: Scatters (droppings) of warthog

Figure 38: Thompson Gazelles

Figure 39: Wildbeaste and Zebra

Figure 40: Mounds of Moles in the "soil pan"

Figure 41: Aardvark holes showing their activities

Figure 42: African Hare Droppings

Figure 43: Harte Beast in the background

This group are not conspicuous in the landscape but can be located based on their habitat types. They were noticed in the grasslands and rock outcrop areas.

Snakes were not physically observed by their presence was noted by the moults that remain in the grasses or on bushes. The common species observed was the spitting cobra (Fig. 44 & 45). This species is common in the Maasai land in the grasslands.

The other taxa observed were the lizards and Geckos (red head and yellow head) in the rock outcrop areas (Fig. 46). They live in the rock crevices or areas with stone where they can hide under them and busk on rocks in the morning sun shine.

Figure 44: Young cobra moult

Figure 45: Mature cobra moult

Figure 46: Gecko on tree stem

6.1.2 Species of Conservation Importance

Among species recorded in the area, only two are enlisted in the IUCN RED LIST of threatened species. This species was recorded from local verbal account include Cheetah (*Acinonyx jubatus*).

6.1.3 Cheetah

Cheetahs are primarily found in open grassy habitats, but also make use of dry forest, savanna woodland, semi-desert and scrub. In Eastern Africa, habitat loss and fragmentation was identified as the primary threat during a conservation strategy workshop (Anon. 2007).

7 IDENTIFICATION OF RISKS AND POTENTIAL IMPACTS ASSESSMENT

7.1 Potential impacts Identified

- Terrestrial habitat alteration
- Alteration of plants habitats
- Introduction of Alien Invasive Plant Species
- Destruction of habitats of Herpetofauna
- Potential Impact: Aquatic habitat alteration
- Temporary obstruction of movement of wild-herbivores
- Poaching for Bushmeat

7.2 Potential Project Activities

It is very important to understand the driving forces on the above potential impacts identified. Thus, it is necessary to know activities involved in the laying down the power transmission line. Such activities include;

Construction of sub-station: These involve clearing and excavation of soil layer to create a stable stratum for the transformers. Vegetation on the sites would be cleared. This would create spot damage on vegetation type.

Construction of Right-of-Way (ROW): traditionally, clearing of tall vegetation is undertaken along designated stretch of 60 m belt. Sometimes grading of the landscape is done to allow vehicles to drop equipment along the power line. Normally vegetation would be destroyed along the proposed power line and access roads. In this particular case, vegetation types that exist and would be affected are the grasses, woody trees and shrubs.

Construction of road: Road is normally constructed within the Right-of-Way to enable vehicle movements during monitoring of the transmission line. Earth moving machines are involved in the process where grading and hurling of soil is done.

Anchoring of pylons: excavation of corner holes for anchoring pylons is done throughout the proposed power line. Small area where pylons will be anchored would be affected.

Operation of vehicles: transportation of equipment and material to site would be a routine activity along the proposed power transmission line. Normally vehicles and moving machines trample on vegetation, also creating weak lines on earth making it susceptible to erosion agents.

Operation of substation and power transmission lines: these are associated with the electric and magnetic fields. The magnetic fields would affect mammals through long-term exposure.

7.3 Assessments of Cumulative impacts

There various existing activities that already poses potential impact on the ecological environment. These include:

Upcoming buildings around the area – competing with pastoral land use; cause barriers for animal movements.

Upcoming farming activities – reducing grazing areas for wild herbivores and habitats

