Community Briefing Document

Lamberts East Wind Farm:
Updated Technical Assessments of Valued Ecosystem Components

1. PROJECT INTRODUCTION

The Lamberts East Wind Farm is a proposed wind farm in the parish of St. Lucy, Barbados and supports the goal of the Barbados National Energy Policy of achieving 100% renewable energy by 2030.

The Lamberts East Wind Farm Environmental Impact Assessment (the EIA) was completed in 2007 and updated in 2010 to meet the requirements of the Environmental Impact Assessment Guidelines and Procedures for Barbados (1998). The EIA, approved in December 2010, included eleven (11) Wind Energy Converters (turbines), a control building, access roads and transmission infrastructure. Since 2010, technology has improved and resulted in quieter, safer and more efficient turbines. The turbines originally planned for the Project are also no longer commercially available. As a result, a revised Project layout has been developed, consisting of five (5) turbines.

A revised assessment titled "*Updated Technical Assessment of Valued Ecosystem Components (VECs): Environmental Impact Assessment (2019)*" was prepared to confirm that the revised Project layout results in similar or improved environmental effects to the original Project layout. The purpose of this Community Briefing Document, also called a Non-Technical Summary, is to provide a summary of the Project and the findings of the technical assessments completed in 2019.

Table of Contents

2. PROJECT BACKGROUND

The Barbados Light & Power Company Limited (BLPC) is proposing to start construction on the Lamberts East Wind Farm in the parish of St. Lucy, Barbados in 2021. The proposed project supports the objectives of the Barbados National Energy Policy 2019-2030 which seeks to achieve 100% renewable energy by 2030.

The development of wind energy aligns with BLPC's 100/100 vision and aspirational goal of 100% transition to renewable energy and electrification, as well as the national strategy of greening the economy by reducing dependence on imported fossil fuel to help achieve a renewable energy future. The Lamberts, St. Lucy location was assessed as one of the most attractive for wind energy and one of the few sites on Barbados capable of accommodating a wind farm. This location was specifically identified in the National Physical Development Plan for wind energy development.

The project was approved through a Letter of Planning Permission from the Prime Minister's Office in December 2010 in accordance with the Town and Country Planning Act Cap.240, titled "*Re: Application No. 3262/11/2004C – Construction of a wind electrical generating station to operate 24 years and consisting of eleven (11) turbines and associated equipment at Lamberts East, Lamberts Plantation, St. Lucy*". The EIA provided a description of the Project, characterized existing conditions, assessed potential environmental effects and identified potential mitigation measures. The impact assessment focused on Valued Ecosystem Components, also called Environmental Components, and potential interactions between Project activities. The approved Project was designed to include eleven (11) turbines, a control building, and associated access roads and transmission infrastructure.

Since that time, BLPC determined that an alternative turbine would be better suited to the Project, due to currrent available technology, logistics and constructability. As a result, a revised Project layout has been developed, which includes five (5) turbines that will produce approximately 10 megawatt (MW) of energy.

Definitions and Acronym List

BLPC	Barbados Light & Power Company Ltd.
dBA	A-weighted decibels: Unit of measurement of the relative loudness of sounds perceived by the human ear
Effects Zone	Area anticipated to experience a certain effect
kW	kilowatt
m	metre
MW	megawatt
Receptor	Shadow Flicker Receptors (for example, businesses or homes)
EIA	Environmental Impact Assessment Lamberts East Wind Farm
VEC	A Valued Ecosystem Component, or Environmental Component, is an element of the environment that has scientific, economic, social or cultural significance, such as air, soil or fish.
Turbine	Wind Energy Converters
ZVI	Zone of Visual Influence: Assessment of turbine visibility

