

**REPORT OF THE INITIAL ENVIRONMENTAL EXAMINATION (IEE)
SUBMITTED TO THE
COAST CONSERVATION DEPARTMENT FOR THE PROPOSED
MAMPURI III WIND FARM PROJECT AT MAMPURI, KALPITIYA
ROAD, PUTTALAM**

PART A - GENERAL INFORMATION ON THE PROJECT

A1. Name of the project

Mampuri III Wind Power Project

A2. Name of the Developer / Company / Firm, Postal Address / Fax No.

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A3. Name of the contact person, Postal Address/Fax No.

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A4. Nature of the Project

A4. 1. Project objectives

The main objective of the 'Mampuri III Wind Power Project' is to establish a 10MW (rated at 14M/S) wind power generation facility which consists of 5 Wind Turbine Generators (WTG), each of 2.1 MW capacity (Make- S88 – 2100 kW from Suzlon Energy Limited, India) along an approximately 5km long coastal stretch covering Narakkali, Mampuri and Nawakkadu villages in the Kalpitiya Peninsula of the Puttalam District. This wind power plant would produce about 29 million kWh of electricity per year. In return, 29 million kWh / year wind energy would save about 5000 MT of Diesel as a fuel to generate equivalent amount of thermal electrical energy and will cut down about 0.75 Million MT of carbon dioxide emission to the atmosphere over its life of 20 years. Thus, this renewable energy will assist in reducing greenhouse gas production.

As a result of the project, there will be direct and indirect benefits transferred to the project area. Some of them would be improvement of the local road network; lighting, employment opportunities and increase in commercial value of the properties in the area.

A4. 2. Project justification

The annual demand for electricity is increasing by 10% each year and it has been estimated that by the year 2010, the total demand for electricity in Sri Lanka will be around 3,800MW.¹

Sri Lanka had an installed capacity of 2,435 MW in 2006 with energy consumed by the different sectors (approximately: domestic 38%, industrial 40%, and commercial 22%)². The generating facilities available in the country in the year 2006 which were connected to the CEB Transmission Grid are as follows:

CEB Hydro Plants	1207 MW
CEB Thermal Plants	548 MW
CEB Wind Power Plants	3 MW
CEB Total	1758 MW
Private Thermal Plants	565 MW
Private Mini-Hydro Plants	110 MW
Private Renewable	2 MW
Private Total	677 MW
Total Capacity	2435 MW

(Source : <http://www.mope.gov.lk/ceb-01.php>)

Sri Lanka's primary energy supply is dominated by biomass and its contribution has been 48% of the total primary energy supply of 10 million tonnes of oil equivalent (toe) in 2007. The other two significant primary sources of energy supply are petroleum and hydropower, which contributed 42.5% and 9.5% respectively¹.

Most of the commercially viable major hydro capacities (approximately 1,140 MW) have already been exploited by the Government with the remaining few large hydropower plants of above 10 MW capacities presently being prepared for implementation. These, if completed, will contribute only around 300 MW by the years 2010/12 but this will not meet the electricity demand in 2010.

The predicted demand in 2010 also cannot be met by fossil fuel-powered electricity generation as it is also becoming increasingly expensive, thus a decentralized, renewable energy production is becoming much needed to compensate the growing power requirement¹. As per National Energy Policy prepared by the Ministry of Power and Energy in 2006, Sri Lanka is to generate 10% of the national electricity demand from renewable energy resources by the year 2015.

In order to achieve this target, Sri Lanka Government has already set up the Sustainable Energy Authority with effect from 01 October 2007, under the Ministry of Power and Energy, with an aim at generating 400 MW of electricity through wind, small hydro power units, bio gas, dendro-power etc. This Authority is empowered to facilitate private sector investment on renewable energy projects².

Wind power has become the most significant option among renewable energy based electricity generation due to its wider availability and zero environmental pollution. Advancement in technologies, especially wind turbine configurations, their control features and high power electronics has increased the single turbine rating to over 5 MW and the total installed capacity to 74GW in the world.

Among the renewable energy sources available in Sri Lanka, wind power has been identified as the most promising renewable power option for large power generation. The Pre-Electrification Unit of Ceylon Electricity Board has carried out a wind resource assessment study in Puttalam and Central Regions of the country in 2002. A wind energy resource atlas of Sri Lanka and Maldives also was developed by the National Renewable Energy Laboratory (NREL) in 2003. It has revealed that there are many areas that are estimated to have "Good" to "Excellent" wind resources in Sri Lanka¹ (Fig.1) and the annual average wind speed in Puttalam is 7.15 m/s. From June to August (during the period of Southwest monsoon), it records values as high as 10.0 m/s. Therefore, Puttalam has been identified as the best site for wind power development.

11. Source: http://www.ncpcsrilanka.org/Roundtable%20Web/Papers/T3_3.pdf

2 Source : <http://www.mope.gov.lk/ceb-01.php>

Considering the Government's new Sustainable Energy Policy and the high potential for wind energy in the area of Puttalam, Senok Wind Resource (Pvt) Ltd. at No. 3, R.A. De Mel Mawatha, Colombo 5, a duly registered company in Sri Lanka is planning to install a 10 MW wind power generation facility at Kalpitiya.

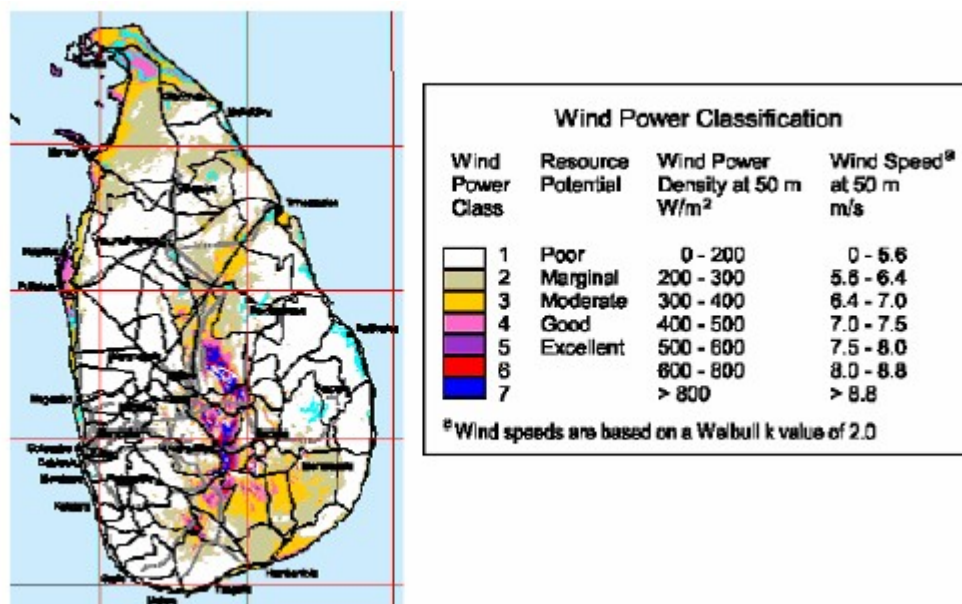


Fig 1 Wind resource assessment in Sri Lanka

(Source: http://www.ncpcsrilanka.org/Roundtable%20Web/Papers/T3_3.pdf.)

The project proponent has obtained Provisional approval from Sri Lanka Sustainable Energy Authority to implement a 10 MW Plant at the earmarked site located in the villages of Narakkali, Mampuri and Nawakkadu in the Kalpitiya Peninsula (Annex 1).

Through this project, it is intended to enhance the capacity of the national grid. In addition, presently there are other Wind Plant sites being developed in the Kalpitiya Peninsula. Thus the Kalpitiya Peninsula will become the biggest wind farm site in the island. The entire Kalpitiya area will have a higher commercial and economic value to lands and other related development activities.

A5. Investment and funding sources

A total of SLR Two thousand six hundred and forty (2,640) Million (or 2.64 Billion) is estimated as the total investment of the project and the following sources will fund this project (Table 1).

Table 1 The sources of funding for the project

Source	Amount to be invested and the nature of investment Rs. Mn	Nature of the Investment	Present status
1. Debt	1,640	Primary Debt	In progress
2. Equity	1,000	Ordinary shares	In progress

A6. Location of the project

Project will be located along an approximately 5km long coastal stretch extending along Narakkaliya, Mampuri, and Nawakkadu villages (belong to 3 GS Divisions-i.e. Narakkaliya Mampuri and Nawakkadu) of Kalpitiya DS Division in the Puttalam District of the North Western Province of Sri Lanka. Fig. 2 indicates the location of the project site.

- I Provincial Council – North Western**
- II District and Secretariat- Puttalam**
- III Local Authority- Kalpitiya**
- IV Divisional Secretariat- Kalpitiya**
- V Grama Niladhari Divisions- Narakkaliya Mampuri and Nawakkadu**

Site is accessible from a turn from Palavi - Kalpitiya main road at the 9th Km post towards sea side. The junction is called Taluwa (Daluwa) and the site is met about 4 Km from Daluwa junction towards sea.

Geographical location of Mampuri wind site can be noted as follows:

- Approximately 12 Km from Palavi junction towards west.
- Approximately 4 Km from Taluwa (Daluwa) junction towards sea.
- Commencing from the road adjacent to the CEB Coal Power project, the site extends 5km southwards

Fig. 3a-3d (the survey plans) shows the accessible roads and the surroundings.

A7. Extent of the site

Approximately 5km

A8. Location map with surrounding development and infrastructure

The total project area lies outside the jurisdiction of the Coastal Conservation Department. A setback distance of 45m has been set by CCD in their Revised Coastal Zone Management Plan of 1997 for this area and all the turbine locations will be beyond this distance as indicated below in Table 2.

Table 2 Approximate distance from beach vegetation line to Turbine location

Wind turbine location number	Approximate distance to beach vegetation line (m)
5	970
4	850
3	825
2	880
1	990

There are two other wind power projects by two sister companies of Senok Wind Resource (Pvt) Ltd. in the same area. Stage I has already been developed by Senok Trade Combine Ltd, and Stage II will be developed by Senok Wind Energy (Pvt) Ltd. Fig. 4 shows the other wind power projects of the surrounding areas.

Project site lies within a fisheries and agricultural area. However, there is no interference to these activities from the project.

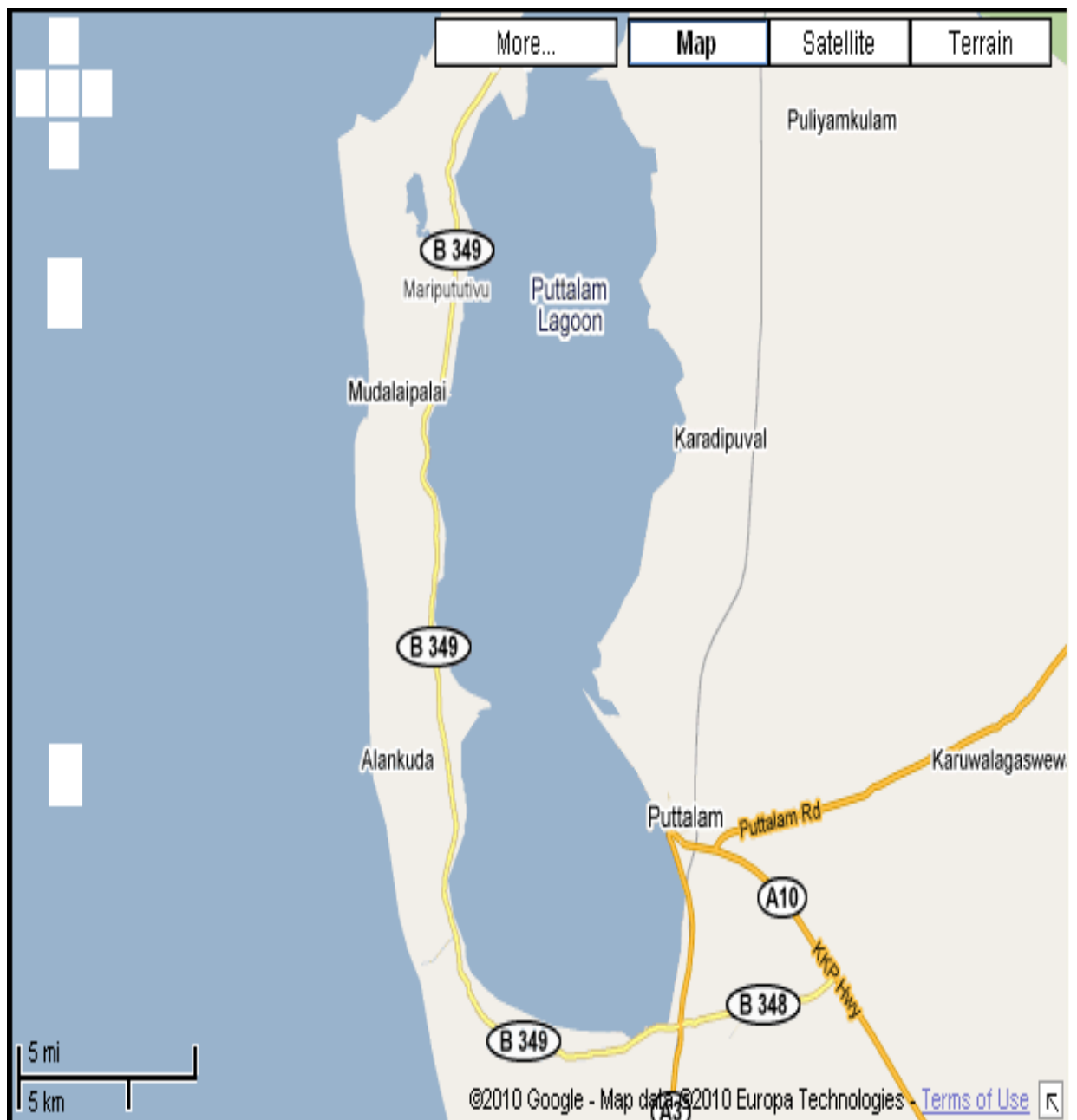


Fig. 2 Location of the project

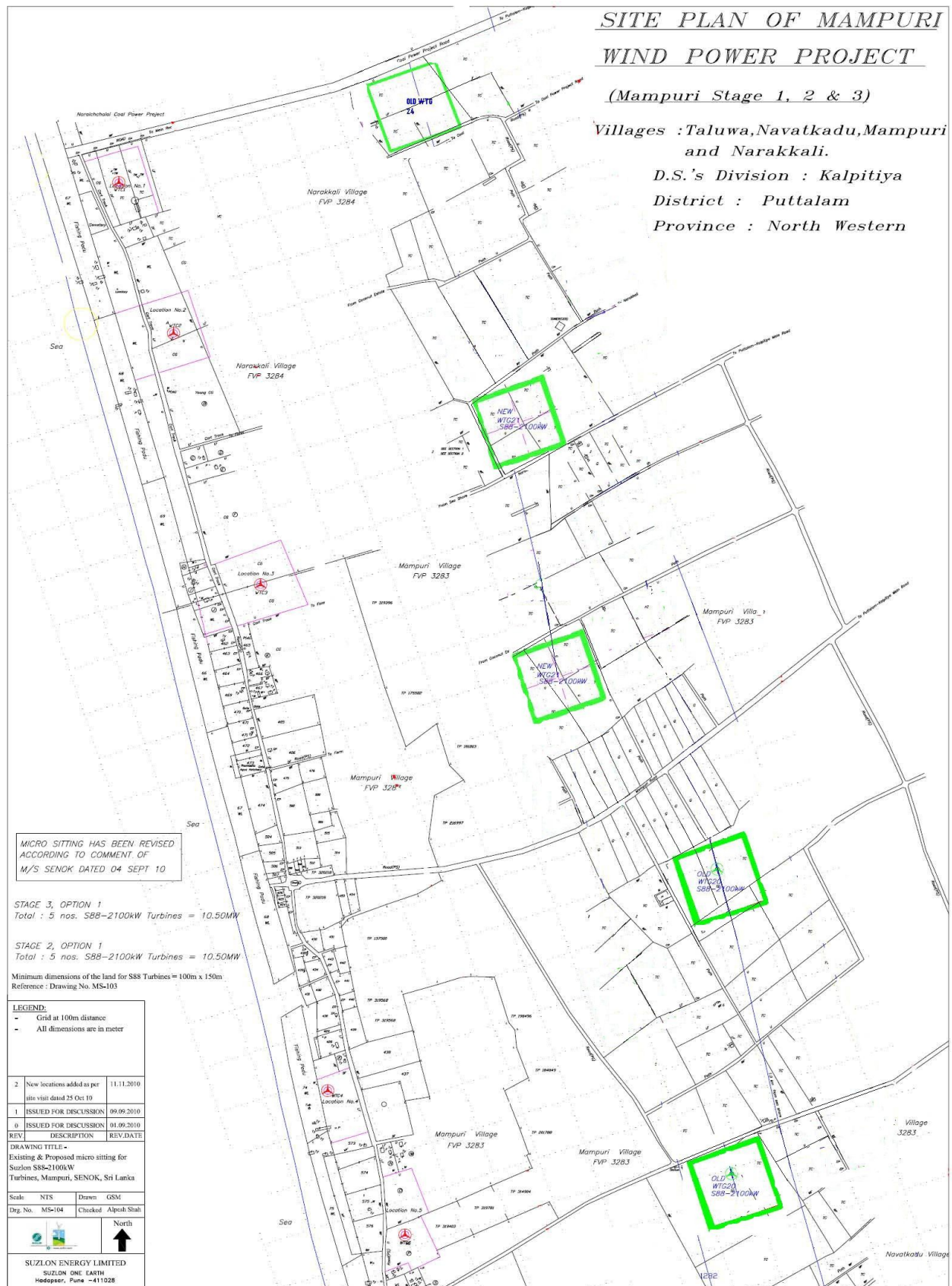


Fig. 3a Survey Plan of Mampuri III Wind Power Project



Fig.4 Wind power projects in the surrounding areas

A9. Survey plan of the project site with extent of the project area

Figs. 3a show detailed Site Survey Plans.

A10. Present ownership

The proposed strip of land for the project extends over several blocks of state and private land. Some blocks of state land have been allocated to people for development as Jayabhoomi grants. Land required for the project will be purchased from private owners while the state land will be leased from the Kalpitiya Divisional Secretariat.

A.11. Description of the applicable laws, regulations, standards and requirements covering proposed project

Applicable laws and regulations

There are several Acts, Laws, Regulations and Guidelines stipulated by various government agencies in relation to the projects of this nature. Among them, the following are directly relevant to the project.

- ❖ National Environmental Act No 47 of 1980 and amended in 1988 and 2000
- ❖ Coast Conservation Act No 57 of 1981 , amended by Act No 4 of 1996
- ❖ Fauna and Flora Protection Ordinance as amended by Act No 49 of 1993
- ❖ Flood Protection Ordinance No 4 of 1924
- ❖ Irrigation Ordinance No 32 of 1946, amended by Act No 48 of 1968 and by Act No 13 of 1994
- ❖ Land Development Ordinance of 1935
- ❖ National Water Supply and Drainage Board Law No 2 of 1974 amended by Act No 13 of 1992
- ❖ Nuisance Ordinance No 15 of 1862 as amended by Act No 57 of 1946
- ❖ State Land Ordinance No 8 of 1947
- ❖ Soil Conservation Act of No 51 of 1951
- ❖ Urban Development Authority Law No 41 of 1978
- ❖ Provincial Councils and Local Government Act
- ❖ National Aquaculture Development Authority of Sri Lanka Act No. 53 of 1998
- ❖ Fisheries and Aquatic Resources Act No. 2 of 1996
- ❖ Antiquities (Amended) Act No. 24 of 1998
- ❖ North western Province Environmental Statute 12 of 1990
- ❖ Sri Lanka Electricity Act No. 20 of 2009

Jurisdictions relevant to the project

Table 3 analyses the jurisdiction areas that are relevant to the project.

Table 3 Evaluation of the project wholly or partly falling within the relevant jurisdiction areas

	Jurisdiction	Yes	No
1	100 meters from the boundaries of or within any area declared under the National Heritage Wilderness Act No 3 of 1988		X
2.	100 meters from the boundaries of or within any area declared under the Forest Ordinance (Chapter 451)		X
3.	Coastal Zone as defined in the Coast Conservation Act No 57 of 1981 and setback limits defined in the CZMP of 1997 in respect to Kalpitiya Peninsula		X
4.	Any erodible area declared under the Soil Conservation Act (CM50)		X
5.	Any flood area declared under the Flood Protection Ordinance (Ch449)		X
6.	Any flood protection area declared under the Sri Lanka Land Reclamation Corporation Act 15 of 1968 as amended by Act No 52 of 1982		X
7.	60 meters from the bank of a public stream as defined in the Crown Lands Ordinance (Chapter 454) and having a width of more than 25 meters at any point of its course		X
8.	Any reservations beyond the full supply level of a reservoir		X
9.	Any archaeological reserve, ancient or protected monument defined or declared under the Antiquities Ordinance (Ch 188)		X
10.	Any area declared under the Botanic Gardens Ordinance (Ch446)		X
11.	Within 100 meters from the boundaries of or within any area declared as a sanctuary under the Fauna and Flora Protection Ordinance (Chapter 469)		X
12.	100 meters from the high flood level contour of or within a public lake as defined in the Crown Lands Ordinance (Ch 454) including those declared under section 71 of the said Ordinance		X
13.	Within a distance of one mile of the boundary of a National Reserve declared under the Fauna and Flora Protection Ordinance.		X
14.	Any gazetted Beach seine (Sinhala –Ma-del) areas under the Fisheries and Aquatic Resources Development Act	X	
15	Falling within the tourist development area that has been identified for development		X

A12. Clearances/ permits obtained or should be obtained from relevant State agencies and /local authorities

Table 4 shows the details of clearances/permits obtained or should be obtained.