Existing ranches – already blocked movement of animals across landscape

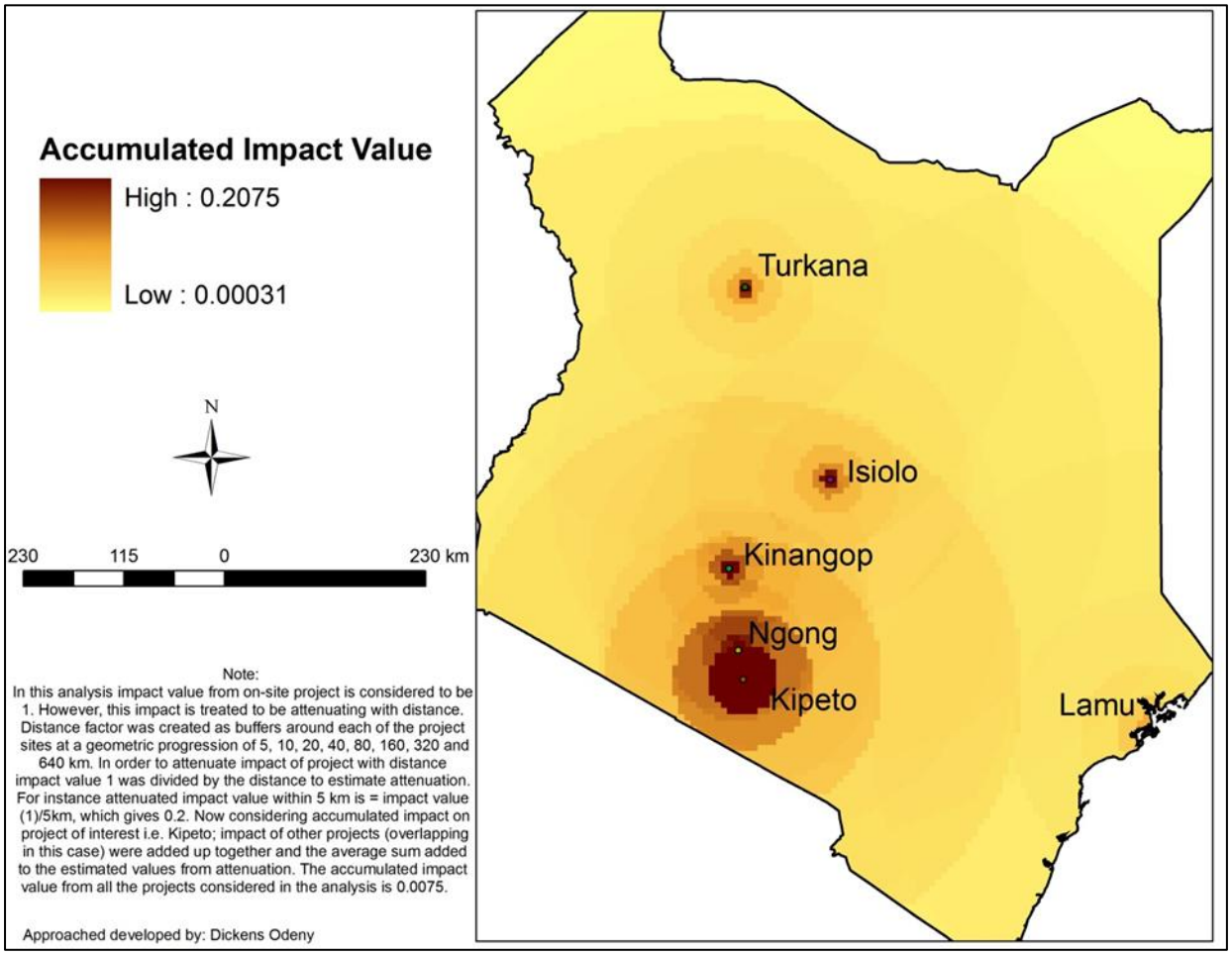
Livestock grazing – competition for pastures with wild herbivores

Fencing of plots – blocking movement of herbivores and reducing grazing areas for wild herbivores

Increased usage of access road connecting Kajiado – Rongai area – potentially raises Incidences for road kills by vehicle that moves in between the areas

Development projects – e.g. wind power; indirectly intensify impact of another project.

Cumulated impact value calculated from concept developed in Kipeto area is 0.0075 (Fig…). Adjusted risk is therefore 0.75, which will be added to any impact assessment done for the ecological environment variable identified.



7.4 Description and Assessment of Potential Impacts

7.4.1 Potential Impact: Terrestrial woody plant alteration

The source of potential impact is from the activities of construction of the right-of-way. The designated line of power transmission passes across landscape that has isolated sparse woodland especially occurring in the seasonal river (stream) valley. Construction of the right-of-way therefore would have a negative impact on the system such as creating disconnection of the small habitats (isolated woodland). The riverine woodland, for instance, at causing fragmentations; where habitat is small it can reduced significantly the size of the habitat.

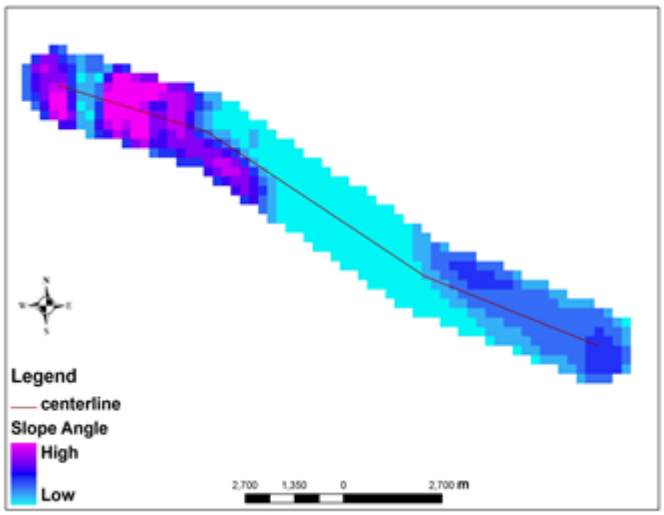
Construction of the right-of-way normally involves clearing of vegetation or to some extent grading rugged terrain. The emergence of invasive species is common on areas that have been disturbed. This species grows very fast with limited resources such as nutrients, moisture and are not reduced by livestock since they are not palatable.