DESCRIPTION OF PROPOSED PROJECT

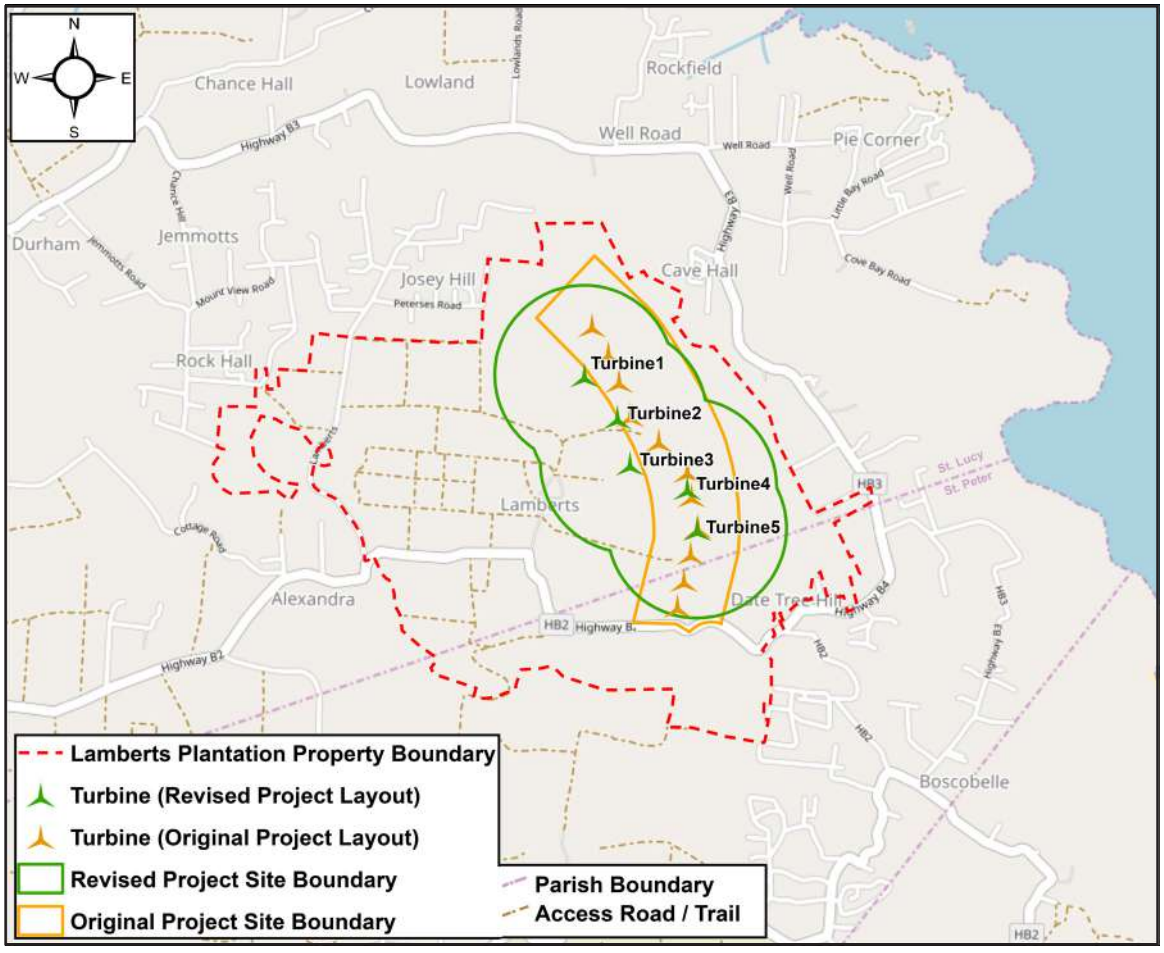
Proposed Layout and Comparison to Original Layout

The proposed Project revision includes the construction of a 10 MW wind farm, which includes five (5) turbines, a control building and access roads at Lamberts East in the parish of St. Lucy, Barbados. A new transmission line will connect the site to the existing Trents substation.

The main changes to the Project layout as a result of the change in turbine technology are summarized in the table and shown below.