Table 4 Details of clearances/permits obtained or should be obtained

Clearance/ permit	Status
1. Provisional approval from Sri Lanka Sustainable Energy Authority	Obtained (Annex1)
2. Letter of Intent from CEB to develop the Project	Pending
3. Approval from the Coast Conservation Department	Obtained (Annex2)
4. Approval from the Divisional Secretary, Divisional Secretariat, Kalpitiya	Obtained (Annex3)
5. National Water Supply & Drainage Board Approval	To be obtained
6. Irrigation Department Approval	To be obtained
7. Puttalam District Coordination Committee approval	To be obtained
8. District Land Utility Committee Approval	To be obtained
9. District Environmental Committee Approval	To be obtained
10. District Agricultural Committee approval	To be obtained
11. Approval from the Kalpitiya Pradeshiya Sabha	To be obtained
12. North Western Provincial Council Environmental Department Approval	In progress -request letter attached (Annex4)
13. Generating License	To be obtained
14. Civil Aviation Authority Approval for Wind Mast Construction	Obtained- letter attached (Annex 5)
15. Approval from Road Development Authority for transportation of heavy vehicles and equipment	In progress
16. Approval from Department of Agrarian Development	To be obtained
17. Approval from Coconut Cultivation Board	N/A
18. Approval from Ministry of Tourism	N/A
19. Approval from the Survey Department of Sri Lanka	N/A
20. Approval from the Department of Wildlife Conservation	N/A
21. Approval from Forest Department	N/A
22. Approval from the Ministry of Defence, public Security, law and Order	To be obtained
23. Approval from Department of Archaeology	N/A
24. Solid waste disposal arrangement with Kalpitiya Pradeshiya Sabha during operational phase of the project	To be obtained

PART B – PROJECT DETAILS

B1. Description of the project

The development of the project includes the engineering, procurement and construction including transporting and commissioning of the wind power generating facility and its operation and maintenance for 20 years. The Project will consist of 5 wind turbine generators (WTG), each of 2.1 MW capacity (Make- S88 – 2100kW from Suzlon Energy Limited, India) and a 690/33 kV transformer switchyard. The other infrastructure facilities (i.e. a central control room; a maintenance workshop; and staff quarters) will be shared with the Mampuri Wind Power Project I that has already been developed by Senok Trade Combine Limited. 5 Wind Turbine Generators (WTG) will be constructed at intermittently selected locations within about a 5km stretch. A 33kV transmission line that would be constructed parallel to the existing 33Kv line along the Kalpitiya road up to Norochcholai 220 kV substation, the nearest facility owned by the Ceylon Electricity Board. Technical support would be provided by the CEB to the project developers to construct the transmission line. A grid interconnection arrangement at 33kv level will be proposed by the Ceylon Electricity Board.

WTGs will be installed in a row at a distance of about 396m from each other while maintaining more than 600m distance from the Mampuri fishing village. Wind power plant is designed to operate automatically and is monitored from a computerized central monitoring station. Starting and stopping of wind turbines also could be done from this station.

During the construction period of the above structures, the project will use the existing infrastructure and during the project implementation, all infrastructure facilities would be enhanced by the project for its smooth operation.

B2. Project layout plan

Layout plans for the 5 WTG are given in Fig. 3a.

B3. Details of all activities in relation to or connected with the project

B3. 1. Clearance of vegetation

The locations selected for the erection of WTG and other facilities have a minimum natural vegetation cover as the area is used for growing vegetable and tobacco. Only tall trees in the area are some coconut and Palmyra trees (Fig. 5). Wherever possible, most of these tall trees will be kept intact except for those that will be removed in the footprint area of the project.



Location of WGT 1-
Abandoned vegetation land

Location of WGT 2- Ear-marked
land has not been cultivated on



Location of WGT 3- Barren and
non cultivated area only with a
few Palmyra trees near the border.

Location of WGT 4- Land is
partly barren and a portion of
vegetation land



Location of WGT 5-
Abandoned vegetable plot.



Figure 5 Vegetation patterns in the turbine locations continued

B3. 2. Excavations

Excavations will be limited only to the cable trenches, turbine, building and transformer bay foundations at each location. Approximate dimensions of cable trench would be 1.0m deep and 1.0m wide, Turbine footing foundations approximately 3m deep, 15m long and 15 m wide, building foundation depth would not exceed 2 m. Transformer bay foundation would be about 1.5m deep including the spill containment area. Machinery and earthmoving equipment will be brought into the site for soil excavation, transportation and erection work. Excavated soil will be utilized for the improvement of road network of the area and any other soil stabilization at site.

B3. 3. Construction work

All constructions will be confined to the survey plan No179 (Fig. 3a-3d). All constructions will be carried out in accordance with the structural plans which will be submitted to the Coast Conservation Department by the project, prior to commencement of construction. Any expansion or changes to the project/process other than the expansions indicated in the proposal will not be carried out without prior approval of the Coast Conservation Department and the Provincial Environmental Authority.

Turbine footing foundation and foundation for buildings will require concrete which will be brought to the site in ready mix form in order to minimize the discharges. The nature of construction consists mainly of dry construction methods and assembling of manageable sized parts which does not require a major labour force and constructional infrastructure on the site. Dry construction methods also require fairly low volume of water. Construction of the buildings will be carried out mostly with manual labour except in the erection of WTG for which machinery will be used.

B3. 4. Vehicle and Equipment Maintenance and Cleaning

Specific areas will be allocated for controlled cleaning and maintenance of the earth moving and erection equipment. Oil spills and dry lubricants will be cleaned up regularly and prevent any soil contamination.

B3. 5. Construction Camp Operations

Mostly the workers will be selected from the Kalpitiya area and no big camps are anticipated. However a proper, temporary dwelling unit will be hired /constructed during the construction period.

B4. Requirement of labour during construction and operation period

Many studies conducted all over the world indicate that the introduction of grid connected wind power projects result in direct and indirect generation of employment. It has been estimated that for each MW of

installed capacity of wind farms, there is an employment potential of three skilled operators and two unskilled persons. The indirect employment opportunities are about four times direct employment. During the construction period, lasting about six months, additional employment is available to 50 local people for civil and electrical work. Based on this information, this project will provide 250 direct and indirect employments to people during its construction and it is intended to hire them from the project area. A permanent staff of 6 members will be employed during the operational period of the project.

B5. Details of methodologies to be adopted during the construction

WTGs will be installed in a row at a distance of about 396m from each other. Area occupied by each WTC foundation will be a circle of diameter 14m. An area of about 150m x 100m will be used during the construction period. This area will be used for temporary storage of WTG parts prior to their installation and operation of the installation cranes. The project intends to acquire the necessary blocks of land for each WTC.

For the purpose of bringing equipment to the site and installing them, it is necessary to construct a good road running parallel to the row of wind turbines. For this, the company would upgrade the existing sandy road along the coast to a paved road. After completing the project, the newly built road would remain open for public use as well. Besides the new road, the company would also invest in improving the existing minor roads in the area.

Construction of the proposed wind power plant consists of following phases:

- Construction of access roads - requires the deployment of light-duty road construction machinery and a small labour force. Time period for road construction is about 50 days.
- Construction of WTG foundations- requires the deployment of machinery for excavation, preparation & pouring of concrete, water bowsers, pumps etc. Labour requirement will be less than 60 at any given time. All foundations will be completed within 60 days. Total volume of excavated soil will be about 230 cubic metres per foundation. About 30% of this will be used to back-fill and the balance will be used to build the earthen ramp for main installation crane.
- Installation of the WTGs and the switchyard- requires the use of 3-4 heavy lift cranes and a gang of about 20 skilled and semi-skilled personnel. Time for completion of this activity will be 45 days.
- Construction of 33 kV transmission line across the 5 km land- will mainly require a 5-ton boom truck, trailer, miscellaneous jigs and a small gang of labour

After the construction phase, all machinery and equipment will be removed and the site will have only WTGs and small switchyard at each location. A computer generated assumed model is attached for clarity (Fig. 6). Installation or operation of any machinery/ equipment other than those stated in the application will not be carried out without prior approval of the Provincial Environmental Authority.



Figure 6 Similar Model to Proposed Wind Power Project

The Project construction will be planned for low wind months from end of October to March.

During construction, the project schedule is focused on minimizing the time required for the large-capacity cranes due to their high operating costs. Before mobilizing the heavy lift cranes, the conventional earthmoving equipment such as excavators, bulldozers, graders, dump trucks, and cement trucks are the first batch of equipment to be brought to the site and are used to construct the foundations and install power cabling. While the infrastructure is being installed, turbine and tower components will be delivered to the site and staged near the foundations. Upon completing assembly of the WTG, electrical and communication connections will be made and turbine testing begins. Once the WTG are commissioned, the commercial energy production will be started.

The WTG consists of four main components, namely, rotor, nacelle, tower and foundation (Fig. 7a). Rotor consists of three blades made out of fibreglass. Function of the rotor is to convert power in the wind into mechanical power that rotates the main shaft. Rotating shaft drives the generator producing electricity. Purpose of the gearbox is to increase the rotor speed to the required generator speed. As shown in Fig. 7b, the shaft, gearbox and generator are located inside the nacelle, which is mounted on top of the tower. As the direction of wind changes, the nacelle automatically turns towards the wind. The power output of the WTG increases as the wind speed increases. The tower height of the WTG is 80 m. The gap between one turbine to the other in a single row will be around 396m.

Parameters of the selected WTG are as follows:

Rotor diameter	88m
Tower height	80m
Rated wind speed	14 m/s
Cut-in wind speed	4 m/s
Shut-down wind speed	25 m/s
Rated output	2100 kW

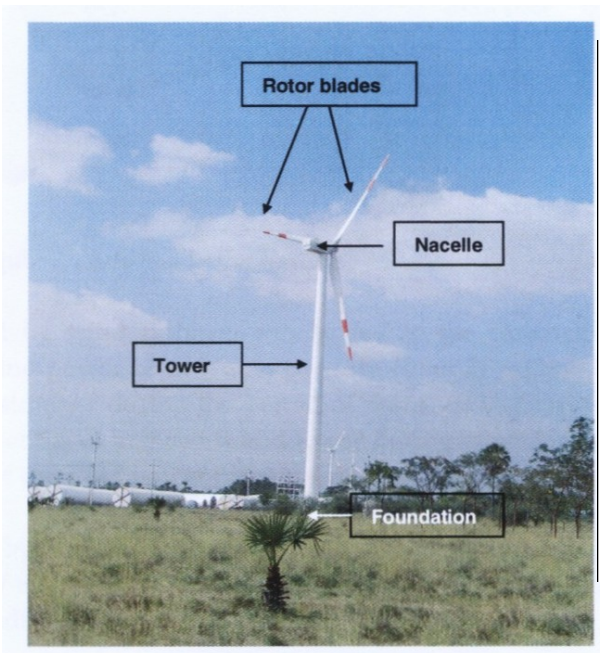


Figure 7a - Main parts of a WTG

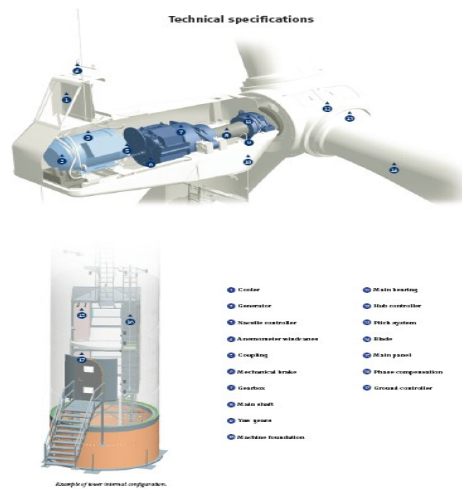


Figure 7b - Parts inside the nacelle

B6. Infrastructure facilities required/provided

Existing infrastructure facilities will be used by the project during the construction period and subsequently the road network will be improved by the project.

B7. Details of laying out of transmission line

The Transmission line will be constructed as approximately 15 km long 33kV conductor Double Circuit line from Mampuri up to Norochcholai Grid Substation as per the CEB Standard Design. The Project will initiate the design and construction of the Transmission Line in consultation with CEB and expects to commence work simultaneously with other construction work of the project.

B8. Aesthetic and visual environment

The project will locate outside the setback distance stipulated by the Coast Conservation Department and the clearing of natural vegetation is not necessary as all sites are vegetable plots or barren land in which natural vegetation have already been cleared. Therefore the present aesthetic and visual environment will not be changed or disturbed by the project.

PART C - INFORMATION ON ENVIRONMENTAL ELEMENTS

C1. Physical Environment

C1. 1. Topography, Geology and Soil

The Kalpitiya Peninsula is an elongated stretch of land extending from Udappuwa in the south to northern end point (Kudramalai Point) at the approximate latitude of 7° 45'. Originally an island, Kalpitiya is now connected to the mainland by a once marshland area included between Puttalam estuary in the north and the Mundal Lake in the south as well as by permanent roads connecting the southernmost tip of the Peninsula to the main land. The Peninsula can be subdivided into two distinguished geographical domains:

- a southern compartment, shaped as an elongated triangle with the southern apex ending at Udappuwa, bounding westwards the Mundal Lake;
- a 30Km north-north-eastwards, forming the western boundary of the Puttalam estuary.

The Peninsula is overall a flat terrain. Its relief is marked by an alignment of dunes in the western part, stretching north to south, not exceeding 8m to 9m in elevation above sea levels (Cooray, 1984). The relief of the project area is marked by a developing sand dune which does not exceed more than 2-3m in elevation above sea level.

Patches of marshland in the northernmost extension of the Peninsula have been reclaimed and some of these areas have been used for shrimp farming. However, many shrimp farms are abandoned nowadays and no shrimp farms are located in the close vicinity of the project site.

Geology of Puttalam region was studied and documented by Swan (1983) and Cooray (1984). According to them, the project area is underlain by sedimentary (Tertiary) Miocene limestone rocks, which are generally fossiliferous. This lime stone bedrock is covered by recent Quaternary (= period covering two million years BP) sedimentary deposits consisting of alluvium and lagoonal estuarine deposits, unconsolidated sands (of the beaches and dunes) and beach rocks.

C1. 2. Hydrology

C1. 2. 1. Water bodies situated in the project area:

There are no permanent streams of surface water in Mampuri area. Short seasonal streams augmented by ground water base flow, discharge directly in to the sea.

C1. 2. 2. Surface drainage patterns of the area

The area is hot and dry having less rain. The water courses in the area are seasonal. The closest water course to the project site is located about 5km southerly to the last turbine location in the row. Due to the very permeable nature of the sandy soil and the essentially flat topography, the part of the rainfall, which is not evaporated, essentially infiltrates into the subsoil. There are places in the Kalpitiya Peninsula, where short seasonal streams develop towards the end of the rainy season when the ground water table reaches its highest level (Anon., 1994).

C1. 2. 3. Groundwater quality

Project area contains a local or discontinuous but productive aquifer in intergranular 'rock' made up of sand, gravel, and alluvial material. The average depths of tube wells constructed in this area is about 20-30m and the water table is in the range of 3-5 m. the yield varies from 0.8-3.7 litres per second. The water is generally hard, saline and contains excess iron. (Anon., 1988)

C1. 2. 4. Observed annual flood levels and duration

No floods are reported from the project area due to the very fact that the very high permeability of soil does not allow any surface retention of runoff water.

C1. 3. Meteorology and Climate

The Mampuri III project site lies in the dry zone of the north western low country which falls within the DL3 agro-ecological region defined as an area where there is a 75% expectancy of an annual rainfall exceeding 580mm. The site is in an area that experiences an average annual rainfall between 1,000-1.250mm range (Somasekaram, 1997). The average monthly air temperature for the area is about 27°C and the seasonal variation is comparatively low. The differences in the temperatures are predominantly diurnal (Somasekaram, 1997). Two Wind Regimes influence the project area, the Southwest monsoon from May to September and the Northeast monsoon from December to February and the inter-monsoon period in October / November with often large scale convective activity and heavy rainfall (Somasekaram, 1997).

C1. 4. Air Quality

The area around the project site has no industrial developments except for fishing which is confined to the boat landing sites and Ma-del hauling sites. Majority of the land around the site are agriculture plots (mainly tobacco and vegetable) with scattered barren land. None of these activities contribute to air pollution. The main source of air pollution would be the traffic along the Palavi – Kalpitiya road and minor traffic on the internal access routes around the Daluwa and Mampuri villages. There can be tractors and

other land vehicles often used for fishing and agriculture activities and they run along the coast. But the contribution from these sources towards air pollution can be considered as negligible, as there is a high wind circulation which can dilute the vehicular emissions in the area. Use of firewood and low quality fuel used for the domestic purposes would be contributing to ambient air quality of the area but again the gravity should be low as the human population in the project site is low.

C1. 5. Noise

There are no significant noise sources located in the project area within the 3km radius due to the fact that the area is generally underdeveloped. Predominantly the area is cultivated with tobacco and vegetable with some isolated trees, barren lands and few houses where migratory fishermen and plantation workers live with their families. A detail noise baseline survey has been done for the project area (Annex 6). According to the results obtained, the existing back ground noise is resulting from the sea waves and wind which ranged between 49-53 L_{90} (db) during daytime and 50-54 L_{90} (db) during night time. The ambient noise levels at boundaries ranged between 50-54 $L_{Aeq,T}$ (dB) during daytime and 53-55 $L_{Aeq,T}$ (dB) during night time.

C2. Ecological Environment

C2. 1. Flora

The flora within the project site was studied in a field survey. The site falls within a vegetable cultivation consisting mainly of cash crops such as tobacco, onion, lima and chilli which are seasonal. Isolated Palmyra and coconut trees also can be seen in the site. None of the species listed above are endemic to Sri Lanka and none are rated by the IUCN as threatened species.

C2. 2. Fauna

The fauna within the project site was studied in a field survey. In the absence of noticeable amounts of naturally vegetated areas, the fauna is reduced to species capable of living in cultivated land. Very few remarkable terrestrial fauna were recorded within the project site or its immediate surroundings (Table 5). The Star Tortoise (*Testudo elegans*), is the one such species of reptiles observed at Mampuri, which is listed by the IUCN (2006) as threatened within Sri Lanka. People of the area reported that Star Tortoises were very common in the Kalpitiya Peninsula some years back but now they are seen occasionally.

Note should also be made on the feral species of Ass, namely *Equus asinus*. *E. asinus* was brought to Sri Lanka by Arab traders, and the animal is confined to the Kalpitiya Peninsula which is also occasionally seen in the surrounding areas.

As the location of WGTs in the site could pose a potential threat to the birds if they are positioned in the flying routes of birds, a special bird survey was carried out by the Field Ornithology Group (FOG) of the

University of Colombo covering Mampuri I,II and III project areas. A final report is submitted (Annex 7) based on their observations from September 2008 – May 2009 covering the migration season 2008/09.

A total of 132 species have been recorded during the survey period. Terns and Gulls are the highest risk group as they show high mobility between sea and the lagoon. Waders are another group of high risk birds. Raptors are also a high potential group of birds to have collision risk with wind turbines. Among the other birds observed, Barn swallow, Blue-tailed bee eater and Asian palm swift are important since those are very common and also use higher layers of the vertical space. Therefore, there is a high potential to have collision risk of these species.

Table 5 List of terrestrial animal species found in the site and surroundings

(Identifications were carried out following Deraniyagala, P.E.P., 1953, 1955, De Silva, A., 1994, 1996)

Family	Species	Common name (S)- Sinhala	Abundance
Reptiles			
Colubridae	<i>Ahaetulla nasutus</i>	Ahatulla (S)	VC
	<i>Amphiesma stolata</i>	Aharakukka (S)	C
	<i>Pryas mucosus</i>	Garandiya(S)	C
Elapidae	<i>Naja naja</i>	Naya (S)	R
Viperidae	<i>Vipera russelli</i>	Polanga (S)	R
Varanidae	<i>Varanus cepedianus</i>	Thalagoya (S)	VC
Scincidae	<i>Mabuya carinata</i>	Hikanala (S)	C
Agamidae	<i>Calotes calotes</i>	Pala katussa(S)	VC
	<i>Calotes versicolor</i>	Gara katussa (S)	VC
Gekkonidae	<i>Gehyra mutilate</i>	Sudu gewal huna (S)	VC
	<i>Hemidactylus frenatus</i>	Gewal huna (S)	VC
Testunidae	<i>Testudo elegans</i>	Tharaka Ibba**(S)	R
Amphibians			
Bufonidae	<i>Bufo melanostictus</i>	Geyi gamba (S)	VC
Mammals			
Scluridae	<i>Funambulus palmarum</i>	Iri Lena (S)	VC
Muridae	<i>Bandicota bengalensis</i>	Podi Urumiya (S)	C
	<i>Bandicota indika</i>	Uru miya(S)	C
	<i>Rattus rattua</i>	Ge miya(S)	C
Soricidae	<i>Suncus murinus</i>	Poduhik meeya(S)	
Pteropodidae	<i>Pteropus giganteus</i>	Ma waula (S)	VC
	<i>Cyanopterus sphinx</i>	Nasketi pol waula (S)	C
Viverridae	<i>Paradoxurus</i>	Kala wedda (S)	C
	<i>hermaphroditicus</i>		
	<i>Equus asinus</i>	Buruwa (S)	R

** Nationally threatened

Table 6 shows some of the fish species that are taken from beach seines in the vicinity of the project site. No species is threatened.