Grassland comprises of a large percentage of landcover in the area. These are areas that provide an ecosystem service to pastoral activities. Grasses in the area are very dynamic with the rainfall season. Grasses are easily affected by trampling by vehicles, clearing of vegetation for road construction and anchoring of electric pylons.

The *Acacia* species form large part of the woody tree species in Kajiado area. The species is in particularly suitable for growth in the dry land due to the adaptation to season droughts. Their distribution in the area is affected by dispersal of animals in the plains and other agents. It plays important role in providing habitat for wild-animals such as birds and mammals.

Unmitigated impact: Terrestrial woody plants during Construction Phase	
Extent of impact	3
Magnitude of impact	4
Duration of impact	5
Probability of impact	3
Risk = (Extent + Duration + Magnitude) x Probability	**- 36**
Confidence of Assessment	Medium
Risk of Cumulative impact	**-37**
Recommendation	Propose mitigation measures
Comments • The impact could influence the decision to develop in the area unless it is effectively mitigated. • Traditional construction of Right-of-Way that involved grading of the belt should be avoided. This causes damage to vegetation and habitats that they provide to animals. • Avoid grading in areas with high slope angles to avoid future possible erosion (see areas below on a	

map)



- Minimize grading of rugged areas by looking for alternative passage within the 60 m ROW.
- Avoid cutting of short trees that heights are lower than the power line. Height difference should be maintained at least 15 m.
- When points of erecting pylons is exactly on cluster of bushes, offset backwards or forward within the proposed line to avoid destruction of the potential habitats or refugia for reptiles and small mammals.

Mitigated impacts on Terrestrial plants during Construction Phase	
Extent of impact	3
Magnitude of impact	2
Duration of impact	2
Probability of impact	1
Risk = (Extent + Duration + Magnitude) x Probability	**-7**
Confidence of Assessment	Low
Risk of Cumulative impact	**-8**
Recommendation	Implement and manage the mitigation measures

7.4.2 Assessment on the Introduction of Alien Invasive Plant Species

The means of introduction of an Alien Invasive Plant Species in an area is not easy to determine. It is normally essential to know in order to strategies how to control the introduction and spread of AIPS in an area. Fear of AIPS is that they displace indigenous plant species and are does not provide good habitat and forage to animal species. In areas where AIPS is introduced the landscape in terrestrial habitat changes significantly with other plant species displaced or suppressed.

Most environmental managers are challenged by the AIPS because they pose unusual characteristics which lack management measures. For instance, some AIPS could be poisonous when eaten by wild herbivores.

AIPS are normally detected after construction activities of the project are over. Introduction of AIPS would be accidental through the gravels used for leveling roads and/or equipment that has soils with propagules of AIPS.

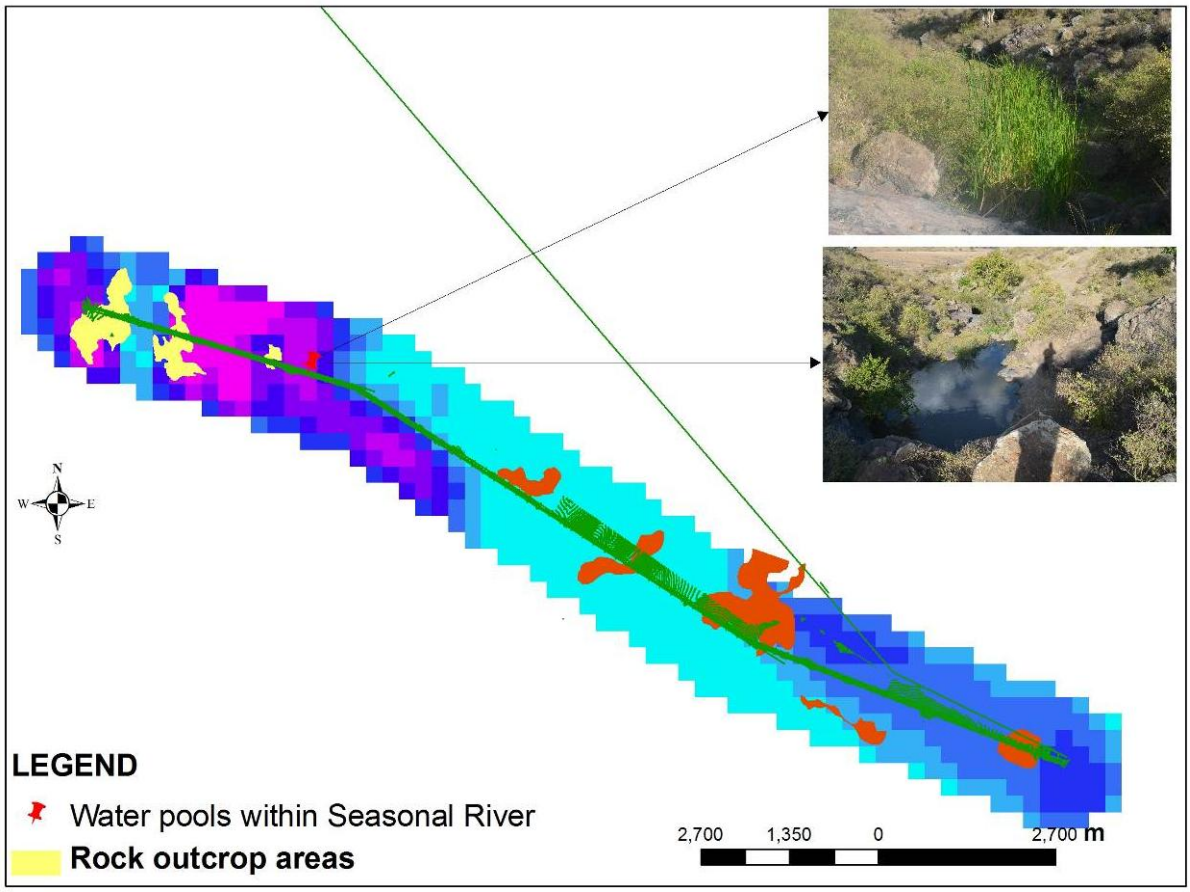
Unmitigated impacts of introduction of Alien Plant Species during Construction Phase	
Extent of impact	3
Magnitude of impact	4
Duration of impact	5
Probability of impact	4
Risk = (Extent + Duration + Magnitude) x Probability	**- 48**
Confidence of Assessment	Medium
Risk of Cumulative impact	**-49**
Recommendation	Propose mitigation measures
Comments/mitigation • Equipment to be used should be decontaminated e.g. washing equipment to remove soil potentially carrying AIPS propagules • Avoid importing soils/gravels to use for level grounds for vehicles to pass in ROW should be avoided. If brought from outside, the surface of the soil should be removed to avoid mixing of soils potentially harboring AIPS propagules with the lower soil profiles. • Since AIPS appears later after soil disturbance, aftermath proliferation of AIPS should be controlled by reducing their population and recruitment	
Mitigated impacts of introduction of Alien Plant Species during Construction Phase	
Extent of impact	1
Magnitude of impact	2
Duration of impact	4
Probability of impact	2
Risk = (Extent + Duration + Magnitude) x Probability	**-14**
Confidence of Assessment	Low
Risk of Cumulative impact	**-15**
Recommendation	Implement and manage the mitigation