Item Changed	EIA 2010	Current Project
Turbine Model	Vestas V52	ENERCON E-70 E4
Proposed Project Output	10 MW	10 MW
Number of Turbines	11	5
Maximum Output per Turbine	850 kW	2.3 MW
Hub Height	49 m	57 m
Rotor Diameter	52 m	71 m
Length of Project Area	1.1 km	700 m

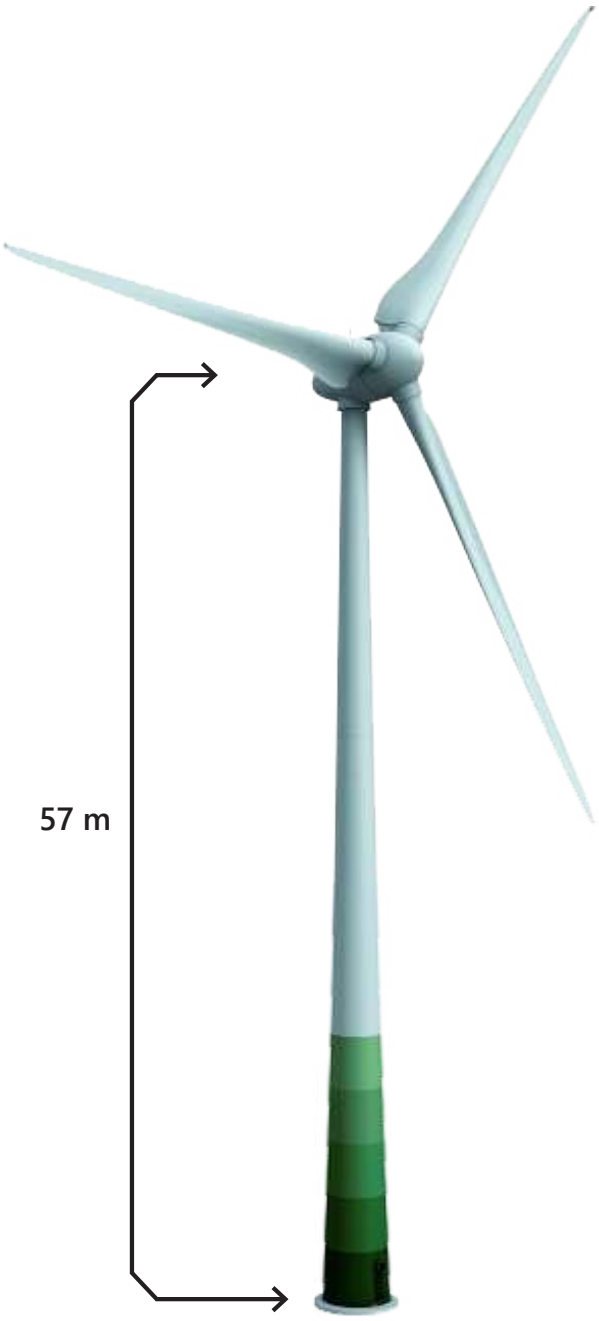
Construction related studies are currently underway, which may influence the ultimate turbine placement. The placement may vary from the figure shown below, however Project setbacks will be maintained and the ultimate turbine placements will be shared with the public.



DESCRIPTION OF PROPOSED PROJECT

Turbine Appearance

The turbines are typically painted pale grey, with gradations of green rings on the areas of the tower closest to the ground, to help them blend in with the surrounding environment.



Project Schedule

Design

- Construction related studies, such as geotechnical testing, will be completed to support the detailed design.

Construction

- Construction is projected to start in 2021 and finish in late 2021.
- The start of construction will depend on the delivery of turbines and overall planning approvals.
- Construction will take approximately six (6) months.
- A detailed schedule will be prepared once the Project design is completed.