Table 6 - Fish species recorded from the beach seine fishery in the vicinity of the

Site (Identifications carried out following De Bruin *et al*, 1995)

Family	Species	Common name – English/ Sinhala
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Carangidae	<i>Caranx sp.</i>	Trevally/Paraw
	<i>Scomberoides commersonianus</i>	Queen fish / Kattawa
	<i>Decapterus russelli</i>	Indian scad Ang paratiya
Centropomidae	<i>Lates calcarifer</i>	Barramundi / Modha
Carcharhinidae	<i>Charcharinus spp</i>	Shark /Mora
Dasyatidae	<i>Dasyatis sp</i>	Rays /Maduva
Chirocentridae	<i>Chirocentrus sp.</i>	Wolf herring/ Katuwalla
Chanidae	<i>Chanos chano</i>	Milk fish/Wekkaya
Leiognathidae	<i>Leiognathus sp.</i>	Pony fish/Karalla
Lutjanidae	<i>Lujanus sp.</i>	Snappers/Thambalaya
	<i>Aprion virescens</i>	Greenjobfish/ Dhiulava
Serranidae	<i>Epinephelus sp.</i>	Grouper/ Kossa
Lactariidae	<i>Lactarius lactarius</i>	False trevally/Pulunna
Belonidae	<i>Ablennes sp.</i>	Needlefish/ Moralla
Clupeidae	<i>Amblygaster sp.</i>	Sardines/ Hurulla
	<i>Sardinella longiceps .</i>	Indian oil sardine /Pesalaya
	<i>Dussumieria sp.</i>	Rainbow sardines/ Thondaya
	<i>Ehirava fluviatilis</i>	Malabar sprat/ Ahirava
	<i>Hilsa kelee</i>	Kelee shad/ Katu koiya
Exocoetidae	<i>Cheilopogon sp.</i>	Flying fish /Piya massa
Pristigasteridae	<i>Ilisha melastoma</i>	Indian Ilisha/As bokka
Hemiramphidae	<i>Hemiramphus sp.</i>	Half beak /Muralla
Gerridae	<i>Gerres sp.</i>	Silverbidy/ Oleya
Lethrinidae	<i>Lethrinus sp.</i>	Emperor/Meevatiya
Mugilidae	<i>Mugil sp.</i>	Gray Mullet/Godaya
Mullidae	<i>Parupeneus sp.</i>	Goatfish/ Nagaraya
Scombridae	<i>Auxis thazard</i>	Frigate tuna /Ragoduwa
	<i>Euthynnus affinis</i>	Kawakawa/ Atawalla
	<i>Rastrelliger sp.</i>	Indian mackerel/Kumbalawa
	<i>Scomberomorus sp.</i>	Spanish mackerel/ Thora
Trichiuridae	<i>Lepturacanthus sp.</i>	Hairtail /Savleya
Engraulididae	<i>Stolephorus sp.</i>	Anchovies/Halmassa
	<i>Encrasicholina sp.</i>	Anchovies/ RathuHalmassa

C3. Land Resources and Land Use

Kalpitiya Peninsula is formed with sand; essentially sand beach, sand dunes, and ridge and runnel sand plains. Sandy regosols are particularly widespread in Kalpitiya. In spite of poor organic content, texture and cation-anion exchange, the permeable sand is well drained and aerated. Slightly to moderately salty groundwater is also available everywhere in the Peninsula at 2 to 5m depth. These conditions provide a suitable environment for some cash crops thus agriculture is by far the main economic activity in Kalpitiya (Anon,1994).

All the selected turbine pad locations fall outside the Coastal Conservation Department controlled areas (i.e. outside 300m from the mean sea water line defined as the Coastal Zone). The coastal Ma-del zones (strip of land allocated for fishing activities along the coast) adjacent to the project site are used for seasonal fishing activities by the fishermen. There are semi-permanent and permanent buildings constructed along the coastal strip for dwellings of fishermen. In addition to these activities, vegetable cultivation too is predominant in the project area. The available undeveloped barren land blocks have been selected for

positioning WTG.

C4. Socio-economic environment

C4.1. Visual Amenity and Landscape Values

Presently the beach of the project area has an aesthetic value as it is used for Beach seine (Sinhala – Madel) operation and as a landing site of fishing boats. Mampuri I site is already commissioned and Mampuri II and the present project will add up to the area. There are other three Wind Plant sites being developed in the area. Thus the area will become the biggest wind farm site in the island. The entire Kalpitiya area will have a higher commercial & economic value to lands and other related development activities.

C4. 2. Local Settlement Pattern and Population

Total population of Kalpitiya Divisional Secretariat as per the survey done in 2006 is 59,036. Of the total population, the female population is 29,690 and the male population is 29,346.

Mampuri village is spread over an area of 10.10 Km² in the Kaplitiya Divisional Secretariat Division. Mampuri area has been developed recently due to the CEB Coal Power Station involuntary resettlement plan. There are 80 new houses build for the resettlement and provided with electricity, water and access road facility along with 1ha cultivable land per family unit. The total population of the new settlement is reported as 240.

Some data on the population structure of Mampuri GN Division (No 605 B)

Total population	2077
No. of females	1059
No. of males	1018
Number of School Children	550
Total number of families	516
Electricity facilities available For families	75%
No. of Cadjan houses (used by migratory fishermen on temporary basis)	58
Permanent houses	458

There are 480 fishing families depending on fishing and related activities. There are 65 fishing boats (OBM), 3 Theppan (traditional craft), 9 permitted Beach seines and three others operating in this area.

Narakkalliya village spreads over an area of 15 Km² in the Kaplitiya Divisional Secretariat Division. Narakkalliya area has been developed as a fishing area for both beach seining and small boat landing. In addition, a eco-friendly hotel complex spreads along the beach owned by a private company.

Some data on the population structure of Narakkalliya GS Division (No 621)

Total population	2565
No. of females	1289
No. of males	1276
Number of School Children	520
Total number of families	580
Electricity facilities available for families	307
No. of Cadjan houses (used by migratory fishermen on temporary basis)	217
Permanent houses	352

There are 398 fishing families depending on fishing and related activities. There are 120 fishing boats (OBM), 40 Theppan (traditional craft), 7 permitted Beach seines.

Navakkadu village spreads over an area of 15 .85 Km² in the Kaplitiya Divisional Secretariat Division. Narakkalliya area has been developed as a fishing area for both beach seining and small boat landing. In addition, it is a major cash crop cultivating area.

Some data on the population structure of Navakkadu GS Division

Total population	2967
No. of females	1187
No. of males	1780
Number of School Children	475
Total number of families	510
No. of Cadjan houses (used by migratory fishermen on temporary basis)	157
Permanent houses	443

There are 328 fishing families depending on fishing and related activities. There are 110 fishing boats (OBM), 20 Theppan (traditional craft), 4 permitted Beach seines.

C4.3. Infrastructure and Industry

CEB Coal Power Station involuntary resettlement plan has improved the infrastructure facility of the area. No visible industry is in existence within the 2 Km radius except agriculture and fisheries.

C4. 4. Archaeological Sites

No archaeological sites are present near the project site.

C4.5. Health and Education Facilities

Health and education facilities in the locality are provided by the government. There are preschools and schools up to secondary education in both Sinhala and Tamil mediums. The closest school is within the 3 km radius of the project site.

C4. 6. Occupational Pattern

In the study area, more than 95% of the population are agriculturists and agricultural labourers and fishermen. Only a 5% are government servants. Due to drought conditions and absence of major industries, most local labourers are migrating to other areas finding employment. The Mampuri III Wind Project will provide additional local employment and supplementary business generation during the construction period.

C 5. Natural and Cultural Heritage and Tourist Resources

No natural and cultural heritages in the area. The project area is not identified as a tourist area. However, Kalpitiya is currently being identified as one of the major tourist area for development.

PART D - ANTICIPATED ADVERSE ENVIRONMENTAL AND SOCIAL IMPACTS AND PROPOSED MITIGATORY MEASURES

D1. Impacts to the land, beach and shoreline and their vegetation

There will not be much of an impact on the topography of the area during the construction period as the land itself is flat nature. The selected area is almost flat and no dramatic changes of the topography are expected. The project location is more than the 45 m setback distance stipulated by the Coast Conservation Department. Therefore, no disturbance to the shore vegetation line is possible thus, there will be no disturbance to the stabilization of the shore. This will ensure that no soil erosion will take place as a result of the establishment of WTGs.

Excavation will be limited only to the cable trenches and turbine footing foundations and foundations of the buildings. Depth of the excavation would not exceed 3 m. About 30% of this will be used to back-fill and the balance will be used to build the earthen ramp for main installation crane, thus disposal of soil will not pose any problem.

No blasting or quarrying is involved at the moment. However, if any unforeseen blasting or quarrying may take place, it will be informed to the Provincial Environmental Authority, North Western Province (PEA-NWP) and will be carried out in accordance with guidelines issued by the relevant agencies concerned.

The construction activities are very limited in terms of civil works and other. Hence there would not be much disturbance to the soil in the area. Concrete will be brought to the site in ready mix form. Hence discharge will be minimal. The nature of construction consists mainly of dry construction methods and assembling of manageable sized parts which does not require major a labour force and constructional infrastructures on the site. Dry construction methods also require only very little amount of water. Construction of the buildings will be carried out mostly with manual labour except in the erection of WTG for which machinery will be used.

D2. Impacts to Groundwater quality

Minimal amount of water will be required to the construction work as concrete will be brought to the site in ready mix form. Hence discharge will be minimal. However, some adverse effects on groundwater is possible through construction waste and accidental spills. Such impacts will be curbed through training of construction workers prior to work and on going basis on spill prevention and careful handling and through facilities prepared for sanitation.

At the moment, there are no plans to extract groundwater. However, if the need arises, a report indicating availability and safe yield obtained from the Water Resources Board/ National Water Supply and Drainage Board will be forwarded to the Provincial Environmental Authority, North Western Province (PEA-NWP).

D3. Impacts of Storm water runoff on pollution of existing waterways

Once the project is completed, total ground area occupied will only be by way of foundations of 8 turbines and 1 building. Therefore there is enough ground for natural seepage of storm water run-off thus impacts such as soil erosion due to storm water run-off does not arise.

Adequate measures will be adopted to drain out storm water without causing obstructions to the natural water drainage in the area. There is a possibility of storm water runoff to contaminate with construction waste and accidental spills. Such impacts will also be curbed through training of construction workers prior to work and on going basis on spill prevention and careful handling and through facilities prepared for sanitation.

There are no waterways connected to the sea in the vicinity of the project area thus there is no pollution of existing waterways or subsequent pollution of the coastal seas around the project site.

D4. Impacts of sewage, waste oil spills, solid wastes and waste water disposal on the environment

A toilet facility with septic tank will be installed in the substation building. Dwelling units built for the construction period for the labour force will use this facility as it will be built with the beginning of the project.

The main source of solid waste during the construction period is excavated soil from the cable trenches and Turbine footing foundations and foundations of the buildings. As all excavated soil will be utilized for back-fill and earthen ramp building, solid wastes will not pose any problem.

Specific areas will be allocated for controlled cleaning and maintenance of vehicles and all wastewater will be collected in soaking pits built to standards within the specific area. This will continue during the full operation period of the project.

Dwelling units hired during the construction period or built for the construction period for the labour force will contain facilities for solid waste and waste water disposal.

During the operation period the only source of solid waste would be garbage of the maintenance staff of the site. Facilities for solid waste disposal will be provided by the project and arrangements will be made with the Kalpitiya Pradeshiya Sabha to transport the solid wastes to their dumping sites.

The effluents generated due to domestic activities will be directed to properly constructed septic tanks/soakage pits in consultation with the relevant Local Authority.

D5. Anticipated problems related to air quality

Air pollution by way of dust will increase during construction (due to truck/vehicle traffic to the project site, minor construction required to erect the WTG, earthwork, development of access roads, vehicle traffic on un-metal road, etc). Also, use of construction vehicles and equipment and idling of vehicles carrying construction raw materials add to the emissions.

The tower foundation will be constructed in week's time maximum. Concrete curing will require about 21 days. Thus the increase in air pollution is temporary. Proper dust control during construction will be done using mechanical water spray to minimize the dust nuisance.

D6. Anticipated problems related to noise

Noise during construction - Project construction involves a variety of noise generating activities that include the use of earthmoving equipment for access road construction, grading, excavating/drilling/minor excavation of tower foundations, tower erection, the construction of ancillary structures, the operation of diesel generators, concreting, material movement, site cleanup and re-vegetation.

Noise levels generated by construction equipment vary significantly depending on the type and condition of equipment, the operation method and schedule and the site of the activity. Construction activities at site are expected to produce noise levels in the range of 84–109 dB(A), with most work carried out during daytime.

This level will be above the NWPEA conditions for the noise levels [less than 70 dB (A) from 0600 -2100hr and less than 60 dB (A) from 2100 -0600]. This type of noise will be only temporary and in order to minimize these temporary disturbances, the Project management will ensure that;

- a) All possible precautions to minimize noise are taken during each activity; particularly in the selection of equipment in good condition
- b) Activities during night time are avoided as far as possible; and
- c) Contractors will undergo training in environmental protection.

Noise during operation - During Project operation, noise will be generated from rotor movement through the air, from turbine operation and from vehicle movements and machinery operation around the site for maintenance and repair purposes. Blades moving through the air produce an aerodynamic noise. This noise is detectable when it is greater than the background noise, generally at wind speeds between the turbine cut-in wind speed (when the turbine starts to generate power) and up to 8-9 metres per second (before the background noise starts to mask the noise from the blades and turbine). In addition, the

operating turbine may produce a tonal noise. Turbine manufacturers nowadays make computer models of the machines before building them, to ensure that the vibrations of different components do not interact to amplify noise. Most of the noise will originate from the trailing (back) edge of the blades. Careful design of trailing edges and very careful handling of rotor blades while they are mounted have become routine practice in the industry. Other things being equal, sound pressure will increase with the fifth power of the speed of the blade relative to the surrounding air. Therefore modern wind turbines with large rotor diameters have very low rotational speed.

A noise contour map is being prepared for 2.1 MW capacity (Make- S88 – 2100 from Suzlon Energy Limited, India) WTGS by Sgurr Energy in the UK, which is the consultancy company appointed by local banks for due diligence work on the Wind Power Projects. According to the information given by the WTG supplier, the maximum calculated noise level (sound pressure) varies from 55 -58.5 dB(A) at the boundaries of all wind turbine locations (150X 150m). This range is less than maximum day time noise level of 70 dB and the night time noise level of 60 dB stipulated by the Urban Development Authority (UDA) after reclassifying the project area as an industrial area.

Any additional conditions stipulated by the Provincial Environmental Authority ,North Western Province (PEA-NWP) as and when required, controlling any kind of pollution created by the operations of the project will be strictly adhered to. A Environmental Protection Licence (EPL) from the Provincial Environmental Authority, North Western Province (PEA-NWP) will be obtained by the project prior to commencement of operation.

D7. Navigation of air crafts

As the project area does not fall within an air traffic route, there will not be any adverse effects on air craft navigation.

D8. Safety of people and animals in the area

Safety measures for the workers will be provided following the procedures of the Department of Labour and the relevant provisions of the factories (Amendment) Law No.12 of 1976.

Following are the probable safety hazards that can cause harm to the people of the area, animals and the working staff. The possible causes and precautions are listed as follows:

- a. Blade damages – keep sufficient gap as the safety buffer zone
- b. Tower failures – keep sufficient gap as the safety buffer zone
- c. Generator fire – it is an isolated fire which will happen at a height of 82m, therefore chances of extensive damage is minimal . However, adequate fire fighting equipment will be installed within the premises to extinguish any accidental fire
- d. Electrocution – Safety buffer zone and warning signs
- e. Fall hazards from height – Use fall protection measures for working people

D9. Ecological Environment

D9.1. Flora

The species richness of flora at the project site is extremely low. The species are also of very low significance in terms of threat levels or endemism. However, they are important in terms of coast protection, the creepers in particular. As the turbine locations of the project are well away (825-990m) from the 45m setback distance (from the seaward vegetation line) stipulated by the Coast Conservation Department, the role of creepers in the shore stabilization will continue. The destruction of flora will only be limited to some shrubs, coconut and palmyra trees where the excavations of the cable trenches along the site having a width of 1m and depth of 1m, turbine footing foundations of 15m x 15m at a depth of 3m and for the foundation of the buildings 1m, have to be carried out. As such, the loss of flora through construction replacement of site would not have any significant impact on the overall flora in the area.

D9.2. Fauna

The faunal richness is also equally low in the project area. It is natural for many of the species to move away from the site when the vehicular movements and construction activities are in progress. As for the arboreal species, they will not have major problems as a majority of trees in the project sites will remain intact.

The major concern in the development project is the potential "bird kills" resulting from birds hitting the wind mill blades. The bird survey results (Annex 7) indicates that Turbine locations 1, 2, 3 and 4 of Mampuri I project are considered significant for mitigation. As these 4 turbine locations are parallel to the Mampuri III turbine locations 1-4, the project wishes to apply precautionary action to these turbine locations which will be carried out simultaneously with the erection of turbines. If necessary, same precautionary actions will be applied for other turbine locations as well. As per recommendations given by the expert group who carried out surveys on bird migrations, the project will use the following precautionary measures to reduce bird collisions with turbine blades;

- The most important measure is the use of turbines of solid tubular design (pg 27-28) against lattice design which is known to attract perching raptors and some nesting birds thereby leading to injury or death.
- The proposed tower model Suzlon S 88 - 2100 to be installed at the site are also well below 150m (i.e. 80 m tower height and 43 m blade length = 123 m with the blade vertically above) and all wires will be buried underground.
- The turbine blades will be painted to make them more visible to birds
- Anti perching devices will be installed
- Bird flight "Diverters" will be installed
- Warning devices that employ sound or visual cues will be employed
- White strobe lighting will be installed in the site

D10. Natural Reserves

There are no Natural Reserves in close proximity to the project area. Hence no threat envisaged and no mitigation action needed.

D11. Impacts on Socio-cultural and Economic Development**D11. 1. Social and Economic Development**

Social and economic activities of the area will be improved due to enhanced infrastructure development by the project and some people will be benefited with temporary/permanent employments generated in the area due to the operational and maintenance activities.

Main economic activities such as fishery and agriculture will not be affected as consideration has already being paid to select locations that will not interfere with these economic activities. For instance, none of the existing access paths to the beach by fishermen are obstructed due to the installation of turbines, trenches or buildings. Their fishing activities on the beach are not affected what so ever, due to the fact that the establishment of the turbine bases etc. would be well away from any of the beach activities. The only interference would be with agriculture, particularly, cash crops. When vegetable plots are acquired, the people who are affected will be compensated adequately. In addition, all possible precautionary measures and necessary arrangements will be made to avoid disturbances/obstructions that may cause to the fishing/agricultural and recreational activities due to project activities. In order to avoid user conflicts pertaining to fishing activities including beach seine operations during construction and operation period of the project, an efficient coordinating mechanism will be maintained with the Ministry of Fisheries and Aquatic Resources.

As the Norochcholai Power Plant which is a few kilometres away from the project site has had some adverse reactions by the community, a public consultation programme with the stakeholder groups to enlighten them on the wind farm projects and to exchange views was carried out before the inception of the wind power projects. The stakeholders were extremely positive towards the project and they have promised their fullest cooperation.

D11. 2. Landscape, Natural and Cultural Heritage

Impact will be very minimal as landscape will not be changed. Temporarily used areas will be restored properly and post construction unusable materials will be disposed in consultation with the Kalpitiya Pradeshiya Sabha. There are no activities that will interfere with the natural and cultural heritage of the area.

D11. 3. Resettlement and compensation process

Land required for the project will be acquired from private parties after paying them the compensations they ask for. No resettlement will be needed in this process, as people are not occupying the earmarked blocks of land (they are either barren or cultivated).

D12. Local Roads

Local roads will be improved in order to facilitate the project work. All road widening and construction of new roads carried out by the project will be done with the approval of Road Development Authority, the Local Authority and the relevant agencies concerned.

The project will pay/ re-construct any damages incurred to the existing roads due to transportation of materials during the construction period. These will be done in consultation with Pradeshiya Sabha, Kalpitiya. The project will coordinate with Pradeshiya Sabha, Kalpitiya and relevant government agencies for the maintenance and repair of existing roads.

Proper traffic management plan will be implemented and dust control methods will be implemented during construction period. Impact on the roads will be minimal during the operation period as there is minimum vehicular movements to and fro the project site.

Same road network used by the people in the area will be used by the project for transporting excavated earth and construction materials. Therefore, arrangements will be made to minimize the disturbances to the people of the area by choosing times when the human movements are minimum etc.

D13. Natural disasters

Any damage due to natural disasters including sea erosion will be borne by the project.

D14. Shadow Flicker

Shadow flicker occurs under a special set of conditions when the sun passes behind the hub of a wind turbine and casts a shadow over neighbouring properties. As the general project area is so sparsely populated the minimal shadow flicker impact on the surrounding occupied dwellings is anticipated. In addition, the the proposed siting of wind turbines which conforms to industry standards will also minimize the effect of shadow flicker. So far, there have been no complaints of shadow flicker due to Stage I turbines. Stage III is not likely to pose any problem. However, if any relevant issue arises, the project developer will take necessary mitigation measures, which include providing curtains, blinds, or shutters for windows of the affected dwellings to be used during shadow flicker generation periods, and/or providing screening in the form of vegetation to reduce or prevent shadow flicker.

Table 7 further summarizes the Impacts and Mitigation measures and shows the Environmental Management Plan (EMP).

Table 7 - Environnemental Management Plan (EMP)

This relates to the description of the EMP related activities in the running text above. The various functions responsible for the implementation of the EMP will be defined in the working instructions for staff and external contractors appointed by the Mampuri III Wind Power Project Management.