	measures

7.4.3 Potential Impact: Aquatic Habitat Alteration

The construction of the power transmission line is associated with the construction of right-of-way (ROW) which may pass through the riverine habitat, marshes and rivers (permanent or seasonal). The removal of riverine woodland would be inevitable in order to create the way. The Kipeto-Isinya area does not have permanent rivers but has seasonal stream valleys crossed by the proposed, water pools on seasonal rivers and water-pans on the side of the proposed ROW. At one point part of seasonal river with water pools occur within the proposed ROW (buffer) (Fig. 46). The construction activities of heavy machines might cause the soil susceptible to runoffs. During rainy season, downstream are normally affected by sediment loads from upstream areas. Erosion may occur on areas with weak soil during rainy season. Construction activities might demand water and any attempts of water extraction from the resources could probably drain water that serves ecological role in the area. The water pools also serve livestock and domestic uses.

Figure 47: Locations of water pools in the project area



Unmitigated impacts on Aquatic habitat during Construction Phase	
Extent of impact	2
Magnitude of impact	4
Duration of impact	2
Probability of impact	4
Risk = (Extent + Duration + Magnitude) x Probability	**- 32**
Confidence of Assessment	Medium
Risk of Cumulative impact	**-33**
Recommendation	Propose mitigation measures
Mitigations • There is need to ensure sedimentation is not caused in the drainage system. Minimization of activities that disturb soil layer near the river valley would contribute to the conservation of the system.	
Mitigated impacts on Aquatic habitat during Construction Phase	
Extent of impact	1
Magnitude of impact	2
Duration of impact	1
Probability of impact	2
Risk = (Extent + Duration + Magnitude) x Probability	**-8**
Confidence of Assessment	Low
Risk of Cumulative impact	**-9**
Recommendation	Continue with implementation and management of the mitigation measures

7.4.4 Potential Impact: Temporary obstruction of movement of wild-herbivores

The Kipeto-Isinya landscape is within the Athi-Kapiti which provides dispersal areas for wildlife during wet seasons. During dry season, wild animals move towards the Nairobi National Park. The forage conditions for the wild herbivores are adversely affected during this season, depriving them of feed. Only the isolation of woodland remains serving small mammals, reptiles and birds as a refugia.

Project development will potentially affect activities and behaviours of mammal species. The species depend on the area for habitats, foraging grounds and migration during dry season. Some of the mammals prefer woodlands or bushlands, riverine, grasslands and rocky areas. Activities leading to interference to movements of the animal are viewed as adverse to the species.

Generally, during the construction of the power line there will be movements of vehicles and noise generated by vehicles and construction equipment. The noise would potentially scare animals away from dispersal areas. Speed of the vehicles used in the area would be a concern to lives of Thompson Gazelles. The gazelles normally graze in a group and they tend to follow each other. A vehicle intercepting a group crossing road runs a risk of hitting individuals which normally tries to catch up with the rest.