Operations and Maintenance

- The turbines are expected to run 24 hours a day, 7 days a week, as long as minimum wind speeds are present.
- The wind farm will be remotely operated from BLPC's central control room.
- Continuous monitoring will detect issues and allow remote shutdown of one or all turbines if needed.
- Signs with BLPC and emergency personnel contact details will be permanently located around the site.

Decomissioning

- The wind farm is expected to operate for at least 20 years. Planning Permission has been approved for 24 years of operations.
- At the end of the 24-year period, the turbines will either be repaired, removed or replaced. This will depend on the Planning Permission.
- If the turbines are removed, the site will be restored to an acceptable condition.

GAP ANALYSIS PROCESS

Wood (AMEC Earth & Environmental and Amec Foster Wheeler) have been involved in supporting BLPC in the environmental work conducted for the Lamberts East Wind Farm. This includes preparation of technical reports and the EIA prepared in 2010, the updated technical assessments in support of the EIA prepared in 2019, as well as ongoing environmental studies.

The Project Team (BLPC and Wood) met with the Town and Country Development Planning Office and the Environmental Protection Department in June 2017 and July 2019 to review the status of the Project, changes to turbine technology and the Project layout. It was determined that amended technical documents would be prepared to support the existing Planning Permission, along with an assessment of the environmental effects.

A Gap Analysis was prepared based on a comparison of the currently approved Project layout in the EIA and the revised Project layout. The focus of the Gap Analysis was centered on the Environmental Component model, to determine what level of impact the new Project layout would have on the technical studies completed in the EIA (2010).

The Gap Analysis determined that only four (4) Environmental Components needed further assessment as the revised Project layout, type and number of turbines affected the completed studies. As agreed upon with the Environmental Protection Department and the Town and Country Development Planning Office, the following Environmental Components were re-assessed:

- Shadow flicker
- Visual - Zone of Visual Influence
- Visual– Photomontage
- Sound

BLPC submitted in November 2019 the updated technical assessments of the four (4) Environmental Components to support the review by the Town and Country Development Planning Office and to confirm that the environmental effects of the revised Project layout are no more impactful than the proposed Project layout that forms part of the existing Planning Permission for the Lamberts East Wind Farm.

ASSESSMENT OF ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES

An assessment of environmental effects related to the four (4) Environmental Components was completed for the operational phase of the proposed wind farm. Overall, it is expected that the current Project layout (5 turbines) will result in reduced or similar effects as the original Project layout (11 turbines) that was assessed in the EIA (2010).

Environmental effects related to the construction phase of the revised Project layout are expected to be equivalent to the original Project layout.

SHADOW FLICKER ASSESSMENT

What is Shadow Flicker?

Shadow flicker occurs when sunlight and the rotating turbine blades interact in a way that casts a moving shadow on the ground or an object, creating a flickering effect. It is generally recognized that shadow flicker impacts reduce with distance and usually occur in the morning or evening when the sun is low in the sky and shadows are long. Shadow flicker is only possible when the sun is not blocked by clouds, fog or by an object. There will also be no shadow flicker from a turbine when it is not operating.

Shadow Flicker Assessment

A shadow flicker analysis was completed using the Shadow Flicker module of the ReSoft WindFarm software. The shadow flicker analysis assessed the potential shadow flicker receptors (for example, houses and businesses) and the total number of shadow flicker hours expected in a year.