(Abbreviations- PM: Plant Manager EO: Environmental Officer in charge SL: Shift Leader C: Contractors for various tasks)

Construction Phase

	Environmental Component	Potential Impacts	Impact Source	Mitigation Measures	Remarks	Monitoring frequency	Responsibility	Cost estimate (mitigation and monitoring)
1.	Air quality	Marginal increase of pollution levels due to temporary movements of vehicular and heavy equipment	Vehicular and heavy equipment emissions Dust blowing from open-topped lorries	1. Contractors will undergo training in environmental protection 2. Servicing of vehicles to reduce emissions Use of non peak traffic times 3. Loads are covered when transported 4. Dampening exposed areas and the access roads at regular intervals 5. Transport, loading and unloading will be carried out in a manner to minimize the nuisance to the people by the way of dust	This is a short term impact	Continuous throughout construction phase	SL, C, EO	Rs 465,000/-

	Environmental Component	Potential Impacts	Impact Source	Mitigation Measures	Remarks	Monitoring frequency	Responsibility	Cost estimate (mitigation and monitoring)
2.	Surface Water and Ground Water	Construction waste and accidental spills	Construction activity	Careful handling Equipment prepared for sanitation	Construction workers will be given a spill prevention & handling awareness training prior to work and ongoing basis	Continuous throughout construction phase	SL, C,EO	Rs 75,000/-
3.	Noise	Increased noise level from construction	Construction activities and vehicles	All operations will be carried out taking precautions given below to minimize the nuisance to the neighbourhood; All measures will be taken to keep the noise	This is a short term impact	Continuous throughout construction phase	PM, EO	

				levels less than 70 dB (A) from 0600hrs to 2100hrs and 60 dB (A) from 2100hrs to 0600hrs - Careful selection of equipment and methods - Avoid disturbing activities during night time - Transport, loading and unloading will be carried out in a manner to minimize the nuisance to the people by the way of noise				Rs 600,000/-
	Environmental Component	Potential Impacts	Impact Source	Mitigation Measures	Remarks	Monitoring frequency	Responsibility	Cost estimate (mitigation and monitoring)
4.	Solid wastes	Construction waste (debris)	Construction activity	1. Spoil materials (soil and rock) generated during the site clearance will be used to site levelling, back filling and road improvement work. Arrangements for disposal, if required, will be made in consultation with the Kalpitiya Pradeshiya Sabha	This is a short term impact	Weekly	PM, C,EO	Rs 300,000/-

				2. Solid wastes associated with workforce will be collected regularly and disposed of, in consultation with the Kalpitiya Pradeshiya Sabha 3. Burning solid wastes in the open within or outside the project site will be avoided				
5.	Aesthetic value	Loss of aesthetic value	Spoil materials (soil and rock), Use of land for temporary storage etc.	1. Spoil materials (soil and rock) generated during the site clearance will be used to site levelling, back filling and road improvement work. 2. Arrangements for disposal, if required, will be made in consultation with the Kalpitiya Pradeshiya Sabha 3. Areas used as Temporary storage sites will be restored		At the termination of construction	PM, C, EO	Rs 1,800,000/-
	Environmental Component	Potential Impacts	Impact Source	Mitigation Measures	Remarks	Monitoring frequency	Responsibility	Cost estimate (mitigation and monitoring)
6.	Socioeconomic Environment	Immigration of labour, increase in stress on the	Construction activity	1. Local workers will be employed wherever possible	Awareness programs and training	Regular throughout the	PM, SL,EO	Rs 1,000,000/-

		natural resource and infrastructure facilities. Outbreak of epidemics or diseases. Disturbances to Fishing/agriculture / recreational activities		2. A monitoring, emergency response, and reporting plan will be implemented 3. All precautions will be taken to minimize the disturbances to the agricultural and recreational activities Beach access of fishermen will not be obstructed 4. Efficient coordinating mechanism will be maintained with the Ministry of Fisheries and Aquatic Resources to avoid user conflicts pertaining to fishing activities including beach seine operations during construction period of the project	will be provided during the construction period.	construction phase		Rs 200,000/- Rs 75,000/-
7.	Safety to workers during constructions	Accidents	Construction activity	The procedures for the safety of workers provided by the Department of Labour will be followed and the relevant provisions of the factories (Amendment) law No. 12 of 1976 will be adhered to		Continuous throughout the construction phase	PM, SL	Rs. 400,000/-

	Environmental Component	Potential Impacts	Impact Source	Mitigation Measures	Remarks	Monitoring frequency	Responsibility	Cost estimate (mitigation and monitoring)
8.	Biological Resources	Encroachment of ecological resources	Construction activity	1. WTGs will be located well away from the 45m set back distance stipulated by the Coast Conservation Department 2. All staff will attend regular environmental training sessions that will discuss the sensitive issues and resources in the Project area and the mitigation measures designed to protect them. 3. Strict rules and regulations will be followed to restrict any activity such as collecting of firewood, plant and animal species etc, outside and within the Project boundary.	The Shift Leader will continuously monitor the process and other activities on the site.	Continuous throughout the construction phase	PM, SL,C, Coast Conservation Department	Rs 1,000,000/- p.a
9.	Existing roads	Damage due to transportation of materials	Construction activity	The project will pay/ re-construct any damages incurred to the existing roads due to transportation of materials during the construction period. These will be done in consultation with Pradeshiya		Continuous throughout the construction phase	PM ,C, Pradeshiya Sabha, Kalpitiya	Rs. 2,000,000/-

				Sabha, Kalpitiya				
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Operation Phase

	Environmental Components	Potential Impacts	Source	Mitigation	Remarks	Monitoring frequency	Responsibility	Cost estimate (mitigation and monitoring)
1	Air Quality	Vehicle and/or machinery emissions	Vehicular movement. Machinery for maintenance	1. Contractors will undergo training in environmental protection 2. Servicing of vehicles to reduce emissions	The Shift Leader will continuously monitor the process and other activities on the site	Continuous	PM, SL,EO	Rs 100,000/- per annum Rs 20,000/- quarterly
2	Surface Water and Ground Water	accidental spills	Operational activity	1. Careful handling 2. Equipment prepared for sanitation	Operational staff will be given a spill prevention & handling awareness training prior to operation	Continuous	SL, C,EO	Rs 50,000/-
3	Noise	Noise levels above the standards	Operations, Turbine wings Vehicular movement	1. The turbine type will be carefully chosen 2. The turbines will be located in an optimized way in relation to existing and relocated buildings(i.e blocks of 100mX150m have been selected) 3 Turbines will be installed on resilient foundations to minimize the vibrations 4. All measures will be taken to keep the vibration generated by WTGs at levels less than 5mm/S (measured at peak particle velocity mode) at the boundaries of the site.	The Shift Leader will continuously monitor the process and other activities on the site Regular monitoring of the noise under different conditions	Continuous	PM, SL,EO	Rs 10,000,000/-

	Environmental Components	Potential Impacts	Source	Mitigation	Remarks	Monitoring frequency	Responsibility	Cost estimate (mitigation and monitoring)
				5. Avoid disturbing activities during night time Contractors will undergo training in environmental protection				
4	Shadow Flicker	Disturbance from shadow/light flicker	Turbine blades	The turbine blades will be painted with special purpose paint for minimizing reflection		Continuous	PM, SL,EO	Rs14, 000,000/-
5	Solid Waste	Accumulation of solid waste Uncontrolled handling and dispersal of solid/hazardous waste	Operations	1. Solid Waste that is suitable for dumping will be dumped on site in accordance with the present standards of sanitary regulations. 2. Other types of solid waste will be handled by nominating a contractor to remove the waste and take it to a government designated dumping site in consultation with the Kalpitiya Pradeshiya Sabha 3. Domestic solid wastes will not be disposed in to waterways or at a site where	The Shift Leader will continuously monitor the process and other activities on the site	Continuous	PM, SL,EO	Rs 2,000,000/-

	Environmental Components	Potential Impacts	Source	Mitigation	Remarks	Monitoring frequency	Responsibility	Cost estimate (mitigation and monitoring)
				it is likely to enter a waterway 4. Domestic solid wastes will not be burnt in the open air				

	Environmental Components	Potential Impacts	Source	Mitigation	Remarks	Monitoring frequency	Responsibility	Cost estimate (mitigation and monitoring)
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6.	Effluent discharge	Impairing aesthetic value Contamination of surface and groundwater	Operation of machinery Domestic activities	1. Careful handling 2. Equipment prepared for sanitation 3. Effluent generated due to domestic activities will be directed to properly constructed septic tanks/ soakage pits in consultation with the relevant local authority	Operational staff will be given a spill prevention & handling awareness training prior to operation	Continuous	SL, C,EO	Rs 200,000/- Rs.3, 000,000/-
7	Socioeconomic Environment	Outbreak of epidemics or diseases Disturbance to fisheries, agricultural and recreational activities Increase in job opportunities for local labour	-	1. A monitoring, emergency response, and reporting plan will be implemented 2. All precautions will be taken to minimize the disturbances to the agricultural and recreational activities 3. Beach access of fishermen will not be obstructed 4. Efficient coordinating mechanism will be maintained with the Ministry of Fisheries and Aquatic Resources to avoid user conflicts pertaining to fishing activities including beach seine operations during	The Shift Leader will continuously monitor the wellbeing of the staff. Positive long term impact.	Continuous	PM, Coast Conservation Department, EO, Fisheries Department	Rs 5,000,000/-

				construction period of the project				
	Environmental Component	Potential Impacts	Impact Source	Mitigation Measures	Remarks	Monitoring frequency	Responsibility	Cost estimate (mitigation and monitoring)
8	Public Relations	Negative reactions from the neighbourhood	-	All comments and complaints made by people in the Project area will be recorded together with any action taken to mitigate these reasons for the complaints	Regular information meetings will be held to inform about the development of the Project	Continuous	PM, SL, Monitoring committee	Rs. 200, 000/-
9.	Safety to workers	Accidents	Operation	1. The procedures for the safety of workers provided by the Department of Labour will be followed and the relevant provisions of the factories (Amendment) law No. 12 of 1976 will be adhered to 2. Adequate fire fighter equipment will be installed		Continuous	PM, SL	Rs400, 000/-

				within the premises to extinguish accidental fire 3. Use fall protection measures for workers				Rs50, 000/- Included in wind turbine price
10	Safety of people and animals in the area	Blade damages Tower failures Generator fire Electrocution	Operation	1. Keep sufficient gap as the safety buffer zone 2. Keep sufficient gap as the safety buffer zone 3. fire extinguishing systems 4. Safety buffer zone and warning signs		Continuous	PM, SL	Included in project capital cost
	Environment al Component	Potential Impacts	Impact Source	Mitigation Measures	Remarks	Monitoring frequency	Responsibility	Cost estimate (mitigation and monitoring)
11	Existing roads	Damage due to operational activities	Vehicle movement	The project will coordinate with Pradeshiya Sabha, Kalpitiya and relevant government agencies for the maintenance and repair of existing roads		Continuous	PM ,C, Pradeshiya Sabha, Kalpitiya	Rs. 800,000/- Per annum
12	Biological Resources	Encroachment of ecological resources	Operations	1. WTGs will be located well away from the 80 m set back distance stipulated by the Coast Conservation	The training will be compulsory for all staff.		PM, Coast Conservation Department, EO	

			Wind turbine	Department 2. All staff will attend regular environmental training sessions that will discuss the sensitive issues and resources in the Project area and the mitigation measures designed to protect them. 3. Strict rules and regulations will be followed to restrict any activity such as collecting of firewood, plant and animal species etc, outside and within the Project boundary. 4. Use of turbine towers of tubular design against lattice design which is known to attract perching raptors and some nesting birds thereby leading to injury or death Use of tower model Suzlon S 88 – 2100 which is well below 150m (i.e. 123m) and all wires to be buried underground Painting the turbine blades	The Shift Leader will continuously monitor the process and other activities on the site.			Rs 100,000/- Rs60, 000,000/- Included in the wind turbine price Rs24, 000,000/- Rs8, 000,000/- Rs1, 000,000/-
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				to make them more visible to birds Installing anti-perching devices (if the need arises) Installing bird flight “Diverters”, Installing warning devices that employ sound or visual cues Installing white strobe lighting in the site Monitoring of birds killed by the wings. If the number increases unexpectedly the reasons will be examined and relevant actions taken.				Rs, 1,500,000/- (per year)
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PART E - MONITORING PROGRAMME

E1. Monitoring Plan

In order to ensure the implementation of necessary mitigatory measures for environmental management and pollution control, and to assess the success of mitigation and identifying residual impacts, the management of the project will conduct a comprehensive environmental monitoring program of the different segments of the environment in the vicinity of the project site

There are two basic environmental monitoring tasks

- Construction compliance monitoring
- Post-construction monitoring of maintenance and operational project activities

E2. Parameters to be monitored

Following are the aspects that need close monitoring.

E2. 1. Noise pollution

Noise pollution monitoring is essential to ensure that noise emissions arising during construction works and operational activities are minimal. Noise monitoring will be done with the consultation and assistance from a recognized institute.

E2. 2. Wastewater and sewage treatment and solid waste disposal

The management of the project, through regular surveys, will continuously monitor the wastewater, sewage and solid waste disposal facilities, in order to ensure the adequacy of infrastructure facilities for wastewater and sewage systems and to ensure that adequate facilities are available for solid waste collection and disposal.

E2. 3. Groundwater quality

Regular monitoring will be carried out to ensure that the ground water quality is not changed due to any activity connected with the project, and if observed, immediate action will be taken to rectify the problem.

E2. 4. Storm water run off through open drainage system

Regular monitoring will be carried out to ensure that the natural seepage of storm water is not obstructed within the site.

E2. 5. Impact on fisheries activities of the area

As the site is located in close proximity to fish landing sites as well as a Ma-del Padu (beach seine operating sites), it is very important to monitor on any adverse effects to fishing activities by the project activities. This will be carried out with the assistance of the Kalpitiya Fisheries Inspector and the District Fisheries Office, Puttalam.

E2. 6. Impact on agriculture activities of the area

As the site is located in close proximity to agricultural sites, it is very important to monitor if there are any adverse effects to agriculture activities by the project activities. This will be carried out with the assistance of the officers of the Puttalam District Agriculture Office.

E2. 7. Impacts on fauna and flora

One of the main concerns in this respect is the bird kills. A monitoring programme in collaboration with the Field Ornithology Group of Sri Lanka, University of Colombo was done with the main objective of monitoring the movement of birds within and around the project site. However, if the need arises, further surveys will be carried out. In addition, other parameters such as vegetation recovery on site after manipulations, changes in faunal distribution will be monitored.

E2.8. Impacts on the local communities of the area

A public consultation has already been done to enlighten the people of the area on the wind projects and to obtain their consent for the establishment of the projects. However, monitoring of project activities by the committee can resolve any potential conflict with the local communities.

E3 Institutional Arrangement for impact monitoring

An environmental monitoring committee (EMC) has to be appointed to oversee the implementation of the monitoring plan. As the project approving agency, it is the responsibility of the Coast Conservation Department to call for nominations of Committee Members from relevant Departments/ Agencies.

Considering the parameters that need monitoring, representatives from the Coast Conservation Department (CCD), Department of Fisheries and Aquatic Resources (DFAR), National Aquatic Resources and Research Agency (NARA), Provincial Environmental Authority, North Western Province (PEA-NWP), Kalpitiya Pradeshiya Sabha (Kalpitiya PS), Kalpitiya Divisional Secretariat (Kalpitiya DS), Ceylon Electricity Board (CEB), Agriculture Department, Puttalam District Office together with Project Proponent and Contractor (during the construction period) will be required in the EMC.

Following Table (Table 8) shows the possible involvement of different Agencies/Departments in different activities that need monitoring.

Table 8 - Activities to be monitored and the responsible Agency/Department

Activities to be monitored	Responsible Agency/Department
Construction phase	
- Land clearing and preparation of land	CCD, Kalpitiya PS, Kalpitiya DS
- Transportation and stock piling of construction materials to the site.	Kalpitiya PS
- Noise, dust, damage to the roads, safety of the neighbours	CCD, Kalpitiya PS, Kalpitiya PS, CEB
- Interference to fishing activities due to construction	DFAR, NARA
- Interference to agriculture activities due to construction	Department of Agriculture, Puttalam District Office
Operational phase	
- Solid waste collection, storage and disposal	Kalpitiya PS
- Maintaining the waste water soakage pits	PEA-NWP, Kalpitiya PS
- Effluent discharge into sea	PEA-NWP, CCD
- Interference to fishing activities	DFAR, NARA
- Interference to agriculture activities	Department of Agriculture, Puttalam District Office

E4. Inspection, monitoring and reporting

It is the responsibility of the Project Proponent to facilitate the field visits while the Project Approving Agency has the responsibility of conducting regular meetings.

Regular field visits should be made at each phase of construction (e.g. before commencement of construction, during excavation, during the laying of foundation, during the time when the erection of turbines and buildings and installing cable lines) and once a month meetings to be followed to resolve any conflicts during construction. It is the duty of the committee to ensure the proper implementation of designs and mitigatory measures proposed and if there are any gaps and potential conflicts, the Project Proponent must be advised to rectify the same.

During the operation period, the committee can meet once in three-six months to review the situation of the project and to ensure that the mitigatory measures are properly implemented.

E5. Programme to improve the general environment

As highlighted in earlier sections, the project has given a high priority to both physical and social environmental conservation, which will undoubtedly preserve the pristine quality of the physical environment and the harmony with the local communities. The activities will include, placing the turbines and buildings where the interference with natural environment and local communities are minimal, recycling of resources wherever possible, providing employment to the local communities as much as possible, participating in the social and cultural events of the local communities as an integral member etc. All these will be practised intensively during all stages of construction and operation.

PART F - Summary of project finances

F1. Return on investment for a five year time frame

Table 9 gives a breakdown of the anticipated expenditure and revenue for a five year operational period. According to these figures, 37% return on investment during this period can be anticipated.

Table 9 Return on Investment for a five year time frame

Year of Operation	Project Generation (kWh)	Revenue in SL Rs. (Mn)
1	29958000	623.42
2	29958000	630.35
3	29958000	637.82
4	29958000	645.85
5	29958000	654.51

PART G - CONCLUSIONS

Mampuri III Wind Power Project is set up to develop a 10MW Wind Power facility in Kalpitiya. This is in line with the objectives of the National Energy Policy made by the Ministry of Power & Energy. Wind Power is one of the cleanest methods of generating electrical energy in the world. This surely helps Sri Lanka to attain the sustainable energy development as well as to contribute towards cleaner development mechanism. Following the footsteps of its sister company, Senok Trade Combine Limited, Senok Wind Resource (Pvt) Ltd. has come forward to build another 10MW wind farm in Kalpitiya and is committed to bring up the project in compliance with the international technical standards and the environmental norms.

Kalpitiya is strategically selected to develop the wind farms due to its moderate to high rating in the wind atlas of Sri Lanka. The other areas are the central hills and north and south of the island. Due to various limitations, Kalpitiya is the most preferred location to develop wind farms in today's context. There will be distinct economical, social and environmental benefits locally and globally with the implementation of the project at the earliest.

PART H - REFERENCES

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Web sites

<http://www.mope.gov.lk/ceb-01.php>

<http://www.energy.gov.lk>

Annex1- Provisional approval from the Sri Lanka Sustainable Energy Authority

By Hand

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இலங்கை நிலைபெறுதகு வலு அதிகாரசபை
மின்வலு சக்தி அமைச்சால் அங்கீகரிக்கப்பட்ட அதிகாரசபை
Sri Lanka Sustainable Energy Authority
A Statutory Authority within the Ministry of Power & Energy



My No: SEA/REP/A-10990

2009/09/07

Registration Number	R	- 1109901
Provisional Approval Number	PA	- 245201

President
Senok Wind Power (Pvt) Ltd
3, R A De Mel Mawatha
Colombo-05

Dear Sir

Provisional Approval : Date of Issue - 2009/09/07
: Valid until - 2010/03/06

Project Type : Wind Farm
Project Name : Mampuri-III - Please refer attached map for the allocated Wind Farm Area
Project Capacity - kilowatt : 10000 (Installed generating capacity)

This refers to your application for Provisional Approval for the above Project dated 2009/07/24. Under provisions in Section 17 of SEA Act No 35 of 2007, the Project Approving Committee of Sri Lanka Sustainable Energy Authority (SEA) has granted Provisional Approval to the Project. The Provisional Approval Number shown above should be used in all future correspondence with SEA, and in all reports and other documentation about the Project.

You may now proceed with the pre-construction work on facilities required to use the renewable energy resource (hereafter referred to as the Plant) defined in your application for registration and the pre-feasibility study report, subject to the Terms and Conditions given below.

1. Validity of the Provisional Approval and Extensions

- 1.1 This Provisional Approval is valid for a period of six (6) months from the Date of Issuance stated above.
- 1.2 If the progress of the stipulated pre-construction work during the period of validity of this Provisional Approval is satisfactory, and upon request by the Applicant, SEA may extend the validity only once by a further period of six months. The extension of the Provisional Approval is at the sole discretion of SEA. Under the provision in Section 17(4) in the SEA Act, upon the expiry of a total of one year from the Date of Issuance, this Provisional Approval stands automatically cancelled.

Page 1 of 3

3G-4A, BMICH, බොද්ධාලෝක මාවත, කොළඹ 07. ශ්‍රී ලංකාව. 3G-4A, BMICH, බොද්ධාලෝක මාවත, කොළඹ 07. இலங்கை. 3G-4A, BMICH, Bauddhaloka Mawatha, Colombo 07, Sri Lanka.

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பொது } ஃக்சிமைல் } மின்னஞ்சல் } செய்தி } தலைவர் }
Office } Facsimile } E-mail } Web Site } Chairman }

Annex1 contd.

- 1.3 Upon such expiry of this Provisional Approval, SEA reserves the right to issue a registration to another Applicant or implement any other mechanism to develop the Project.