"Soil pans" occur within the rocky areas of Kipeto. "Soil pans", a term coined from the field observation are areas where soils occur in a rock pad depressions (Fig. 48). Their sizes ranges from, approximately, 100 m^2 to 500 m^2 and their edge are distinguished by rocks. Some of these "soil pans" have grasses and are inhabited by rodents such as moles. Movement of moles into other areas with soil is less due to the rock barriers around the soil pans. Soil pans represent special habitats that reserve water seepages from the rocks. Most probable means of loss of soil water is through evaporation. These areas are vulnerable to clearing or grading which in turn are uncertain refugia for the species.

The Aardvarks holes indicated the presence of the species in the area. Areas with Aardvark holes are possible habitats for the species or foraging areas. The holes were observed within the 60 m proposed ROW. And thus, construction activities could possibly destroy where they reside or foraging grounds.

In the lowland area of the study areas, bushlands of *Acacia* and *Balanites* dominate and they form grazing areas for the angulates (Fig. 47). During the study period, the area had more grasses and shrubs that supports the herbivores. Animals are more?? predominant in this area than the upper area, which is formed by the grassland and isolations of bushes. Local accounts mentions during wet seasons the lower area is visited by some of the species of conservation importance such Eland and Cheetah.

Cheetahs are normally active during day time. This pattern might be interfered during construction but it is important to note the animal have a wide ranging area and normally follow the movement of prey.

Figure 48: Distribution of major mammal species along the Kipeto-Isinya transmission line

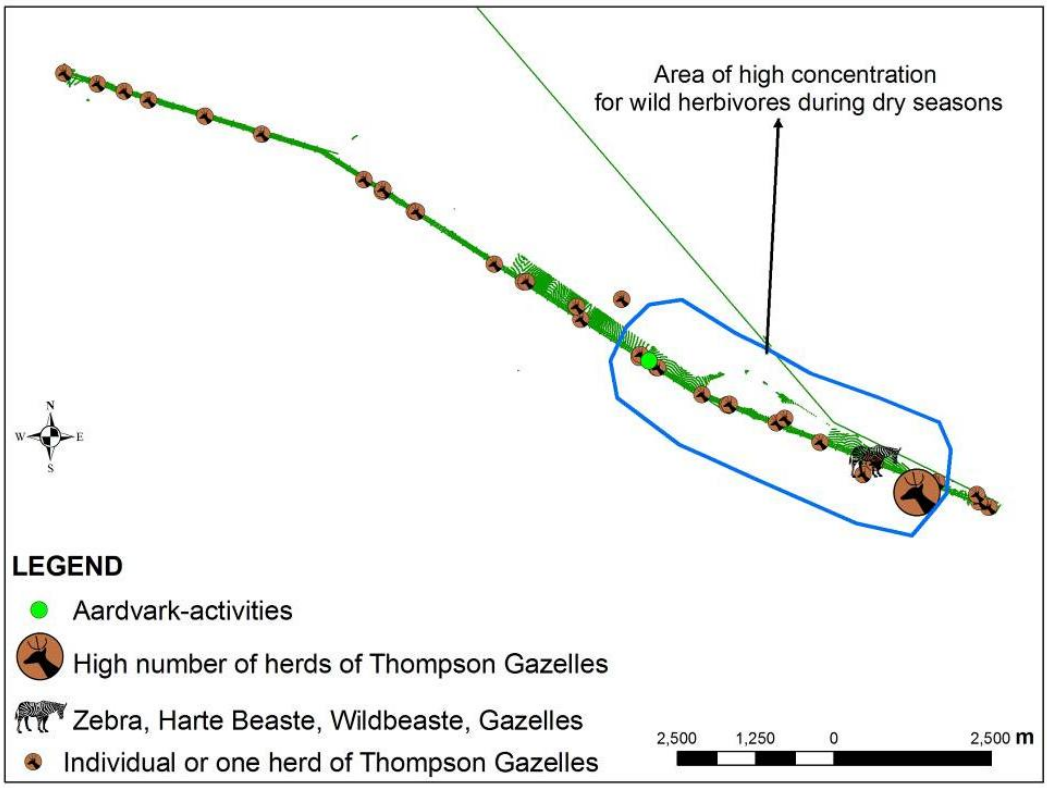
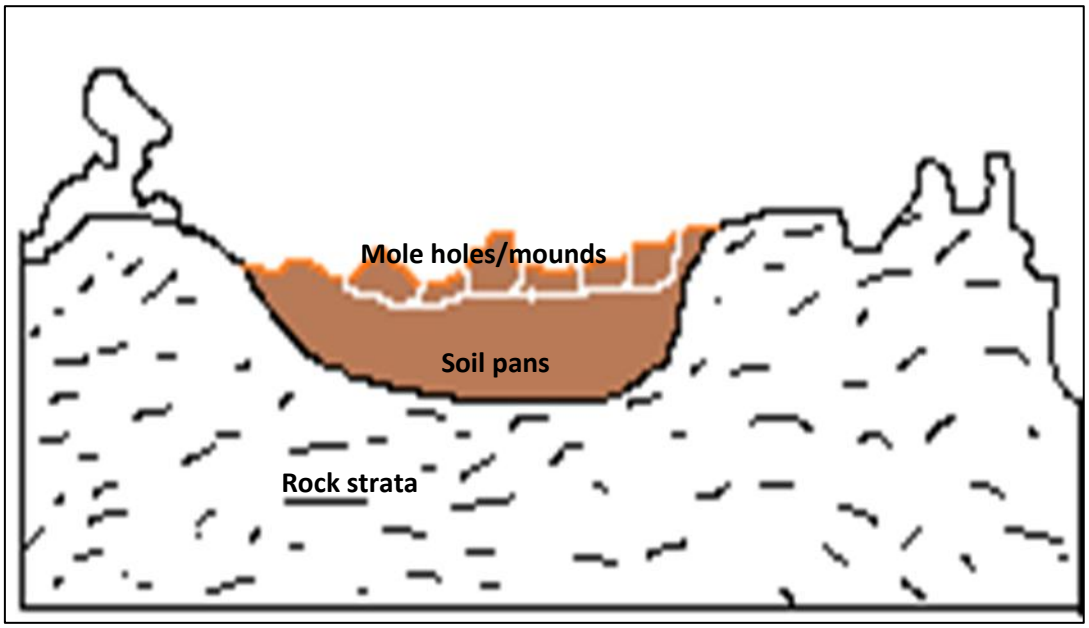