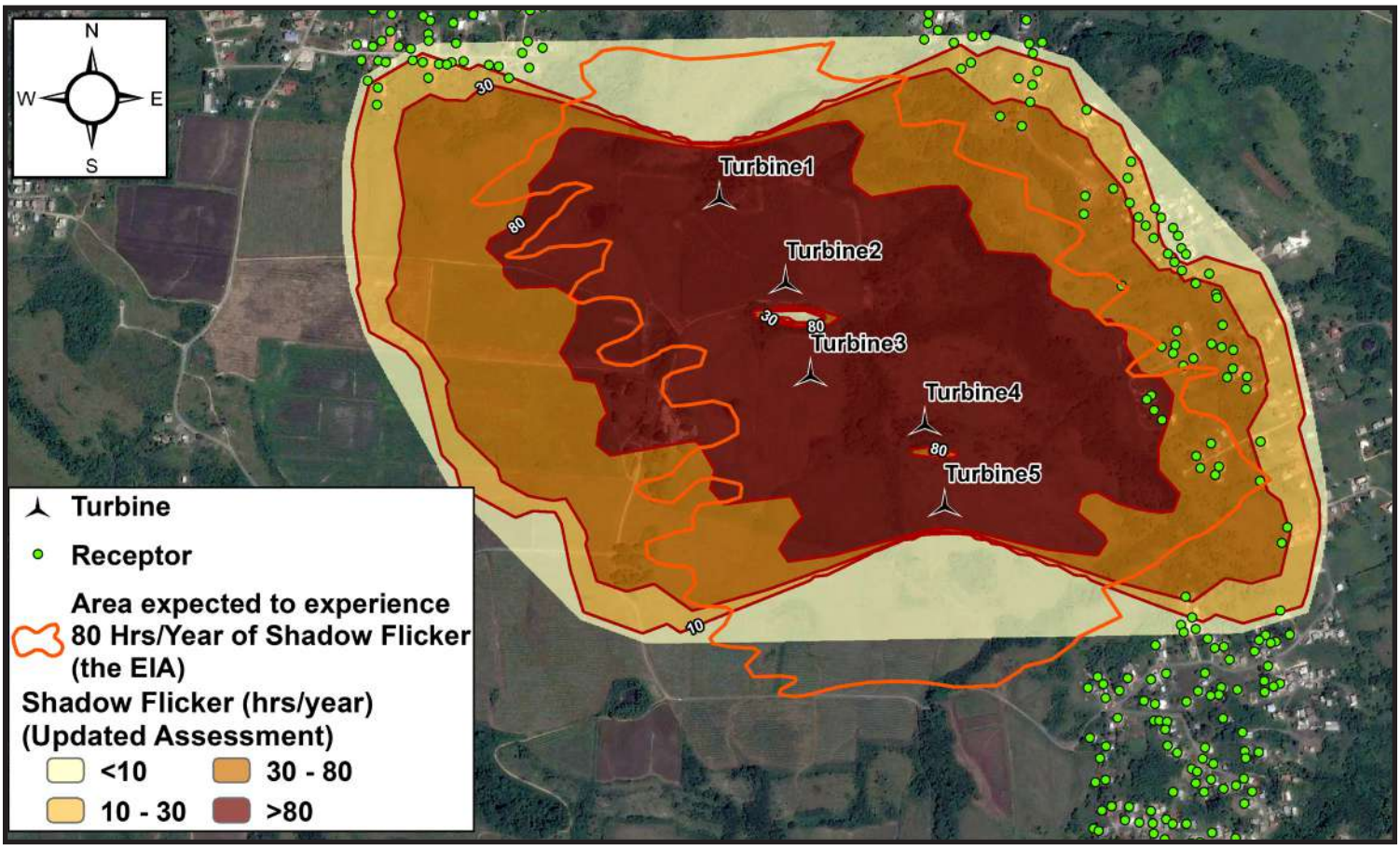
The shadow flicker receptors that experience more shadow flicker hours per year are mostly located to the east and west of the turbines, as a result of the main wind direction and the rising and setting sun when sun angles are low. The assessment identified that:

- Four (4) receptors to the east of the Project may experience more than 80 hours per year of shadow flicker.
- Thirty-two (32) receptors to the east of the Project may experience between approximately 30 and 80 hours per year of shadow flicker.
- Thirty (30) receptors to the east and the north-west of the Project may experience between approximately 10 and 30 hours per year of shadow flicker.
- Twenty-five (25) receptors located to the east and the north-west of the Project may experience less than 10 hours per year of shadow flicker.