2. Pre-construction Work, Obligations and Responsibilities of the Applicant

- 2.1 During the validity of this Provisional Approval, you should submit to the SEA, the Feasibility Study Report and an outline plan for the construction of the Plant.
- 2.2 You should ensure that structures required to harness the renewable energy resource and the Plant shall conform to the relevant standards, regulations and codes as stipulated by the respective approving agencies.
- 2.3 During the validity of this Provisional Approval, you should conduct relevant preparatory work leading towards engineering design, such as (a) the Project design, (b) the land use and survey plan of the Project area, (c) analysis of the renewable energy resource, and (d) environmental protection studies
- 2.4 During the validity of this Provisional Approval, you should obtain the legally required administrative permission from the institutions listed below, as relevant.
 - I. Letter of Intent to purchase electricity from Ceylon Electricity Board.
 - II. Approval from the Central Environmental Authority
- 2.5 During the validity of this Provisional Approval, you are required to obtain any other approvals required for the environmental approval process.
- 2.6 You are required to obtain the necessary approvals from local authorities and the provincial councils as necessary, in line with the prevailing legal framework.
- 2.7 You should not conduct any construction work at the site or the associated resource without the Renewable Energy Permit. However, instruments and other devices required for measurements and other studies/investigations may be installed with the approval of the relevant agencies.

3. The Renewable Energy Permit

- 3.1 Upon fulfillment of the above conditions, and upon your request, a Renewable Energy Permit (the Permit) for a period of twenty years, valid from the Commercial Operation Date of the Plant, as stipulated in Section 18(4) of SEA Act will be issued by SEA, allowing you to proceed with the construction of the Plant. A period of two years will be allowed for the construction and commissioning of the Plant.
- 3.2 Upon your request, the Permit may be issued to a special purpose Project Company incorporated for the purpose of securing Board of Investment concessions.
- 3.3 The fee for the Permit will be Rs 50,000/-.

4. The Power Purchase Agreement and Tariffs

- 4.1 Once the Permit is issued, you should enter into a Power Purchase Agreement within a period of one month.

Annex1 contd.

4.2 Since the installed capacity of the Plant is less than or equal to ten (10) Megawatt, you will be eligible to enter into a Small Power Purchase Agreement (SPPA). The SPPA is a 20-year standardised and non-negotiable agreement. A copy of the SPPA is available upon request.

4.3 The schedule of tariffs payable for SPPAs entered into in a particular year will be those announced for that year. Information on tariffs is available upon request, and also on the SEA website, www.energy.gov.lk.

5. General

5.1 SEA will provide you guidance and assistance to obtain statutory approvals required to expeditiously implement your project

5.2 Any costs incurred by you in the fulfillment of requirements specified in this Provisional Approval are at your own risk and expense, and not a responsibility whatsoever of the SEA.

5.3 The progress of the Project should be reported to the SEA once in every three months from the date of this Provisional Approval.

Yours truly,

SRI LANKA SUSTAINABLE ENERGY AUTHORITY

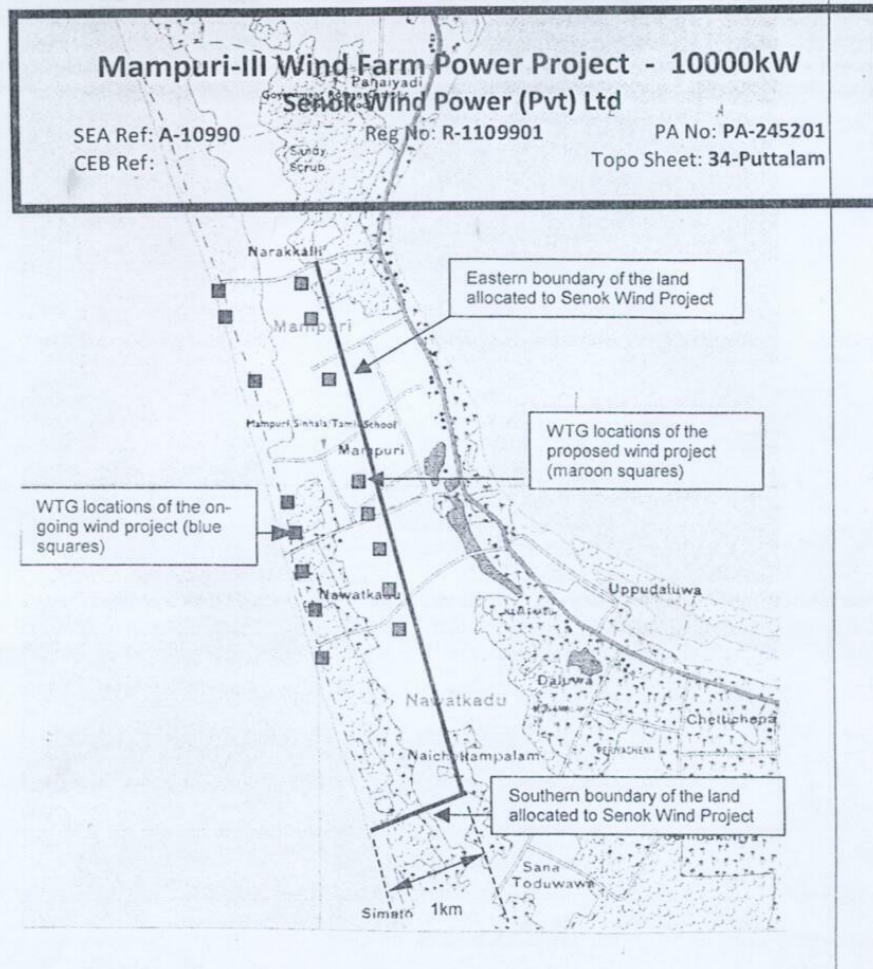


Director General

Copy :	Deputy General Manager (Energy Purchases) Ceylon Electricity Board	- Map showing the location of the Project is attached herewith for your information and necessary action.
:	Director General Public Utilities Commission	- for your information
:	Director General Central Environmental Authority	- for your information
:	Finance Manager, SEA	- This has reference to the payment made by the developer as per your receipt number 3187 of 2009/07/24.

Annex 1 contd.

Name of the project	Mampuri Wind Power Project-Stage3
Project Capacity	10 MW
Proposed location of the power plant: provide the details below	
Village/ Grama Niladhari division	Mampuri, Mampuri
Divisional Secretary division	DS - Kalpitiya
District	Puttalam
Paste in the box below the relevant part of the 1:50,000 map showing the land identified for the proposed wind project. (You may also insert a scanned image of the map) Topo Sheet No. & Name : 34 - Puttalam	



First registration of an on-grid renewable energy project under provisions in Section 16 (2)(a) and (e) of SEA Act No 35 of 2007. Submit to: Renewable Energy Division, Sri Lanka Sustainable Energy Authority, 3G-4A, BMICH, Baudhhaloka Mawatha, Colombo 7.

Annex 2 - Approval from the Coast Conservation Department

**PERMIT FOR A DEVELOPMENT ACTIVITY ISSUED
UNDER PART III - SECTION 14 OF THE
COAST CONSERVATION ACT No. 57 OF 1981**

Permit No. P/CO/17

Name of Permit Holder : President, Senok Wind Energy Pvt Ltd. Mampuri II
Senok Wind Resource Pvt Ltd. Mampuri III
(Surname) (Other Names)

Postal Address : No. 3 R.A. De Mel Mawatha, Colombo 05

Nature of Development Activity : 10 MW Wind Power Project Mampuri stage 11 and
10MW wind power project Mampuri stage 111

Location of Development Activity : Narakkalliya, Mampuri Nawakkadu

Province : North Western

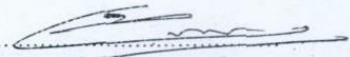
District : Puttalam

Local Authority : Kalpitiya

Particulars of Survey Plan submitted by Applicant :
.....
.....

Duration of Permit : 08.01.2010 to 07.01.2011

Conditions Attached :
.....
.....


Signature & Designation of
Authorised Officer
(Issued for and on behalf of the Director /
Coast Conservation)

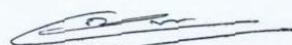
Date : 11.01.2010

CM 008835 - 5,000 (2008 / 03) Department of Government Printing, Sri Lanka

Annex 2 contd.

- (1) All constructions should be confined to the Survey Plan No.174 (Mampuri stage 2) and 179 (Mampuri stage 2) prepared by Mr. S. Keragasabapathy, Registered License Survey
- (2) All constructions should be carried out in accordance with the structural plans submitted to the Coast Conservation Department by the developer. (Detail designs of the building plans should be submitted to the Coast Conservation Department prior to commencement of constructions).
- (3) A 80 m set back area from the permanent vegetation line of the beach front should be maintained as a structure free buffer zone.
- (4) Necessary clearance from Environmental Authority of North Western Provincial Council, Pradeshiya Saba, Kalpitiya and other relevant government agencies should be obtained prior to commencement of constructions.
- (5) The developer should coordinate with the Department of Fisheries and Aquatic Resources on fishing activities including beach seine operations in the area in order to avoid user conflicts during construction and operation period of the proposed project.
- (6) The existing fishing activities and beach access should not be obstructed by the proposed project
- (7) A copy of bird study report should be submitted to the Coast Conservation Department once the bird study is completed and if the study finds significant bird movements close to the winds turbine appropriate precautions should be taken to minimize the damage of birds.
- (8) Noise level of the wind turbines should adhere to new environment standards imposed by the Central Environmental Authority.
- (9) Existing water ways connected to the Sea in the project vicinity area should be maintained and monitored.
- (10) The developer should be liable to pay potential damages to the existing roads due to transportations of materials during the construction phase. If any damage to roads due to this project they should be repaired in consultation with the Kalpitiya Pradeshiya Saba and relevant government agencies.

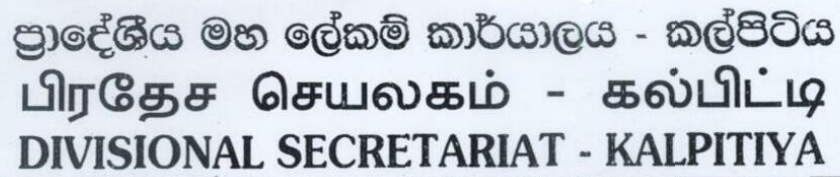
- (11) The developer should submit a detailed monitoring plan prior to commencement of construction activities and should allocated adequate amount of funds to implement the monitoring plans and a competent/recognized institute should be implemented the monitoring plan.
- (12) Potential damages on proposed project due to the natural disasters including sea erosion should be born by the developer.
- (13) This permit will be invalid if violation of the any of the above conditions. In such a case this department will consider relevant structures as unauthorized and will take action according to the Coast Conservation Act No. 57 of 1981.



Anil Premaratne
Director/Coast Conservation.

Copies to :

- | | | |
|-----|----------------------|--|
| (1) | Chairman | - Pradeshiya Saba, Kalpitiya |
| (2) | Divisional Secretary | - Kalpitiya |
| (3) | General Manager | - Ceylon Electricity Board |
| (4) | Director General | - Urban Development Authority |
| (5) | Director General | - National Aquatic Resources Research & Development Agency |
| (6) | Director General | - Department of Fisheries & Aquatic Resources |
| (7) | Director | - North Western Provincial Environmental Authority. |
| (8) | Director (Env. Mgt) | - Board of Investment of Sri Lanka |
| (9) | Area Engineer | - CCD, Negombo |



2010.02.03


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 කොළඹ 05

கார்ட்டு } 032 226 0446
 அலுவலகம் }
 ருக் } 032 226 0446
 தொலை நகல் }



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பிரதேச செயலகம் - கல்பிட்டி
DIVISIONAL SECRETARIAT - KALPITIYA

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 Your No. }

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 Date }

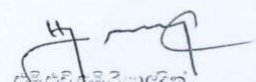
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 பிரதேச செயலகம் - கல்பிட்டி
 DIVISIONAL SECRETARIAT - KALPITIYA

☎ ප්‍රදේශීය ලේකම් } 032 567 4220
 பிரதேச செயலகம் }
 ගණකාධිකාරී } 032 567 4286
 கணக்காளர் }

කාර්යාලය } 032 226 0446
 அலுவலகம் }
 ගෘහස්ථ } 032 226 0446
 தொலை நகல் }



SENOK

2nd February, 2010.

Mr. Saman Senanayake
The Director
Provincial Environmental Authority (NWP)
Malagawa
Kurunegala.

Dear Sir,

WIND POWER PROJECT - MAMPURI 11I - 10 MW

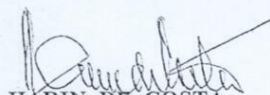
Senok Wind Resource (Pvt) Limited has received a Provisional Approval from Sustainable Energy Authority to set up a 10 Mw wind power plant in the Kalpitiya peninsula. Our proposal is to set up this plant within the same 4.5 km X 1 km, block of land already allocated to us, extending from Narakkaliya through Mampuri to Nawakkadu, along the coast as depicted in the annexed map.

As you are aware we have already obtained the necessary approvals and the environmental clearances, for this entire stretch of land on a part of which our initial 10 MW Wind Power Project, by our sister company Senok Wind Power (Pvt) Ltd, has already commenced.

Please be good enough to grant us approval to commence work no sooner we take position of the required lands.

Thanking you

Yours Sincerely,
SENOK WIND RESOURCE (PVT) LTD


HARIN DE COSTA
DIRECTOR

SENOK WIND RESOURCE PRIVATE LIMITED

3, R. A. De Mel Mawatha Colombo 5, Sri Lanka
Tel +94 11 250 1425, +94 11 2580017 email wind@senoksl.com
Fax +94 11 258 0022, www.senoksl.com

මගේ අංකය எனது கிலக்கம் } PEA/PKT/SC/ My No: } WP/M/193/08		පළාත් පරිසර අධිකාරිය (වයඹ) மாகாண சுற்றாடல் அதிகாரசபை (வ.மே.மா.) PROVINCIAL ENVIRONMENTAL AUTHORITY (NORTH WESTERN PROVINCE)	A nn e x	
உமது அංකය உனது கிலக்கம் } Your No: }	මගේ අංකය எனது கிலக்கம் } PEA/PKT/SC/ My No: } WP/M/193/2008			පළාත් පරිසර අධිකාරිය (වයඹ) மாகாண சுற்றாடல் அதிகாரசபை (வ.மே.மா.) PROVINCIAL ENVIRONMENTAL AUTHORITY (NORTH WESTERN PROVINCE) "මළිගාව", කුරුනෑගල. "மாளிகாவ", குருநாகல். "MALIGAWA", KURUNEGALA, SRI LANKA.
Mr.Har Director Senok No. 3, Colom	මගේ අංකය உனது கிலக்கம் } Your No: }	13 .10.2008		
This re Enviro above I heref 13.10. validit	Managing Director, Senok Trade Combine Ltd., No. 3, R.A.De Mel Mawatha, Colombo 05.			
On yo subjec	<u>CERTIFICATE OF SITE CLEARANCE FOR THE PROPOSED 10 MW WIND POWER PROJECT – MAMPURI TO NAICHETTAMPALM, KALPITIYA.</u>			
1. No ex 2. Pro Ce PE 3. Me wi of	With reference to your application dated 05.03.2008 submitted to this authority for obtaining a site clearance certificate, the Provincial Environmental Authority of the North Western Province (PEA-NWP) hereby inform you that the approval could be granted for the setting up of above Project at the block of land depicted in the Survey Plan No. 121A/2008 and land extends Mampuri to Naichettampalam, Kalpitiya, subject to following conditions which should strictly be adhered by the Project Proponent (PP- Senok Trade Combine Ltd.,) to abate / avoid environmental pollution likely to arise due to the construction and operation of the above project.			
Conditions:	1.0 1.1 This site clearance is valid for a period of 12 months from the date of this letter. The project should be commenced before the expiry of the validity period. Extension will be considered on re-application one month prior to the expiry of the validity period. 1.2. Costs to be incurred in giving effect to the implementation of the terms and conditions mentioned hereunder shall be borne by the PP as the project implementation costs. 1.3. PP where necessary should obtain fresh approvals in respect of any alteration that are intended to be made to the initial project proposal submitted to PEA-NWP. 1.4. A copy of this clearance should be kept in the project site at all times for purposes of perusal by concerned agencies. 1.5. It is the duty of the PP to inform PEA-NWP of any environmental impacts which are not anticipated at this stage. In such and event, relevant guidelines and mitigatory measures should be implemented as directed by PEA-NWP.			
Samar Direct Provir "Malig Copy				
දුරකථන අංකය தொலைபேசி } Telephone No }	දුරකථන අංකය தொலைபேசி } Telephone No }	ලේකම් செயலாளர் } Secretary }	අධ්‍යක්ෂ பணிப்பாளர் } Director }	කාර්යාලීය அலுவலகம் } Office }
037 2228019 037 2222171 037 2221531 037 2225236 037 2229688				

2.0	General Con	5.0	Blasting & Quarrying.
2.1	The v the a propo		All locations of blasting and quarrying activities if any should be intimated to PEA-NWP and such operations undertaken in accordance with guidelines issued by the relevant agencies concerned.
2.2	All "Loca	6.0	Construction of Access Roads.
2.3	Proje No. p		Road widening and construction of new roads will have to receive the approval of Road Development Authority / the relevant Local Authority and the relevant agencies concerned
2.4	All re with t	7.0	Disposal of Solid Waste.
2.5	This (WTC	7.1	Spoil material (soil & rock) generated during the site clearance shall be used wherever possible for site leveling, back filling etc. Arrangements for disposal, if required, shall be made in consultation with the local authority of the area (Kalpitiya Pradeshiya Sabha).
2.6	A co migre NWP	7.2	Solid waste associated with the workforce shall be collected regularly and disposed of in consultation with the local authority of the area.
		7.3	Solid waste shall not be burnt in the open within or outside the proposed site.
A.	CONSTRU		
3.0	Transport o	8.0	Temporarily used areas shall be restored properly and post construction unusable materials shall be disposed of in consultation with the relevant local authority.
3.1	Mov Deve peak	9.0	Safety During Construction.
3.2	Tran as no		The contractors shall be bound by the procedures for the safety of workers provided by the Department of Labour and shall adhere to relevant provisions of the factories (Amendment) law No. 12 of 1976 as amended from time to time.
3.3	To p that t		
3.4	Duri acce		
4.0	Noise from All operatio neighborhoc and 50 dB proposed sit		
		B. OPERATIONAL ACTIVITIES.	
		10.0	Water.
			If water is to be extracted from ground water sources, a report indicating availability and safe yield obtained from the Water Resources Board/National Water Supply & Drainage Board should be forwarded to this Authority, prior to such extraction.
		11.0	Noise & Vibration.
		11.1	The maximum noise levels at the boundaries of the premises shall be maintained, in compliance with permissible noise levels specified by the Central Environmental Authority (CEA) under the Extra Ordinary Gazette Notification No. 924/12 and dated 23.05.1996 should strictly be adhered.

B/

B/

D/

- 11.2 To reduce the spread of noise and vibration due to the operation of machinery to
- 11.3
- 12.0 Di 18.0 Any additional condition stipulated by the PEA-NWP as and when required controlling any kind of pollution created by the operations of the industry shall strictly be adhered to.
- 12.1 19.0 Environmental Protection Licence.
- 12.2 The developer shall apply for the Environmental Protection Licence (EPL) in terms of the regulations in relation to obtaining licenses under the North Western Provincial Environmental Statute No. 12 of 1990 one month prior to commencement of operation of the proposed project.
- 13.0 Pr of ac 20.0 This clearance letter issued in relation to this industry should in no way be considered as a final approval granted for the sitting of this industry at this location. In order for this industry to be established at the proposed location, the written approval of the relevant local authority is required.
- 14.0 Th co
- 15.0 Sa Saman Senanayake,
15.1 Director,
15.2 Provincial Environmental Authority (NWP),
"Maligawa",
Kurunegala.
- 16.0
- 16.1 Copy to : i. The Chairman Pradeshiya Sabha, Kalpitiya.
ii. Director, Coast Conservation Department, P.O.Box 556, New Secretariat, Maligawatta, Colombo 10.
16.2 iii. Director General, Dept. of Wild Life Conservation, No.380, Dilco Courts, New Kandy Road, Malambe.
iv. Divisional Secretary, Divisional Secretariat, Kalpitiya
17.0 S v. Director (Environmental Management), Board Of Investment, Colombo
A vi. General Manager, Ceylon Electricity Board, Colombo
ol

B/

Annex 5 –Approval from the Civil Aviation Authority of Sri Lanka


"தொழில்நுட்பம் முதலிடம்"
"பாதுகாப்பு முதலிடம்"
"Safety First"

இலங்கை சிவில் விமானப் போக்குவரத்து அதிகார சபை
Civil Aviation Authority of Sri Lanka

ந. எ. 535
அ. பெ. இல. 535
P. O. Box 535

64, காலி வீதி, கொழும்பு 03, இலங்கை.
64, Galle Road, Colombo 03, Sri Lanka

மேல் குறியீடு :
எமது இல. :
My Ref. No. : **AE/6/4**

திகதி :
Date : **February 10, 2010**

President
Senok Wind Resource Private Limited
3, R.A. De Mel Mawatha
Colombo 05

Dear Sir,

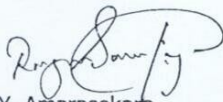
**Clearance for Installation of Two Wind Measuring Masts
Mampuri Stage III**

Reference your letter 02nd January 2010 on above subject.

This Authority has **no objection** to the construction of the proposed 60metre high wind measuring masts at the said location.

Please be informed that the painting and lighting of the masts should be in accordance with conditions stated in the Advisory Circular Number CC/01/1998 issued by this Authority.