Figure 49: Soil pan occurring in a depression within the massive rock



Unmitigated impacts on movement of wild-herbivores during Construction Phase	
Extent of impact	2
Magnitude of impact	4
Duration of impact	2
Probability of impact	4
Risk = (Extent + Duration + Magnitude) x Probability	**- 32**
Confidence of Assessment	Medium
Risk of Cumulative impact	**-33**
Recommendation	Propose mitigation measures

Mitigations

- Speed of vehicles should be controlled at a maximum limit of 40 km/h. Once a driver note a herd of gazelles is crossing s/he should wait until all have crossed or slow down to avoid hitting individuals
- Avoid grading or clearing of vegetation where the mounds of moles and Aardvark holes occur. These are probably their hidings from predators and severe climate conditions.
- Operation of construction activities should be restricted to day time from 8am to 5pm. This provides time for foraging for nocturnal animals. This group is normally sensitive to presence of human activities and flood lights at night.
- During dry season the upland is dry of grasses but the lowland still have grass, herbs and shrub reserves. Most of herbivores migrate to this area thus construction activities during dry season can affect utilization of this area. Construction should therefore be scheduled after the onset of rainfall. Generally, vegetation in the area respond very fast to rainfall hence herbivores will disperse to avoid any adverse impacts.

Mitigated impacts on movement of wild-herbivores during Construction Phase	
Extent of impact	1
Magnitude of impact	2
Duration of impact	1
Probability of impact	2
Risk = (Extent + Duration + Magnitude) x Probability	**-8**
Confidence of Assessment	Low
Risk of Cumulative impact	**-9**
Recommendation	Continue with implementation and management of the mitigation measures

7.4.5 Potential Impact: Poaching for bush meat

Potential of poaching wild herbivores for bush meat might take place. Poachers would easily intrigue contactor personnel. The location of the area is convenient for quick transportation of bush meat to Nairobi market.

Unmitigated impacts of poaching for bushmeat during Construction Phase	
Extent of impact	3
Magnitude of impact	4
Duration of impact	1
Probability of impact	3
Risk = (Extent + Duration + Magnitude) x Probability	**- 24**
Confidence of Assessment	Low
Risk of Cumulative impact	**-25**
Recommendation	Propose mitigation even when impact is below threshold
Mitigations • Personnel should be screened when entering and leaving construction sites. • Enhance screening of local contract workers using local community • Local people should be alerted by the constructors to be able to detect visitors potential of poaching	
Mitigated impacts of poaching for bushmeat during Construction Phase	
Extent of impact	1
Magnitude of impact	1
Duration of impact	1
Probability of impact	2
Risk = (Extent + Duration + Magnitude) x Probability	**-6**
Confidence of Assessment	Low
Risk of Cumulative impact	**7**
Recommendation	Maintain the current management

7.4.6 Potential Impact: Destruction of habitats for herpetofauna

The construction activities would potentially affect movement of the species. Most of the species hide in holes, under stones and rock crevices. Disturbance during construction by excavation and grading by earth movers might destroy habitats of this species.

The speed at which vehicles move in the area will determine occasions of road kill accidents. Normally the herpetiles crawl and they are prone to road kills by vehicles. Species normally affected are snakes, lizards and geckos.