A comparison of the area expected to experience more than 80 hours per year of shadow flicker as part of the original Project layout compared to the revised Project layout is shown on the next page. The comparison demonstrates that the revised Project layout has reduced the number of receptors that are located within the 80 hours per year area by eight (8), representing a reduction of 67% of potentially affected receptors.

In comparison to the findings of the EIA (2010), the technical assessment confirmed that the revised Project layout has reduced the effects related to shadow flicker.

SHADOW FLICKER ASSESSMENT



Mitigation Measures

The reduction in the number of turbines has resulted in a reduction in the overall number of shadow flicker hours.

If needed, additional mitigation measures may be implemented to reduce impacts related to shadow flicker. The need for additional mitigation measures would be evaluated in consultation with stakeholders where practical and feasible. These measures may include:

- Planting screening vegetation (trees and bushes that exceed 2 metres in height) in specific locations.
- Installing curtains and/or shutters to block shadow flicker into buildings or constructing screens, trellis structures or fences strategically placed to block effects of shadow flicker at receptors.
- Potentially reducing the hours of turbine operation when sunlight, wind speed and the angle and position of the sun combine to create a flicker effect.

VISUAL ASSESSMENT - VISUAL ZONE OF INFLUENCE

Proposed Layout and Comparison to Original Layout

A zone of visual influence (ZVI) analysis was completed using the Zone of Visual Impact module of OpenWind software. The ZVI assessment identified where on the island the five (5) turbines would be visible, as shown and listed below:

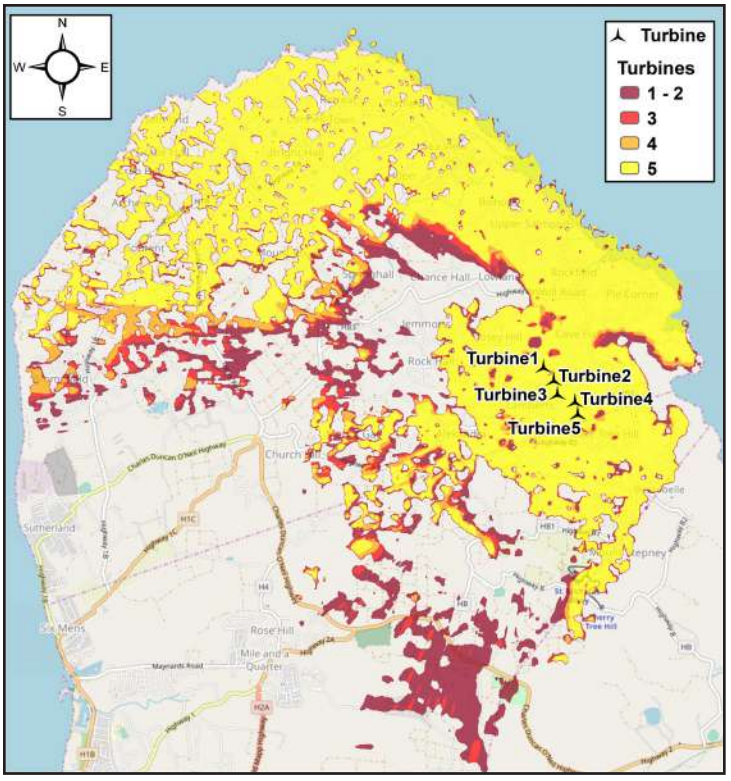
- Within approximately 1.5 km of the centre of the turbines, all five (5) turbines are generally visible.
- Between approximately 1.5 km and 3 km, visibility for all turbines is limited to areas along the east coast between Pie Corner and Sea View, and south of the Project between Mount Stepney and Cherry Tree Hill. All other areas have intermittent visibility of some of the turbines.
- Beyond 3 km, visibility of turbines is scattered in areas located in the northern regions of the island.