Yours faithfully,


Y. Amarasekara
(Aerodrome Inspector)
For Director General of Civil Aviation

தொழில்நுட்ப / காரியாலயம் / Gen Office :
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Annex 6 Ambient noise level measurements at the project site

E&EMC / NOISE -208- 454 /2008

Ambient Noise Level Measurements

At

**SENOK Trade Combine Ltd.'s
Proposed Wind Power Mill Site
Puttalam**

By

ENERGY & ENVIRONMENTAL MANAGEMENT CENTRE

NATIONAL ENGINEERING RESEARCH AND DEVELOPMENT CENTRE

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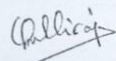
Email: emc@nerdc.lk

Annex 6 contd.

Ambient Noise Level Measurements

1. Name of the Establishment : SENOK Trade Combine Ltd.
2. Address : No.3 , R A De Mel Mawatha
Colombo - 05
Contact Person : Mr. Harin De Costa
Director
Tel : 011 2501425/ 2580017/0777398030
Fax: 011 2580022/2595000
3. Dates of Measurement : 04.09.2007 to 05.09.2008
4. Measurements taken by : R.Tusiyandan
Technical Assistant
DBD Sirimanna
Technical Assistant
5. Instruments used : Integrating Averaging Sound Level Meter
1. CR :832 A – Type 2 - Cirrus
2. CR :832 B – Class 2 - Cirrus
Settings : Frequency Weighing - A
Parameters - Leq, L₉₀
Time Weighing - Fast
6. Results : Refer Table 01, 02, and figure 01.
Measurements were taken according to the
National Environmental (Noise Control) Regulation
No. 1 of 1996, gazetted on 23rd May 1996 in No.
924/12.

Signed by



P M G Pathiraja
For Head/Energy & Environmental Management Centre
11.09.2008

1. Ambient Noise Level Measurements at Proposed Wind Mill Power Site 1 at Norochcholai Coastal Area

Table 1 : Ambient Noise Level at Proposed Wind Mill Power Site 1

Date	Duration	Noise Level $L_{Aeq,T}$ (dB)	Background L_{90} (dB)
04.09.2008	1220-1235	54	51
	1235-1250	54	51
	1300-1330	53	52
	1430-1500	53	52
	1530-1600	53	52
	1630-1700	53	52
	1730-1800	53	52
	1830-1900	53	52
	1930-2000	53	52
	2030-2100	53	52
	2215-2245	53	52
	2330-2400	53	52
05.09.2008	0030-0100	53	52
	0130-0200	53	51
	0230-0300	53	52
	0330-0400	53	52
	0430-0500	53	52
	0530-0600	53	52
	0630-0700	53	51
	0715-0745	53	51
	0845-0915	52	51
	0930-1000	52	51
	1030-1100	50	49
	1130-1200	50	48
	1215-1230	50	48

- Remarks :**
1. During the measurement only sea noise & wind noise were observed in the site area
 2. In the first day, during the measurement it was very sunny
 3. In the second day, during the measurement it was cloudy with variable wind speed
 4. See the Appendix for standard values & figure 01 for locations.

Annex 6 contd.

2. Ambient Noise Level Measurements at Wind Mill Power Site 8 at Daluwa Coastal Area

Table 2 : Ambient Noise Level at Proposed Wind Mill Power Site 8

Date	Duration	Noise Level L _{Aeq,T} (dB)	Background L ₉₀ (dB)
04.09.2008	1300 – 1315	54	53
	1315 – 1330	54	53
	1400 – 1430	54	53
	1500 – 1530	54	53
	1600 – 1630	54	53
	1700 – 1730	54	53
	1800 – 1830	55	54
	1900 – 1930	55	54
	2000 – 2030	54	53
	2100 – 2130	54	53
	2200 – 2230	54	53
	2200 – 2230	54	52
	2300 – 2330	54	52
05.09.2008	0100 – 0130	54	52
	0200 – 0230	53	51
	0300 – 0330	53	51
	0400 – 0430	53	51
	0500 – 0530	52	51
	0600 – 0630	52	50
	0700 – 0730	52	50
	0800 – 0830	53	51
	0900 – 0930	54	52
	1000 – 1030	53	51
	1100 – 1130	52	50
	1200 – 1230	52	49

Remarks :

1. During the measurement only sea noise & wind noise were observed in the site area
2. In the first day, during the measurement it was very sunny
3. In the second day, during the measurement it was cloudy with variable wind speed
4. See the Appendix for standard values & figure 01 for locations.

Appendix

Extracted from the **NOISE LEVEL CRITERIA** gazetted on 23.05.1996 in gazette No. 924/12 under the National Environmental Act No. 47 of 1980, as amended by Act No. 56 of 1988.

SCHEDULE I

Maximum permissible Noise Levels at Boundaries in LAeq' T.

Area	LAeq' T	
	Day Time	Night Time
Low Noise	55	45
Medium Noise	63*	50
High Noise	70	60
Silent Zone	50	45

* Provided that the noise level should not exceed 60 dB (A) inside existing houses, during day time.

For the purposes of schedule I :-

"Low noise area" means an area located within any Pradeshiya Sabha area.

"Medium noise area" means an area located within any Municipal Council or Urban Council area;

"High noise area" means any export processing zone established by the Board of Investment or industrial estates approved under Part IV C of the National Environmental Act;

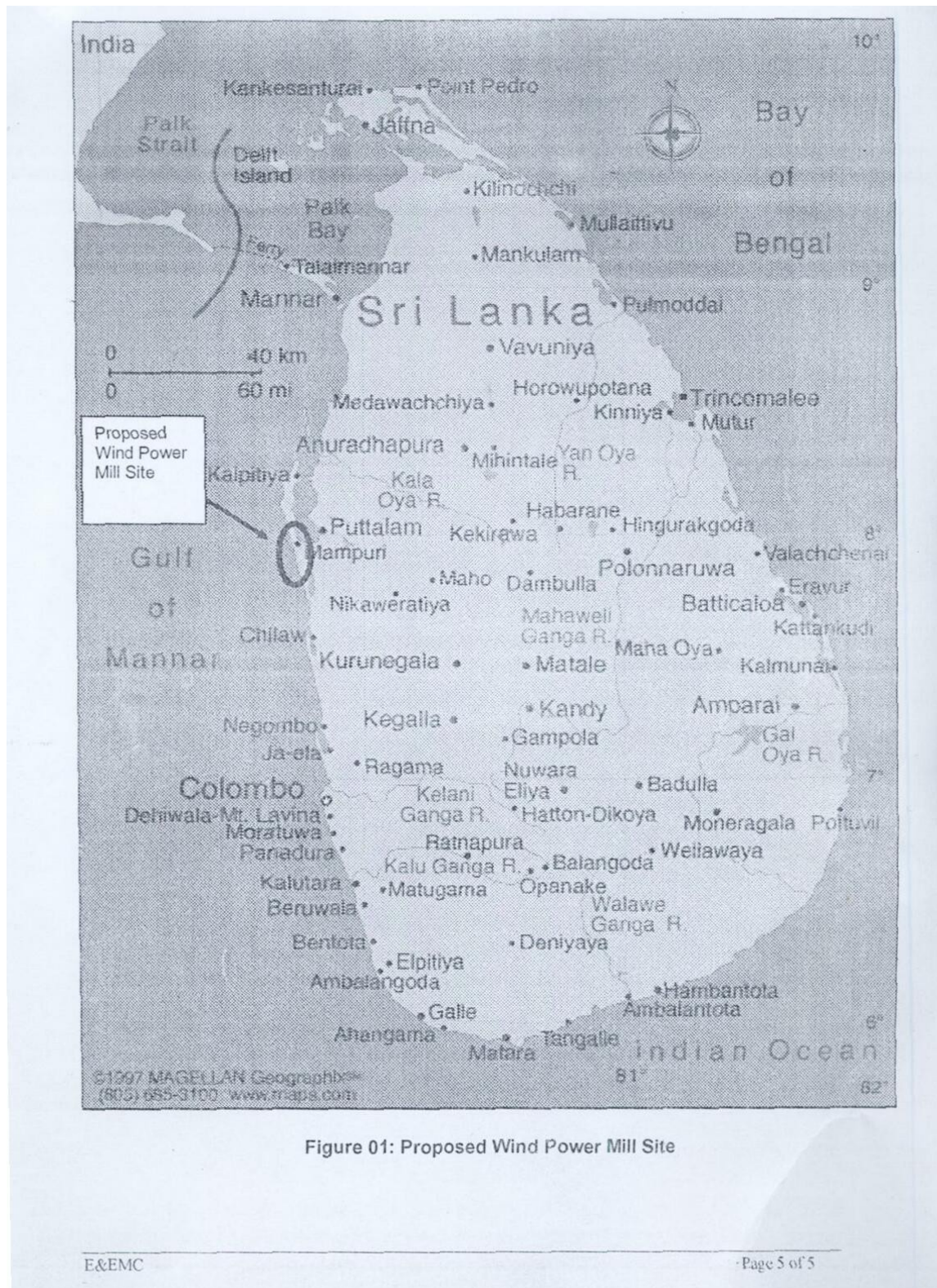
"Silent zone" means the area covered by a distance of 100 meters from the boundary of the courthouse, hospital, public library, school, zoo, sacred areas and areas set apart for recreation or environmental purposes.

SCHEDULE II

The following noise levels will be allowed where the background noise level exceeds or is marginal to the given levels in schedule I.

- (a) For low noise areas in which the background noise level exceeds or is marginal to the given level
- Measured Background Noise Level
+3 dB (A)
- (b) For medium noise areas in which the background noise level exceeds or is marginal to the given level
- Measured Background Noise Level
+3 dB (A)
- (c) For silent zone in which the background noise level exceeds or is marginal to the given level
- Measured Background Noise level
+3 dB (A)
- (d) For high noise areas in which the background noise level exceeds or is marginal to the given level
- Measured Background Noise level
+5 dB (A)
- Measured Background Noise level
+3 dB (A)
- (i) For day time
- (ii) For night time

The above maximum noise levels should be maintained inside the boundary of the land, in which the source noise is located.



Potential Impacts of Proposed Wind Turbines on Birds at Mampuriya, Puttalam

Final Report for the Senok Wind Power Private Limited



C. D. Kaluthota & S.W. Kotagama



**Field Ornithology Group of Sri Lanka
Department of Zoology
University of Colombo
Colombo 03.**

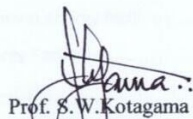
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Web: www.fogsl.net**

Annex 7 contd.

Starting in December 2007, we studied the bird population in the area (South of Mampuriya) on a pilot scale and then initiated a detail study from September 2008 to May 2009 in the Mampuriya Site. This report though specifically covers the later dates, the conclusions and discussion is influenced by the former inquiry. We are confident of the results to the level of accuracy defined by the observational methods applied.

The 'risk of bird strikes', can be effectively minimized through sound mitigation and monitoring. The study has enabled the identification of this risk and the proposed mitigation and monitoring should enable the 'Wind Turbines' to meet the highest environment standards required.

We wish the venture all the success.



Prof. S. W. Kotagama
Professor of Environment Science
President / Field Ornithology Group of Sri Lanka

June 2009

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Introduction

As the demand for energy increases, attitude towards alternative energy amplified in recent past. One of the major alternatives among many others is wind energy generation. Hence, wind energy generation stations are being constructed across the world. Wind power has been used in many countries in Europe and the United States with a great deal of success. However, concerns have been raised about the possible environmental impact of these turbines on birds. Research in this area has focused primarily on mortality caused by birds striking turbine blades and associated wires. However, other aspects such as behavioural changes, disturbance to breeding, wintering or staging birds as a result of turbines have not been examined extensively.

With respect to avian mortality at wind power generating stations, the greatest concern has been for raptors and migrating passerines. The concern for raptors generally stems from the fact that many populations are small and thus even a few deaths can lead to declines (Morrison *et al.* 1998). Passerines which form the largest group of birds are also considered at risk because they are known to fly into human-made structures causing mass kills of thousands of individuals. While raptors and passerines are generally at greatest risk of injury or death from turbines, the impact of such structures on all bird species should be considered on a site-by-site basis since bird diversity and abundance are site specific.

The goal of this report is threefold:

1. Assess the bird diversity, abundance and potential effects of wind turbines;
2. Recommend ways of reducing potential impacts of turbines on birds based on published researches;
3. Recommend a program whereby potential effects of wind turbines on birds can be monitored.

Methodology

Different methodologies were adapted to find out

1. Avifaunal richness and abundance of the area
2. Seasonal changes of the diversity and abundance
3. Diurnal changes of the diversity and abundance
4. Use of vertical space by the birds in the area
5. Flight paths crossing the project site
6. Collision risk at different locations

Establishing a sampling protocol, designing forms to collect field data, and selecting study plots were completed before starting the surveys. The field studies were designed to detect individual birds within the study plots and to characterize their specific activities. Each of these elements was tested in the field and refined as necessary before formal data collection began. Map 1 shows the locations identified for installations of turbines.

Surveys were conducted from September 2008 to May 2009 covering the migration season 2008/09.

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Map 1: Selected locations for the establishment of turbines



Birds inhabiting the area

Surveys were conducted along the coastal strip starting from the Norachcholai Coal Power Plant in North to nearly 10 km South in the site assigned to Senok Windpower(Pvt) Ltd.. Around 1000m from the coast to inwards which contains a mixture of habitats were subjected to the survey. No comprehensive survey was done in the area previously.

Two Important Bird Areas namely Puttalam lagoon IBA and Mundal Lake IBA are located close to project area. Further one marine sanctuary is also located in the area. However, project area does not belong to any of the conservation area either in full extent or partially.

Although the area is a mixture of habitats all of them are disturbed habitats that provide minimal facilities for the avifauna. Large portion of the surveyed area is covered by coconut plantations in various stages of growth. Coastal grasslands and beach area provides waders and sea birds, opportunities for them to feed. Further, cultivated areas of cash crop monocultures and home gardens form considerable portion in the area.

Status

A total of 132 species were recorded during the survey period from September 2008 to May 2009 (Annex 1). This represents 48 families while majority belong to Lariidae (16 species), Accipitridae (15 species) and Ardeidae (11 species). Number of species recorded is a 26.8 % of country's known birds (492) of all forms including migrants and vagrants. Out of 132 species, 86 are breeding resident in the island however; breeding status in the project area is unknown. Number of migrant species recorded in the area was 32, while four species which are considered as vagrants to the island were also reported during the surveys. Another 10 species which have both resident and migrant populations in the island were also identified

during the surveys. However, to separate these two populations and identify the breeding status of resident species in the area, surveys during the breeding period is essential.

Commonness

Based on the number of observations made during the survey period in the migratory period, an index was developed to identify the commonness of the species in the survey area. If the number of observed days of a particular species out of total survey dates exceeds 80% it is categorised as a very common species. Accordingly, Common species (60-80%), uncommon species (40-60%), rare species (20-40%) and very rare species (0-20%) were identified. However, status of the species identified based on this index does not necessarily reflects the commonness of those species in the country. Results show that only 19 species are very commonly found in the project area. Numbers of species in each category are given in Table 1.

Table 1: Commonness of the species found in the project area

Commonness	Number of Species
Very Common	19
Common	12
Uncommon	8
Rare	11
Very Rare	82

Bird Groups

This list of species identified through surveys includes: 35 species classified as waterbirds (seabirds and waterfowl), 16 species of raptor, 13 wader species and 68 species classified as passerines and other families. These bird groups exhibit different behaviours and habitat preferences, which should be considered when examining the possible impacts of the proposed wind energy site.

Waterbirds (including seabirds, waterfowl and waders)

Seabirds spend much of their lives in marine environments, generally coming no further inland than the shore. However, almost all sea bird species (Terns and Gulls) found during the survey period showed high mobility between sea and the lagoon. This group of birds is the highest risk group identified during the survey. Since Puttalam lagoon provides important habitats for aggregating terns and gulls, it is important to identify their flight paths between sea and the lagoon

Waders are another group of aggregating birds, which shows high mobility between suitable habitats. Shallow coastal water bodies are considered ideal habitats as feeding grounds for the migrating waders. Since the Kalpitiya peninsula is full of coastal water bodies including Puttalam lagoon IBA, it is expected to have higher movement of waders in the area. Identified wader species except Lapwings and Thick-knees are highly mobile between

suitable habitats, and observed so. However, during this migratory period, no large aggregations more than 100 birds of waders were observed along the coast.

Raptors

Raptors are a high potential group of birds to have collision risk with wind turbines and therefore extensively studied all over the world. Among 16 species of raptors recorded in the project area, only two species namely Brahminy Kite and Shikra were very common, while all the others were rare or very rare. However, all these recorded species shows movements in all vertical layers, especially the space 30m above ground. The perching habit of raptors on tall trees or structures also makes them vulnerable to collision with wind turbines.

Only three species of nocturnal raptors were recorded during the surveys, however, few other species are likely to inhabit the area. Among the recorded species, Collared Scops Owl was common in the area, while two other species were very rare. However, these species are not categorised as highfliers.

Other birds

Most of the passerine and other birds species occur in the project area are residents while few species of migrants were also reported. Among the species in this category, Barn Swallow, Blue-tailed Bee-eater, and Asian Palm Swift are important since those are very common and also use higher layers of the vertical space. Therefore, there is a high potential to have collision risk of these species. However, all these three species are swift in flying movements and therefore, it is believed that they will show high avoidance rate once turbines are in place. Common Myna, House Crow, Indian Roller, and Rock Pigeon are very common in the area and likely to move in the higher layers commonly.

Species of Special Conservation Concern

No globally threatened species were recorded during the surveys. However, three species which are categorised as Nationally threatened species (IUCN & MENR 2007) are found in the project area. However, all these three species namely, Saunders's Tern (Critically Endangered), White-naped Woodpecker and Besra (Vulnerable) were very rarely recorded in the area. Further seven species that are categorised as near threatened in the national level, were also reported in the project area. Among these species Grey Francolin is the only species recorded very common during the study period. List of threatened and near threatened species recorded from the project area is annexed (Annex 2).

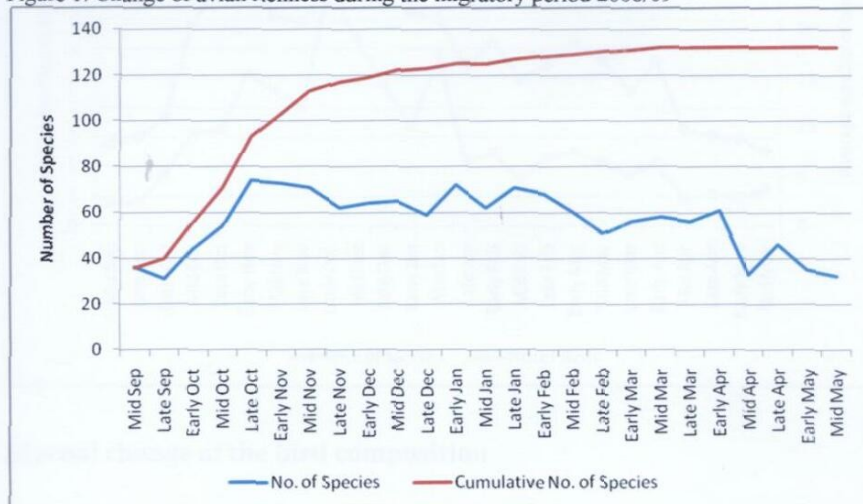
No Restricted Range species (Endemic species) recorded in the project area.

Seasonal changes of the diversity and abundance

Results of the general surveys conducted in the area, showed a fluctuation of species richness throughout the period. Number of species that inhabit the area increased significantly during September and October, and thereafter continued with some fluctuations till February (Figure

1). After February, number of species recorded in the area started to drop and in May it was similar to the condition prevailed in September. The increase of number of species is caused by two ways, first by addition of migratory species which comes during September and October, then by addition of resident species due to favourable conditions especially the lowered wind speed in the area.

Figure 1: Change of avian richness during the migratory period 2008/09

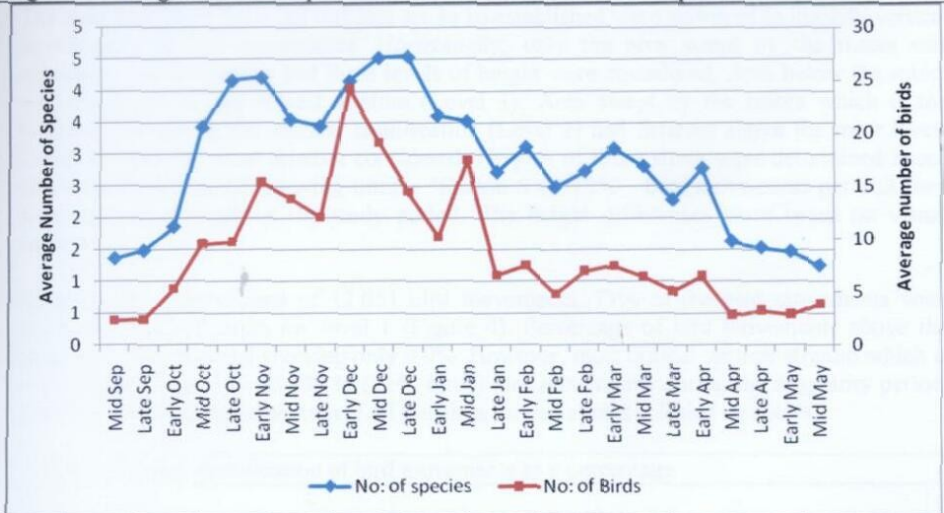


Surveys were conducted at the locations where wind turbines are planned to establish to assess avifaunal composition of the selected location. Only the area swept by the rotors was considered for this survey, accordingly a total of eight locations surveyed for five minutes periods during the selected time blocks throughout the migratory period. Results of this study further confirm the above mentioned findings by showing higher diversity during the period from November to February (Figure 2). During February and March, both average number of species and number of birds recorded in a unit time period were settled in lower level compared to previous months. However, during April and thereafter, values dropped and became more or less similar to the condition prevailed during September last year.