Unmitigated impacts on habitats of herpetofauna during Construction Phase	
Extent of impact	2
Magnitude of impact	4
Duration of impact	2
Probability of impact	3
Risk = (Extent + Duration + Magnitude) x Probability	**- 24**
Confidence of Assessment	Low
Risk of Cumulative impact	**-25**
Recommendation	Mitigate even when below threshold
Comments • Impact on the species will be localized. Disturbance of their habitats would affect negatively the hidings of geckos and lizards such in the rock outcrop area. Implementation of operation times, speed limit and driver's keenness.	
Mitigated impacts on habitats of herpetofauna during Construction Phase	
Extent of impact	2
Magnitude of impact	2
Duration of impact	1
Probability of impact	2
Risk = (Extent + Duration + Magnitude) x Probability	**-10**
Confidence of Assessment	Low
Risk of Cumulative impact	**-11**
Recommendation	Maintain the current management

7.4.7 Potential Impact: Exposure of wild herbivore to electric and magnetic fields

EMF is associated with the power transmission lines. EMF is invisible lines of force emitted by and surrounding any electrical device. Electric fields are shielded by materials that conduct electricity, and other materials, such as trees and building. Magnetic fields pass through most materials and are difficult to shield. Both electric and magnetic fields however, decrease with distance. There is concern over risks of electrocution and potential health associated with the exposure to EMF on human than wild animals though the evidence on the latter is weak.

Normally areas cleared for ROW experience dominance of grasses. The extensive area also provides wild herbivores with an open area safe from predators. The amount of time the herbivore spent under the pylon cables will determine how much they will be exposed. It is not clear how the EMF would affect wild mammals but a general fear is expressed on the unknown magnitude of impact.

Some locals have expressed fear of possible electrocution through the wire fences that crosses the landscape. This also includes fear for the lives of their livestock and wild herbivores. Accounts from people from different places where pylons and powerful transformers are located indicate that people normally feel dizzy when they stay near the utilities for few hours. In addition, metallic object conduct electricity during rainfalls. This accounts and experience has not been scientifically validated but is considered in this review to address opinions.

Unmitigated impacts of EMF on the wild herbivore during Operation Phase	
Extent of impact	1
Magnitude of impact	2
Duration of impact	5
Probability of impact	2
Risk = (Extent + Duration + Magnitude) x Probability	**- 16**
Confidence of Assessment	Low
Risk of Cumulative impact	**-17**
Recommendation	Mitigate even when below threshold
Comments/mitigation • The traditional way of constructing ROW should be avoided. Clearing of vegetation should be avoided as much as possible to avoid incidences of wild herbivores congregating along the ROW. • In case there will be possible electric inductions on wire fences, rubber breaks should be introduced on wires to avoid possible conduction of electric domains.	
Mitigated impact of EMF on the wild herbivore during Operation Phase	
Extent of impact	1

Magnitude of impact	1
Duration of impact	5
Probability of impact	2
Risk = (Extent + Duration + Magnitude) x Probability	**-14**
Confidence of Assessment	Low
Risk of Cumulative impact	**-15**
Recommendation	Maintain current management and any other low cost strategies suggested

7.4.8 Temporary interference of ecosystem service: Pastoral

Kipeto-Isinya landscape is utilized by both livestock and wild herbivores, which interact in grazing areas as observed during field study. Unlike the wild herbivores, livestock are led to grazing areas and thus where they go is determined by the pastoralists. Moreover, presence of human and the activities does not prevent them from utilizing pastors.

The operation during construction phase of the project would potentially affect livestock herds especially with by the movement of vehicles. Since livestock would easily move out of way compared to wild herbivores, they run a risk of accidents with the vehicles.

Just like the wild herbivores, changing the vegetation types along the ROW would also affect them. The lowlands which apparently reserve grasses for long during dry is also used by pastoralists from the area. The construction activities would cause interference; however, the impact is envisaged to be temporary.

Unmitigated impacts of interference of ecosystem service: Pastoral during Construction Phase	
Extent of impact	2
Magnitude of impact	4
Duration of impact	1
Probability of impact	2
Risk = (Extent + Duration + Magnitude) x Probability	**-14**
Confidence of Assessment	Low
Risk of Cumulative impact	**-15**
Recommendation	Mitigate even when below threshold

Comments/mitigation • This mitigation controls behaviour in the field during construction. • Speed of vehicles should be controlled at a maximum limit of 40 km/h. Once a driver note livestock herds nearby or crossing s/he should wait until all have crossed or slow down to avoid hitting individuals.	
Mitigated impact of interference of ecosystem service: Pastoral during Construction Phase	
Extent of impact	1
Magnitude of impact	1
Duration of impact	1
Probability of impact	1
Risk = (Extent + Duration + Magnitude) x Probability	**-3**
Confidence of Assessment	Low
Risk of Cumulative impact	**-4**
Recommendation	Maintain current management

8 ECOLOGICAL MANAGEMENT PLAN

The Ecological Management Plan (EcMP) below is proposed for the proposed Electric and Power Transmission Line Kipeto-Isinya. The EcMP identifies environmental impact, activities that cause the potential impacts, mitigations and who is responsible. Impacts whose potential risk scores more than 30 are considered in the EMP. It is envisaged that the EcMP will control negative impacts and give responsibility to relevant authority on management of environmental issues.