The reduction in the number of turbines resulted in a similar reduction in the general area from where the turbines would be visible. The areas where turbines are visible have become more scattered, with many areas now showing no noticeable visibility. Visibility was also significantly reduced in the central and northern areas of the island, including Church Hill and Mount Gay.

In comparison to the findings of the EIA (2010), the technical assessment confirmed that the revised Project layout has reduced the effects related to visual impacts.

Mitigation Measures

- The location of the access road to the site was chosen to reduce visibility for the residences to the east of the site.
- The tower height of the turbine was kept to a minimum reasonable dimension to reduce visual impact.
- The number of turbines was reduced from the original Project layout while still producing a comparable amount of energy.
- The selected turbine, with typically painted pale grey units and gradations of green rings on the areas of the tower closest to the ground, help them blend in with surrounding grassy regions.



VISUAL ASSESSMENT - PHOTOMONTAGE

What is a Photomontage?

A photomontage is a combination of several photographs, joined together to show a more complete picture of a subject.

Photomontage Visual Assessment

Photomontages were prepared to demonstrate what the windfarm would look like from key viewpoints at Risk Road, Pie Corner, Berry Hill and Josey Hill. The viewpoint locations are shown below and the photomontages from each viewpoint are shown on the next page.

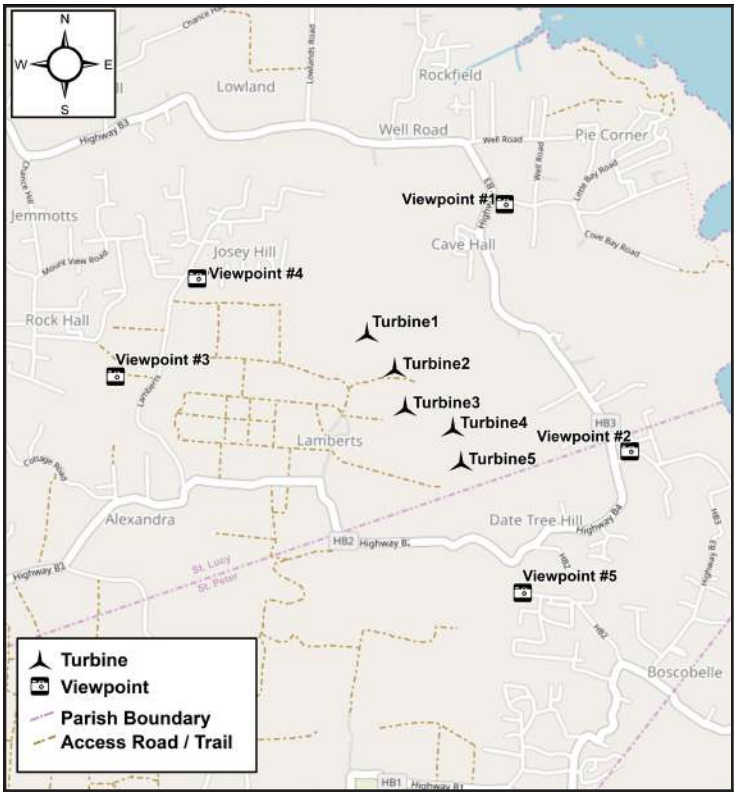
The number of turbines was reduced to five (5) for this assessment with a slight increase in the hub height of the new turbine model. As a result, all turbine hubs are predicted to be visible from each of the viewpoints. Given the nature of the landscape, the turbines will be partially hidden by vegetation from some viewpoints.

Reducing the number of turbines to five (5) reduces the overall visual effects of the Project. With the previous Project layout of eleven (11) turbines, there were twice as many turbines that could potentially be seen.

The technical assessment confirmed that the current Project layout does not worsen the effects related to visual impacts, and instead has a similar visual effect as the original Project layout.

Mitigation Measures

- The location of the access road to the site was chosen to reduce visibility for the residences to the east of the site.
- The tower height of the turbine was kept to a minimum reasonable dimension to reduce visual impact.
- The number of turbines was reduced from the original Project layout while still producing a comparable amount of energy.
- The selected turbine, with typically painted pale grey units and gradations of green rings on the areas of the tower closest to the ground, help them blend in with surrounding grassy regions.