Based on these observations it can be concluded that there is a high risk of bird collisions during the period from October to January, and less risk till April. Further, as the rotation do not occur at wind speeds or happens extremely slowly, thus the risk of bird strikes is minimal or zero. However, this conclusion was made based on the study carried out during a single migratory period and therefore this will not be applied to the all migratory seasons. It is known fact that many variables affect bird diversity and abundance especially for this kind of location where mixture of disturbed habitats present and high mobility of birds prevail. The need for continuous monitoring during operations is thus justified.

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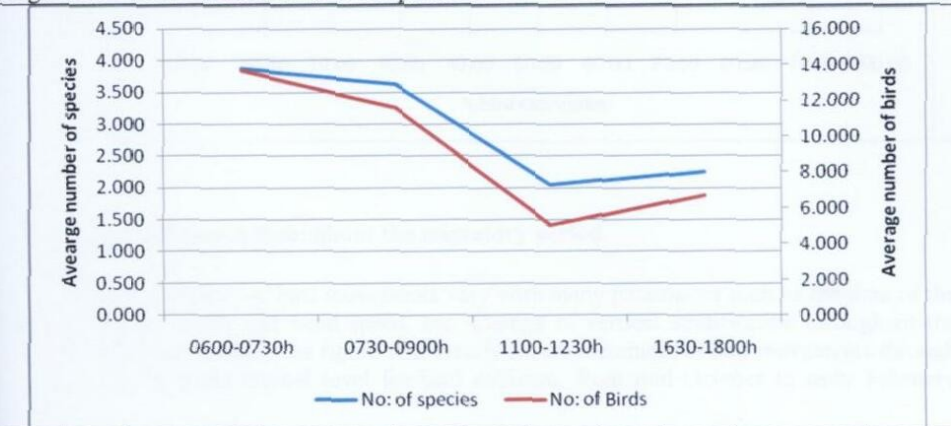
Figure 2: Average number of species and birds recorded at selected points



Diurnal change of the bird composition

Diurnal change of bird composition was observed during the study period (Figure 3). Based on the results from point counts conducted at the selected locations of turbine construction, number of birds and number of species were higher in the mornings. Considerable drop of both average number of species and number of individuals were observed during the mid day and evenings. Hence it can be concluded that there is a higher bird collision risk in the mornings.

Figure 3: Diurnal variation of bird composition



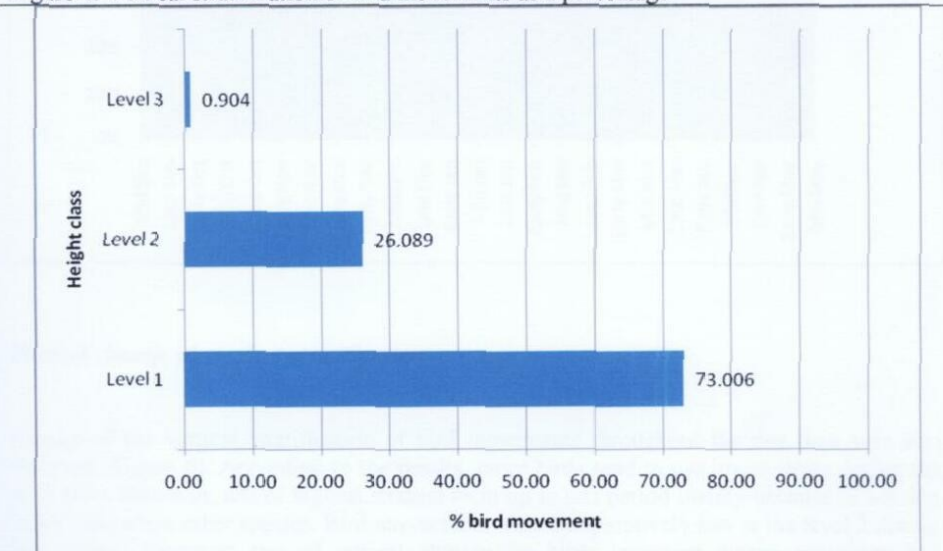
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Vertical stratification of bird movements

The locations where the wind turbines are to be established were surveyed to identify vertical stratification of bird movements. Horizontally, only the area swept by the rotors was considered for this survey and three levels of height were considered. Area below the rotors was considered as the lowest stratum (Level 1). Area swept by the rotors which is the important stratum in the vertical stratification (Level 2) and Stratum above the rotor levels (Level 3) were the other stratum considered. Heights of these strata were determined based on the specifications of the wing turbine 'Suzlon S 64-1250'. Bird movements per unit time were assessed throughout the study period. The height differences were based on visual estimates.

Based on the observations of 12,051 bird movements, 73% of the bird movements were below the level of rotors *i.e.* level 1 (Figure 4). Percentage of bird movements above the rotors was very minimal showing only 0.9%. However, most critical vertical stratum which is swept by the rotors had 26.089 % (3144 birds) bird movements during the migratory period. This is a considerable percentage if all the birds moved across collided on rotors.

Figure 4: Vertical stratification of bird movements as a percentage



Vertical stratification throughout the migratory period

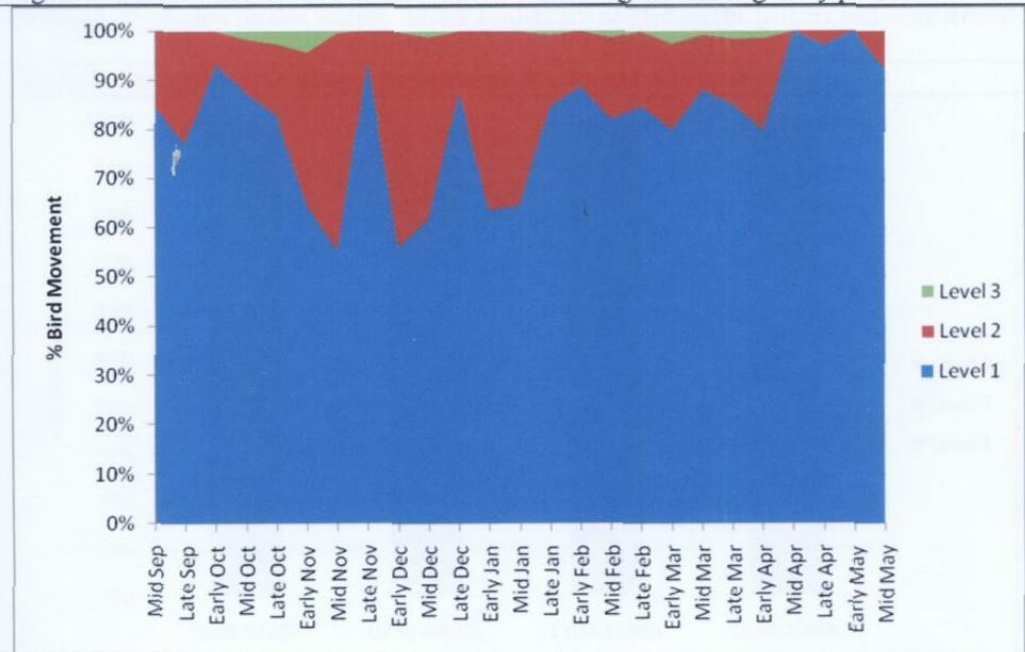
However, percentages of bird movements vary with many parameters such as the time of the day, location, month and wind speed, etc. Change of vertical stratification throughout the study period was given in the figure 5. It clearly shows increment of bird movements through level 2 which is the critical level for bird collision, from mid October to early February

Annex 7 contd.

period. This also shows the higher probability of bird collision in the said period compared to other months of the study period.

During the period of higher movements through level 2, it shows two huge drops. These drops were mainly because of high wind speeds that prevailed in those days. Correlation of bird movements with wind speed will be discussed later.

Figure 5: Vertical stratification of bird movements throughout the migratory period



Diurnal change of vertical stratification

Change of the vertical stratification of bird movements throughout the day time was also observed (Figure 6). According to the results, more birds tend to use lower strata during the noon time. However, use of highest stratum went up in this period mainly because of soaring raptors and some other species. Bird movements were comparatively low at the level 2 during this period. However, use of critical stratum by birds increases during mornings and evenings, showing comparatively higher potential for bird collisions.

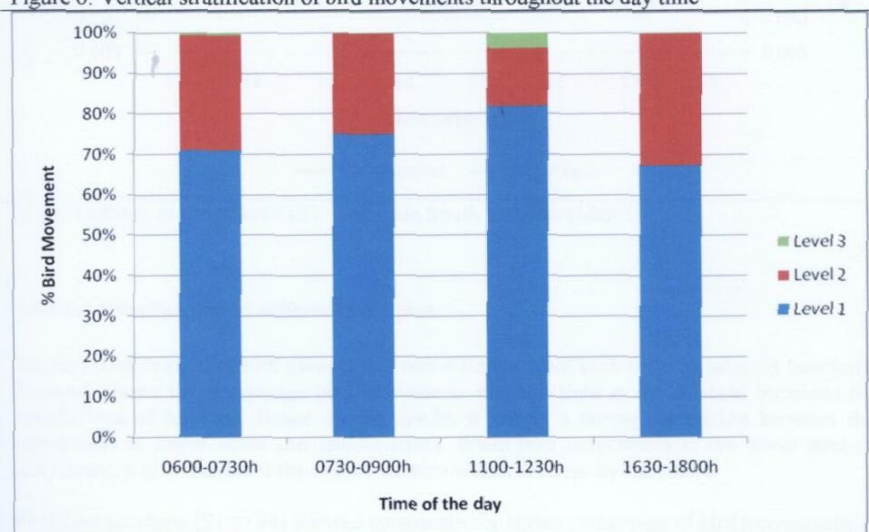
Identification of Flight paths of birds

Surveys were conducted to identify flight paths that cross the project area. Based on the observations made along the study area, a flight path that crosses the development area was identified. Sea birds mainly terns and gulls use this flight path to move between the sea and the lagoon. Birds move along this flight path as individuals, pairs and most commonly as

flocks sometimes up to 300-400 birds. This flight path covers the area that is planned to install four southernmost turbines. The flight path located at the place where the shortest distance between sea and lagoon and therefore birds can cross the land bridge easily.

However, high traffic along this flight path was observed only after November and before February. This coincides with the period where higher diversity and population size prevailed in the area. Based on the Observations of bird movements along the flight path, flocks of birds are more vulnerable to collide on turbines than pairs or single birds. However, to have a thorough conclusion on this matter, further studies are needed on the heights and consistency.

Figure 6: Vertical stratification of bird movements throughout the day time

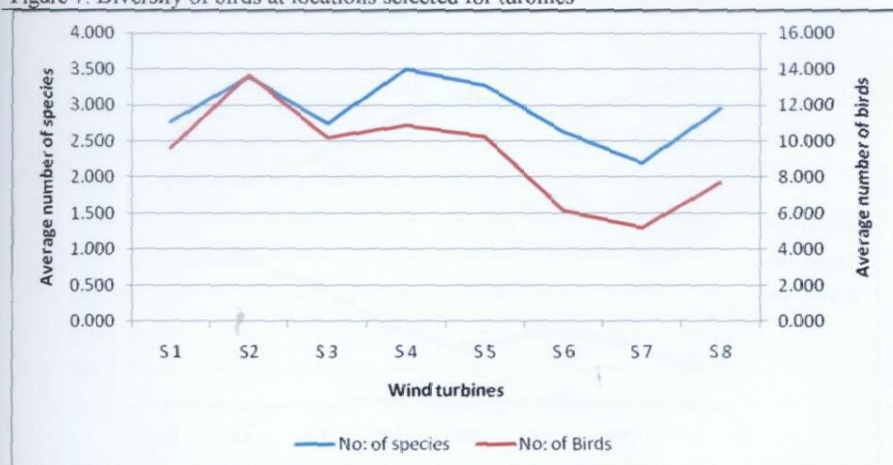


Collision risk at different locations

Locations identified for the installations have different characteristics and therefore assessed separately for collision risk of birds. The habitats of the selected locations are either coconut plantations or coastal grasslands. After turbines were installed at these locations there will be more or less homogeneous habitat type in all locations.

However, differences of species composition in these locations were observed. Many factors such as the habitat type, wind speed, disturbances, flight paths, etc affect on the species composition. Figure 7 shows the average number of species and birds in a unit time period, in this case five minutes in the area covered by the rotors. Higher number of birds observed at southernmost turbines from S1 to S5. This is mainly because of the use of flight path between the sea and lagoon in peak months of the bird population.

Figure 7: Diversity of birds at locations selected for turbines



Note: Turbines are numbered (S1 –S8) from South to North (Map 1)

Vertical Stratification at different locations

Vertical stratification of bird movements was different from each other at selected locations. Figure 8 shows the percentage bird movements per unit time at the selected locations for installations of turbines. Based on the results it shows a strong correlation between the movements in lower strata and middle strata. When bird movements at the lower stratum goes down, it is increased at the second stratum which is swept by the rotors.

First four locations (S1 to S4) showed comparatively higher percentage of bird movements. It was more than 20% of the total bird movements at each location and S2 showed the highest value (40%).

When consider the average number of birds per unit time crossing the turbine, it was also high at above mentioned four locations (S1 –S4). Average numbers of birds crosses at the level of rotors were 3.54, 5.46, 3.32 and 2.31 for five minute periods at S1, S2, S3 and S4 respectively. Movement of more than two birds per five minutes across the rotors is a comparatively higher number (Figure 9).

These higher values for bird numbers at the critical levels were mainly due to the existing flying path crossing these turbines. Based on these results it can be concluded that southernmost four turbines (S1, S2, S3 and S4) have higher risk of bird collisions since higher bird movement percentage is through the rotors.

Figure 8: Percentage bird movements in different heights at proposed turbines

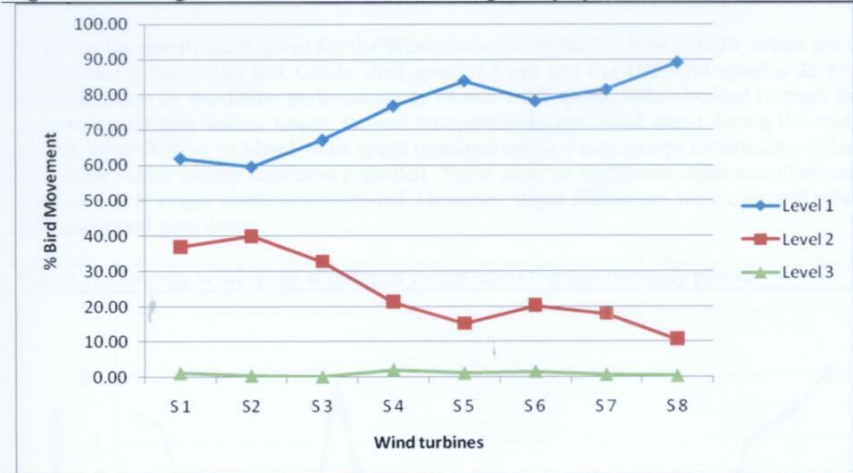
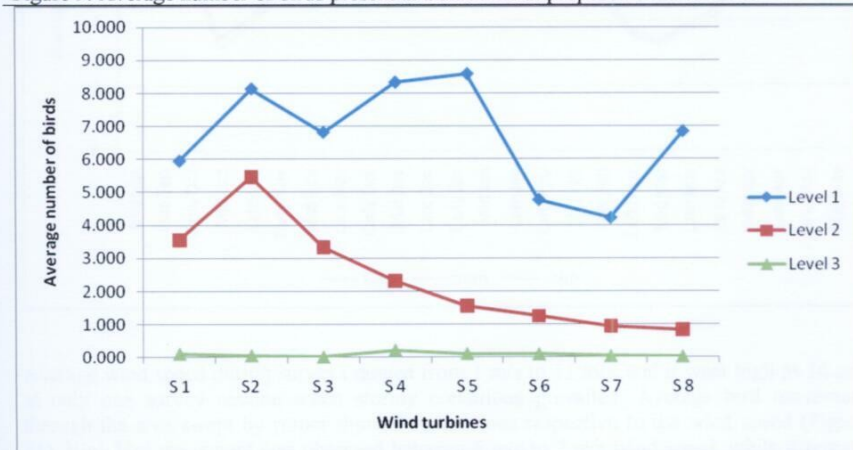


Figure 9: Average number of birds present at a unit time at proposed wind turbines

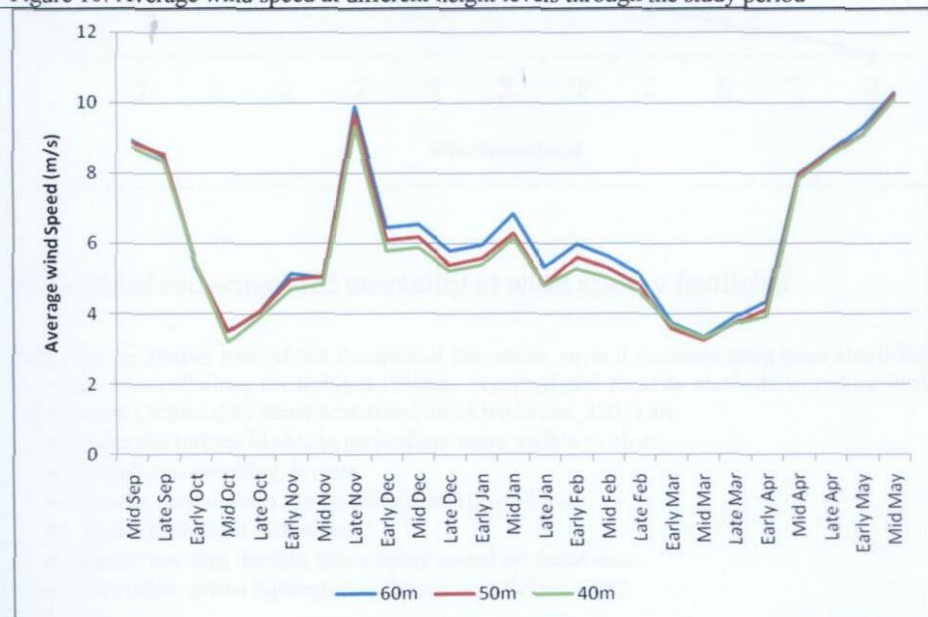


Note: Turbines are numbered (S1 –S8) from South to North (Map 1)

Bird movements and the wind speed

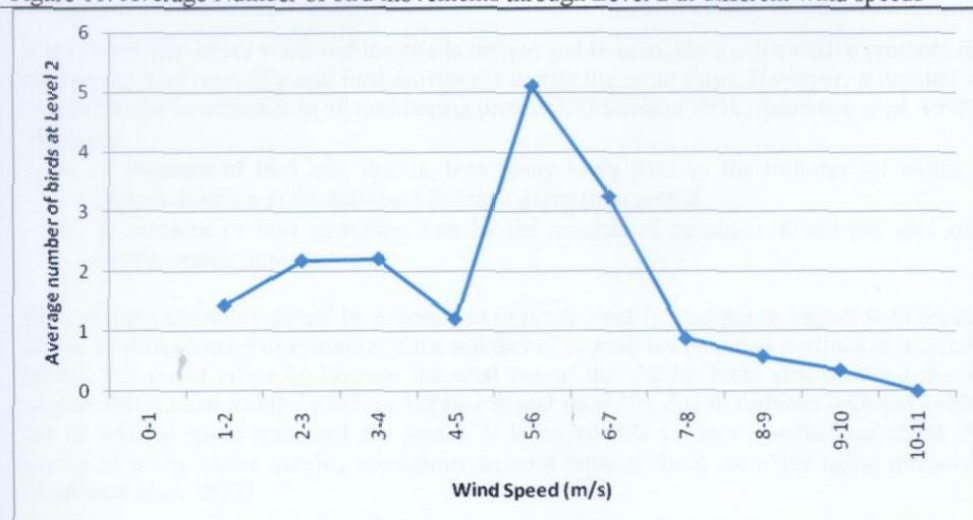
Based on the specification given for the Wind tower model Suzlon S 64 – 1250, which are to be installed at the project site, Cut-In wind speed is 3 m/s and Cut-Off wind speed is 22 m/s. Turbines reach its maximum performance at 14 m/s wind speed. Data obtained through the meteorological data testing tower, showed comparatively low wind speed during the study period. From October to March wind speed remained below 7 m/s, except for few days in late November where stormy condition prevailed. There were no significant differences between wind speeds at height levels above ground. However, slight differences were observed when the wind speed goes down.

Figure 10: Average wind speed at different height levels through the study period



Average wind speed during surveys ranged from 1 m/s to 11 m/s, and it went high as 16 m/s at only one survey session when stormy conditions prevailed. Average bird movement through the area swept by rotors showed fluctuations respective to the wind speed (Figure 11). High bird movement was observed between 5 m/s to 7 m/s wind speed, while it remain below 1, above the 7 m/s wind speed. Hence, it can be concluded that there is a minimal risk between 7-10 m/s wind speed and no risk above 10 m/s wind speed. However, there can be bird movements at the critical stratum at higher wind speeds above 10 m/s. Hence, it is advisable to monitor the situation during the high-wind period that coincides with the non-migratory period.

Figure 11: Average Number of bird movements through Level 2 at different wind speeds



Methods of reducing bird mortality at wind energy facilities

Based on the studies carried out throughout the world, several methods have been identified to reduce bird collisions on turbines. Widely accepted and feasible methods to reduce bird collisions as proposed by some scientists (Strickland *et al.* 2001) are

- Paint the turbine blades to make them more visible to birds;
- Install anti-perching devices;
- Ensure that turbines are no taller than 100-150 m;
- Install bird flight "Diverters";
- Install warning devices that employ sound or visual cues;
- Use white strobe lighting (Gauthreaux and Belser 1999).