Potential impact	Project components	Aspects affected	Activity/risk source	Mitigation: Action/control	Monitoring aspect	Responsibility
Terrestrial plant alteration	Construction of ROW	Area of coverage Presence Individual plants	Construction phase	Avoid grading in areas with high slope angles to avoid future possible erosion Minimize grading of rugged areas by looking for alternative passage within the 60 m ROW. Avoid cutting of short trees that heights are lower than the power line. Height difference should be maintained at least 15 m. When points of erecting pylons is exactly on cluster of bushes, offset backwards or forward within the proposed line to avoid destruction of the potential habitats or refugia for reptiles and small mammals.	Presence or absence of habitats and plant species	Contractor
Temporary obstruction of movement of wild-herbivores	Construction of ROW	Movement of animals	Construction phase	Speed of vehicles should be controlled at a maximum limit of 40 km/h. Once a driver note a herd of gazelles is crossing s/he should wait until all have crossed or slow down to avoid hitting individuals Avoid grading or clearing of vegetation where the mounds of moles and Aardvark holes occur. These are probably their hidings from predators and severe climate conditions. Operation of construction activities should be restricted to day time from 8am to 5pm. This provides time for foraging for nocturnal animals. This group is normally sensitive to presence of human activities and flood lights at night. During dry season the upland is dry of grasses but the lowland still have grass, herbs and shrub reserves. Most of herbivores migrate to this area thus construction activities during dry season can affect utilization of this area. Construction should therefore be scheduled after	Occurrence of species near ROW	Contactor Local community

Potential impact	Project components	Aspects affected	Activity/risk source	Mitigation: Action/control	Monitoring aspect	Responsibility
				the onset of rainfall. Generally, vegetation in the area respond very fast to rainfall hence herbivores will disperse to avoid any adverse impacts.		
introduction of Alien Invasive Plant Species	Construction of ROW	Species displacement/ destruction	Construction phase Operation phase	Equipment to be used should be decontaminated e.g. washing equipment to remove soil potentially carrying AIPS propagules Avoid importing soils/gravels to use for level grounds for vehicles to pass in ROW should be avoided. If brought from outside, the surface of the soil should be removed to avoid mixing of soils potentially harboring AIPS propagules with the lower soil profiles. Since AIPS appears later after soil disturbance, aftermath proliferation of AIPS should be controlled by reducing their population and recruitment	Emergence of new species (i.e. AIPS)	NMK
Poaching	Routine entrance and exit by constructors into ROW	Species population (poaching for bushmeat especially zebra, gazelle, Elands	Construction phase	Personnel should be screened when entering and leaving construction sites. Local people should be alerted by the constructors to be able to detect visitors potential of poaching	Illegal entrance into ROW	Contractor Local community KWS
Aquatic habitat alteration	Movement of vehicles/ equipment	Area of occupancy for plants	Construction	Contractor should work within the construction space of the ROW. If by any chance there will be need for temporary use of extra space then, such areas should not have tree species. Constructor should consult relevant authority e.g. KWS and KFS	Sedimentation	Contractor NMK

9 REFERENCES

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10 APPENDICES

Appendix A: General plant species observed along the proposed transmission line route

Plant species	Plant species
Acacia drepanolobium	Pilicosepalus curviflorus
Acacia brevispica	Achyranthes aspera
Acacia gerrardii	Plectranthus comosus
Acacia xanthophloea	Leonotis nepetifolia
Acacia tortilis	Ocimum suave
Acacia nilotica	Persicaria pulchrum
Glycine wightii	Commelina Africana
Commiphora Africana	Cyphostema orondo
Ficus sycomorus	Kalanchoe sp.
Aloe volkensii	Abutilon mauritiana
Aloe spp.	Justicia exigua
Dovyalis abyssinica	Cyperus alternifolius
Dovyalis caffra	Cyperus sp.
Euphorbia tirucalli	Olea Africana
Euphorbia candelabrum	Osyris lanceolata
Croton dichogamus	Leucas glabrata
Acalypha racemosa	Asparagus Africana
Euclea divinorum	Phyllanthus amarus
Tarchonanthus camphorates	Grewia similis
Psiadia panctulata	Grewia bicolor
Maytenus senegalensis	Dombeya rotundifolia
Cordia ovalis	Datura stramonia
Balanites aegyptiaca	Solanum anguivis
Cussonia holstii	Solanum nigrum
Acokanthera schimperi	Gardenia ternifolia
Carissa edulis	Tarenna graveolens
Plumeria rubra	Scutia myrtina
Rhus natalensis	Digitaria milanjiana
Rhus vulgaris	Cynodon dactylon
Lantana trifolia	Eragrostis tunuifolia
Vitex ???	Aristida adoensis

Plant species	Plant species
Ipomea obscura	Lippia javanica
Boerhavia diffusa	