The proposed wind power site has already taken some precautionary steps to reduce bird mortality. The most important measure is the use of turbines of solid tubular design against lattice design, which is known to attract perching raptors and some nesting birds, thereby leading to injury or death. The proposed tower model Suzlon S 64 – 1250 to be installed at the site are also well below 150 m, and all wires are buried underground.

However, monitoring of bird mortality and bird behaviour at wind turbines is essential to carryout at least for one full year from its establishment. A draft monitoring protocol is annexed with this report (Annex 3). If mortality continues to appear to be a serious issue at certain windmill locations, the management should seriously consider reducing bird strikes by implementing some of the above mentioned measures and taking precaution through managing rotation times, considering peak bird movements.

Monitoring Bird Mortality at Wind Energy Facilities

It is evident that every wind turbine site is unique and thus requires a distinctive protocol for monitoring bird mortality and bird movement across the wind farm. However, a number of factors should be common to all monitoring protocols (Morrison 1998, Anderson *et al.* 1999). These are:

- A measure of bird use; that is, how many birds pass by the turbines (or within a certain distance of the turbines) during a given time period
- A measure of bird mortality; that is, the number of carcasses found per unit area and/or search time.

Both of these variables should be assessed in order to identify changes in impact with season or site modifications. For example, if the number of mortalities recorded declines in a certain period, this could either be because the total use of the site by birds also declined due to another factor such as high wind, or because actual mortality due to turbines declined (while use of vertical space remained the same). It is impossible to draw conclusions about the impact of a site under varying conditions without both of these variables being measured (Anderson *et al.* 1999).

Most studies shows that it also benefit from a measure of bird use at a reference, or control, site located some distance from the turbines.

However, to conduct this kind of monitoring scheme, it is essential to have a skilled bird survey team, since identification of bird species and measuring distances and heights of bird movements need some credibility. This will require to have at least one officer dedicated for the task of assuring environmental safeguards. It would be necessary that this officer is competent in bird identification (those in the area) too. Assistance could be provided by the Field Ornithology Group of Sri Lanka/ University of Colombo, in assisting this task.

A draft monitoring protocol is provided in Annex 3.

Recommendations

- Locations S1, S2, S3 and S4 are considered significant for mitigation, and we suggest that installation must involve 'painting of blades' and 'use of diverters'. These should be done with installation.
- All windmills should in the least contain the painting to distract and reduce any risk of strike.
- Monitoring must be part of the operational programme.

Acknowledgements

Thanks to D. Samarasinghe, K. Dayananda, D.M de Silva, H. De Silva, and Chanaka Kumara for their hard work at the field. Members of FOGSL volunteered for bird surveys at several occasions.

Annex 7
contd.

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Annex

Annex 1 - List of birds recorded in the project area

Common name	Scientific name	Status	Commonness
Grey Francolin	<i>Francolinus pondicerianus</i>	BrR	VC
Indian Peafowl	<i>Pavo cristatus</i>	BrR	VR
Lesser Whistling-duck	<i>Dendrocygna javanica</i>	BrR	VR
Asian Openbill	<i>Anastomus oscitans</i>	BrR	VR
Black-headed Ibis	<i>Threskiornis melanocephalus</i>	BrR	VR
Yellow Bittern	<i>Ixobrychus sinensis</i>	BrR	VR
Cinnamon Bittern	<i>Ixobrychus cinnamomeus</i>	BrR	VR
Black Bittern	<i>Ixobrychus flavicollis</i>	BrR	VR
Black-crowned Night-heron	<i>Nycticorax nycticorax</i>	BrR	VR
Striated Heron	<i>Butorides striata</i>	BrR	VR
Indian Pond-heron	<i>Ardeola grayii</i>	BrR	VC
Cattle Egret	<i>Bubulcus ibis</i>	BrR	VC
Grey Heron	<i>Ardea cinerea</i>	BrR	VR
Purple Heron	<i>Ardea purpurea</i>	BrR	VR
Intermediate Egret	<i>Mesophoyx intermedia</i>	BrR	VR
Little Egret	<i>Egretta garzetta</i>	BrR	VR
Little Cormorant	<i>Phalacrocorax niger</i>	BrR	R
Indian Cormorant	<i>Phalacrocorax fuscicollis</i>	BrR	VR
Common Kestrel	<i>Falco tinnunculus</i>	BrR/M	R
Oriental Honey-buzzard	<i>Pernis ptilorhynchus</i>	BrR	VR
Black-winged Kite	<i>Elanus caeruleus</i>	BrR	VR
Black Kite	<i>Milvus migrans</i>	BrR	VR
Brahminy Kite	<i>Haliastur indus</i>	BrR	VC
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>	BrR	VR
Crested Serpent-eagle	<i>Spilornis cheela</i>	BrR	VR
Western Marsh-harrier	<i>Circus aeruginosus</i>	M	VR
Pallid Harrier	<i>Circus macrourus</i>	M	VR
Pied Harrier	<i>Circus melanoleucos</i>	M	VR
Montagu's Harrier	<i>Circus pygargus</i>	M	VR
Shikra	<i>Accipiter badius</i>	BrR	VC
Besra	<i>Accipiter virgatus</i>	BrR	VR
Common Buzzard	<i>Buteo buteo</i>	M	VR
Booted Eagle	<i>Hieraaetus pennatus</i>	M	R
Changeable Hawk-eagle	<i>Spizaetus cirrhatus</i>	BrR	VR
White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	BrR	R
Common Moorhen	<i>Gallinula chloropus</i>	BrR	VR
Eurasian Thick-knee	<i>Burhinus oedipnemus</i>	BrR	R
Black-winged Stilt	<i>Himantopus himantopus</i>	BrR	VR
Yellow-wattled Lapwing	<i>Vanellus malarbaricus</i>	BrR	VR

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Red-wattled Lapwing	<i>Vanellus indicus</i>	BrR	VC
Common Ringed Plover	<i>Charadrius hiaticula</i>	M	VR
Little Ringed Plover	<i>Charadrius dubius</i>	BrR/M	VR
Kentish Plover	<i>Charadrius alexandrinus</i>	BrR/M	R
Lesser Sand Plover	<i>Charadrius mongolus</i>	M	UC
Greater Sand Plover	<i>Charadrius leschenaultii</i>	M	VR
Caspian Plover	<i>Charadrius asiaticus</i>	M	VR
Whimbrel	<i>Numenius phaeopus</i>	M	VC
Common Sandpiper	<i>Actitis hypoleucos</i>	M	VR
Sanderling	<i>Calidris alba</i>	M	VR
Brown-headed Gull	<i>Larus brunnicephalus</i>	M	UC
Black-headed Gull	<i>Larus ridibundus</i>	M	VR
Gull-billed Tern	<i>Sterna nilotica</i>	BrR/M	VC
Caspian Tern	<i>Sterna caspia</i>	BrR/M	VR
Lesser Crested Tern	<i>Sterna bengalensis</i>	M	UC
Great Crested Tern	<i>Sterna bergii</i>	BrR/M	C
Sandwich Tern	<i>Sterna sandvicensis</i>	M	VR
Roseate Tern	<i>Sterna dougallii</i>	M	VR
Black-naped Tern	<i>Sterna sumatrana</i>	Va	VR
Common Tern	<i>Sterna hirundo</i>	M	C
Little Tern	<i>Sterna albifrons</i>	BrR	C
Saunders's Tern	<i>Sterna saundersi</i>	BrR	VR
Sooty Tern	<i>Sterna fuscata</i>	M	VR
Whiskered Tern	<i>Chlidonias hybrida</i>	M	C
White-winged Tern	<i>Chlidonias leucopterus</i>	M	VR
Lesser Noddy	<i>Anous tenuirostris</i>	Va	VR
Pomarine Jaeger	<i>Stercorarius pomarinus</i>	Va	VR
Rock Pigeon	<i>Columba livia</i>	BrR	VC
Spotted Dove	<i>Stigmatopelia chinensis</i>	BrR	VC
Rose-ringed Parakeet	<i>Psittacula krameri</i>	BrR	C
Pied Cuckoo	<i>Clamator jacobinus</i>	BrR	VR
Common Hawk-cuckoo	<i>Cuculus varius</i>	BrR/M	VR
Lesser Cuckoo	<i>Cuculus poliocephalus</i>	M	VR
Grey-bellied Cuckoo	<i>Cacomantis passerinus</i>	M	VR
Drongo Cuckoo	<i>Surniculus lugubris</i>	BrR	VR
Asian Koel	<i>Eudynamys scolopacea</i>	BrR	C
Greater Coucal	<i>Centropus sinensis</i>	BrR	VC
Barn Owl	<i>Tyto alba</i>	BrR	VR
Collared Scops-owl	<i>Otus bakkamoena</i>	BrR	C
Brown Hawk-owl	<i>Ninox scutulata</i>	BrR	VR
Indian Nightjar	<i>Caprimulgus asiaticus</i>	BrR	VR
Asian Palm-swift	<i>Cypsiurus balasiensis</i>	BrR	VC
Little Swift	<i>Apus affinis</i>	BrR	VR
Indian Roller	<i>Coracias benghalensis</i>	BrR	VC

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Stork-billed Kingfisher	<i>Pelargopsis capensis</i>	BrR	VR
White-throated Kingfisher	<i>Halcyon smyrnensis</i>	BrR	C
Common Kingfisher	<i>Alcedo atthis</i>	BrR	VR
Pied Kingfisher	<i>Ceryle rudis</i>	BrR	VR
Little Green Bee-eater	<i>Merops orientalis</i>	BrR	R
Blue-tailed Bee-eater	<i>Merops philippinus</i>	M	VC
Eurasian Hoopoe	<i>Upupa epops</i>	BrR	VR
Brown-headed Barbet	<i>Megalaima zeylanica</i>	BrR	VR
Black-rumped Flameback	<i>Dinopium benghalense</i>	BrR	VR
Greater Flameback	<i>Chrysocolaptes lucidus</i>	BrR	VR
White-naped Woodpecker	<i>Chrysocolaptes festivus</i>	BrR	VR
Indian Pitta	<i>Pitta brachyura</i>	M	VR
Ashy Woodswallow	<i>Artamus fuscus</i>	BrR	C
Brown Shrike	<i>Lanius cristatus</i>	M	C
Black-hooded Oriole	<i>Oriolus xanthornus</i>	BrR	VR
White-bellied Drongo	<i>Dicrurus caerulescens</i>	BrR	VR
Asian Paradise-flycatcher	<i>Terpsiphone paradisi</i>	BrR/M	VR
House Crow	<i>Corvus splendens</i>	BrR	VC
Jungle Crow	<i>Corvus leuclantii</i>	BrR	UC
Barn Swallow	<i>Hirundo rustica</i>	M	C
Red-rumped Swallow	<i>Hirundo daurica</i>	BrR/M	VR
Jerdon's Bushlark	<i>Mirafra affinis</i>	BrR	UC
Oriental Skylark	<i>Alauda gulgula</i>	BrR	VR
Ashy-crowned Sparrow-lark	<i>Eremopterix griseus</i>	BrR	VR
Zitting Cisticola	<i>Cisticola juncidis</i>	BrR	VC
Grey-breasted Prinia	<i>Prinia hodgsonii</i>	BrR	VR
Jungle Prinia	<i>Prinia sylvatica</i>	BrR	VR
Ashy Prinia	<i>Prinia socialis</i>	BrR	VR
Plain Prinia	<i>Prinia inornata</i>	BrR	R
Red-vented Bulbul	<i>Pycnonotus cafer</i>	BrR	VC
White-browed Bulbul	<i>Pycnonotus luteolus</i>	BrR	UC
Common Tailorbird	<i>Orthotomus sutorius</i>	BrR	VR
Blyth's Reed-warbler	<i>Acrocephalus dumetorum</i>	M	UC
Clamorous Reed-warbler	<i>Acrocephalus stentoreus</i>	BrR	VR
Yellow-billed Babbler	<i>Turdoides affinis</i>	BrR	VC
Common Myna	<i>Acridotheres tristis</i>	BrR	VC
Brahminy Starling	<i>Sturnus pagodarum</i>	BrR/M	VR
Rosy Starling	<i>Sturnus roseus</i>	M	VR
Indian Robin	<i>Saxicoloides fulicatus</i>	BrR	VR
Purple-rumped Sunbird	<i>Nectarinia zeylanica</i>	BrR	R
Purple Sunbird	<i>Nectarinia asiatica</i>	BrR	R
Long-billed Sunbird	<i>Nectarinia lotenia</i>	BrR	R
House Sparrow	<i>Passer domesticus</i>	BrR	UC
White-throated Munia	<i>Lonchura malabarica</i>	BrR	VR

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Scaly-breasted Munia	<i>Lonchura punctulata</i>	BrR	VR
Richard's Pipit	<i>Anthus richardi</i>	M	C
Paddyfield Pipit	<i>Anthus rufulus</i>	BrR	VR
Blyth's Pipit	<i>Anthus godlewskii</i>	M	VR
Grey-necked Bunting	<i>Emberiza buchanani</i>	Va	VR

Status: BrR – Breeding Residents, M – Migrant, Va – Vagrant

Commonness: VC- Very Common, C – Common, UC – Uncommon, R – Rare, VR – Very Rare

Annex 2 - Nationally Threatened species recorded in the project area

Species	Threat Status
Saunders's Tern	Critically Endangered
White-naped Woodpecker	Vulnerable
Besra	Vulnerable
Grey Francolin	Near Threatened
Greater Flameback	Near Threatened
Common Hoopoe	Near Threatened
Common Hawk Cuckoo	Near Threatened
Barn Owl	Near Threatened
Eurasian Thick-Knee	Near Threatened
Black-shouldered Kite	Near Threatened
Clamorous Reed Warbler	Near Threatened

Annex 3 - Draft bird monitoring protocol

The goal of this study is to determine the effects of eight wind turbines proposed at Mampuriya, on birds breeding, staging or migrating in the area. Currently, very little is known about the type and abundance of birds using this area, other than the results obtained through the baseline survey. The protocol is standardized so that results can be compared among potential and existing wind power facilities.

We highly recommend that a service provider with significant bird identification experience be hired to conduct the protocol during key periods of migration and breeding, and that employees at the proponent company be trained to do so for future monitoring work.

The number and species of birds at the project area will differ seasonally, within a season, and according to weather conditions and other environmental factors. For this reason, it is important to make every attempt to monitor the site at all times of year, for two to five years. Most wind test sites in the world are monitored every two weeks (Anderson *et al.* 1999). After completion of full one year monitoring programme and based on the results obtained, frequency of monitoring for future years can be adjusted.

The objectives of this monitoring programme are:

1. Determine use of space by birds (*bird utilization rate* – Number of birds observed per unit time and area) at each turbine and at a control site located at some distance from the turbines;
2. Determine *bird mortality rate* (Number of carcasses found per unit area) at these same points;
3. Using the above two variables, calculate *bird collision risk* (mortality/utilization) at each point;
4. Compare bird collision risk at turbines and controls;
5. Identify annual periods of high and low risk;
6. Determine the influence of weather on passage rate and mortality risk.

Methods

Each of the eight turbines should be considered a single survey point. Each turbine should also be compared with a control point located about 300 m (or some other chosen distance) away, with the condition that the habitat should be similar between the turbine point and the control point. The control point should not be established either fully or partially on a water body. Control points should be marked for easy reference and geo-referenced with a GPS for future use. This paired design should allow comparison of bird utilization and mortality rates immediately surrounding the turbines, and some distance (300 m) away from the turbines. However, 300 m may be suitable to determine impacts on small birds, but may not be suitable for birds such as raptors that range large distances.

Each of the eight points should be surveyed at least three times a month from October to April where high bird density and diversity prevails. However, monitoring frequency can be reduced to once in every two weeks from May to September. Surveys should start at first light *i.e.* 0600h, so that dead bodies are more likely to be found before they are scavenged. Additional counts should be conducted following drastic weather changes such as storms during the migration seasons.

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(number of dead birds/point) can be calculated for each turbine and control point. Utilization rate can also be calculated separately for each passage zone (Level 1-3). An index of risk can then be calculated as the ratio of mortality to utilization. This ratio can be compared for

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turbine and control sites, to see if the area immediately around turbines is considered to be more dangerous than the area at some distance from the turbines. Habitat differences between turbine and control points must be taken into account (by measuring standard habitat variables at each point). This ratio can also be compared across the season to determine if risk is higher during the migration, breeding, or wintering seasons, and across various weather conditions to determine if risk is higher during periods of low visibility, storm conditions, etc.

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Sample data Sheet – For Carcass Search

[illegible]

Identification Procedure: Collected, or Photographed, Reference of specimen if collected
Carcass condition: As whole, scavenged, skeleton, cluster of feathers or other (describe in comments section).
Cause of death: As turbine strike, shooting, poisoning, predatory attack or unknown.

Annex 8 Terms of Reference for the Initial Environmental Examination report required by the Coast Conservation Department

Validity

This Terms of Reference is valid only for one and half year period from the date of issues. The Initial Environmental Examination report should be submitted within the validity period.

Part A - Introduction and General Information

- A.1 Name of the project
- A.2 Name of the Developer Company / Firm, Postal Address, Phone / Fax no.
- A.3 Nature of the Project
Aim and scope of the report, objective and Justification
- A.4 Investment and funding sources
- A.5 Location of the project
 - GN Division
 - Pradeshiya Saba
 - Divisional Secretariat
 - District Secretariat
- A.6 Survey plan of the project site with extent of the project area
- A.7 Location map indicating the project site, access to the site, distance to declared areas, Religious places, Sand dunes with minor rock out crops at the coastal edge, surrounding developments and infrastructure (Scale 1:10,000)
- A.8 Present ownership of the project site (state / private / other specify) if state owned letter of consent of the release of the land from the relevant state agency)
- A.9 Description of the applicable laws, regulations, standards and requirement covering proposed project
- A.10 Clearances/permits obtained or should be obtained from relevant state agencies or local authorities (Attach required copies)

Part B - Description of the Project

This Section should describe details of the proposed project under following section.

- B.1 Brief description of the project including major components, size and magnitude of each component with permanent and temporary structures.

- B.2 Project lay out plan (drawings to be provided) indicating all project components, access roads to the site, reservation etc. in order to get a clear picture of the project (Scale 1:1000)
- B.3 Time period for the development and construction
- B.4 Financial allocation and investments
- B.5 Details of all recreation and expected conservation activities related to the project. **(Inland, onshore and offshore, Lagoon)**
- B.6 Water requirements
- B.7 Electricity requirements
- B.8 All other natural resources consumption
- B.9 Waste disposal methods
- B.10 Number of employments to be created
- B.11 Mode of transport of guests and staff.
- B.12 Requirement of labour during construction and operation period.
- B.13. Details of the methodologies to be adopted during the construction.
- B.14 Infrastructure facilities required / provided
 - (i) Details of any access roads to be built or anticipated improvement of Existing Access Roads
 - (ii) Communication
 - (iii) Infrastructure facilities provided by the project to the community and other benefits to the local community
- B.15 Detail of laying out of transmission lines.
- B.16 Aesthetic and visual environmental
 - (i) The tallest height of the proposed structures
 - (ii) Whether the view in the immediate vicinity would be altered, imposed or obstructed as a result of the proposed structure
 - (iii) Proposed landscaping, use of native plant or other measures to preserve or enhance vegetation on the site

Part C - Description of the existing environment of the study area

This chapter should provide information on physical features, ecological resources, social – economic conditions, archaeological and cultural considerations likely to be affected by any aspect of the proposal during the construction or operational phases.

C.1 Physical Features

C.1.1 Topography

Information of the project site should be provided to the extent to understand the topographical aspects of the area.

C.1.2. Hydrology

- (a) Surface drainage pattern of the area
- (b) Surface and ground water availability, water quality and present use and related details.

C.1.3. Geology

General geology and soil types in the site
land use capabilities

C.2 Ecological Resources (Terrestrial and Aquatic)

- (i) List of rare, threatened, endemic flora and fauna within the project site and surrounding area
- (ii) Existing natural habitats / coastal vegetation / special habitats / ecosystems.
- (iii) Is the site in the path of migratory birds / animals., give details
- (iv) All activities in the project area including beach seine fisheries related
- (v) Description pattern of vegetation along the lagoon site.

C.3 Historical and Archeological significant sites

Describe any land marks or evidence of historic, religious, archeological, scientific or cultural importance known to be within the project area and the study site.

C.4 Present land use of the area

- (i) Population characteristics such as population distribution.

C.5 Social and Economic Aspects

- (i) State the socio – economic aspects of the area
 - Income generating sources
 - Existing infrastructure facilities
 - Nature of households and principle economic activities
 - Fisheries activities
- impacts due to changes of land use
- impacts on cultural / archeological values
- Sociological impacts
- Any other impacts not listed here but may be significant.

Part E - Proposed Mitigatory Measures

This chapter should set out the proposal to minimize the impacts identified in part D to acceptable levels including conformity to any regulations, gazetted Sri Lankan standards and other statutory requirements mitigatory measures should be practical and effectiveness should be evaluated under this chapter.

Part F - Monitoring Programme

A suitable monitoring programme should be suggested in this chapter to monitor the changes and implementation of mitigatory measures

This project program should include the following

- Parameters to be monitored
- Frequency of monitoring
- Responsible agencies.

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contd.

Part G - Conclusion and Recommendations

Annex 9 Survey team of the IEE

1. Professor Ajantha De Alwis, Department of Zoology, University of Sri Jayewardenepura, Nugegoda
2. Mr. Kapila Gunaratne, IUCN, Colombo
3. Mr. Indika Samaraweera, Research Assistant