VISUAL ASSESSMENT - PHOTOMONTAGE

SOUND ASSESSMENT

A sound model of the Project was created using the sound prediction software CadnA. The Government of Barbados does not have specific sound level standards for wind farm developments, so the sound model was based on guidelines used in other areas, such as the Ministry of Environment, Conservation and Parks in Ontario, Canada and the Institute of Acoustics in the United Kingdom.

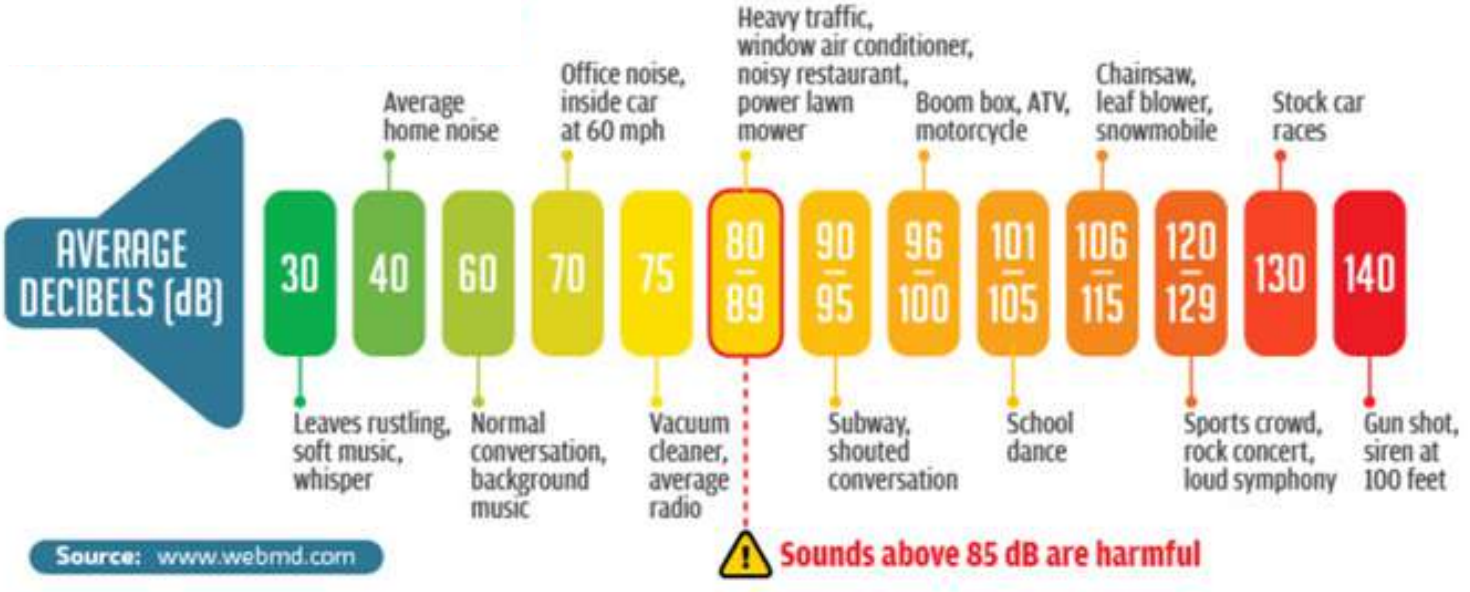
Based on preliminary information from the updated Sound Impact Study, including the existing conditions measured on site and continuous monitoring which was conducted between October 2017 and February 2019, it was determined that for more than 90% of the monitoring period, the background (existing) sound level measurements were above 45 dBA.

The sound assessment determined that sound levels generated from the operation of the wind farm will be below existing sound levels in the area (for example, sounds from traffic and waves).

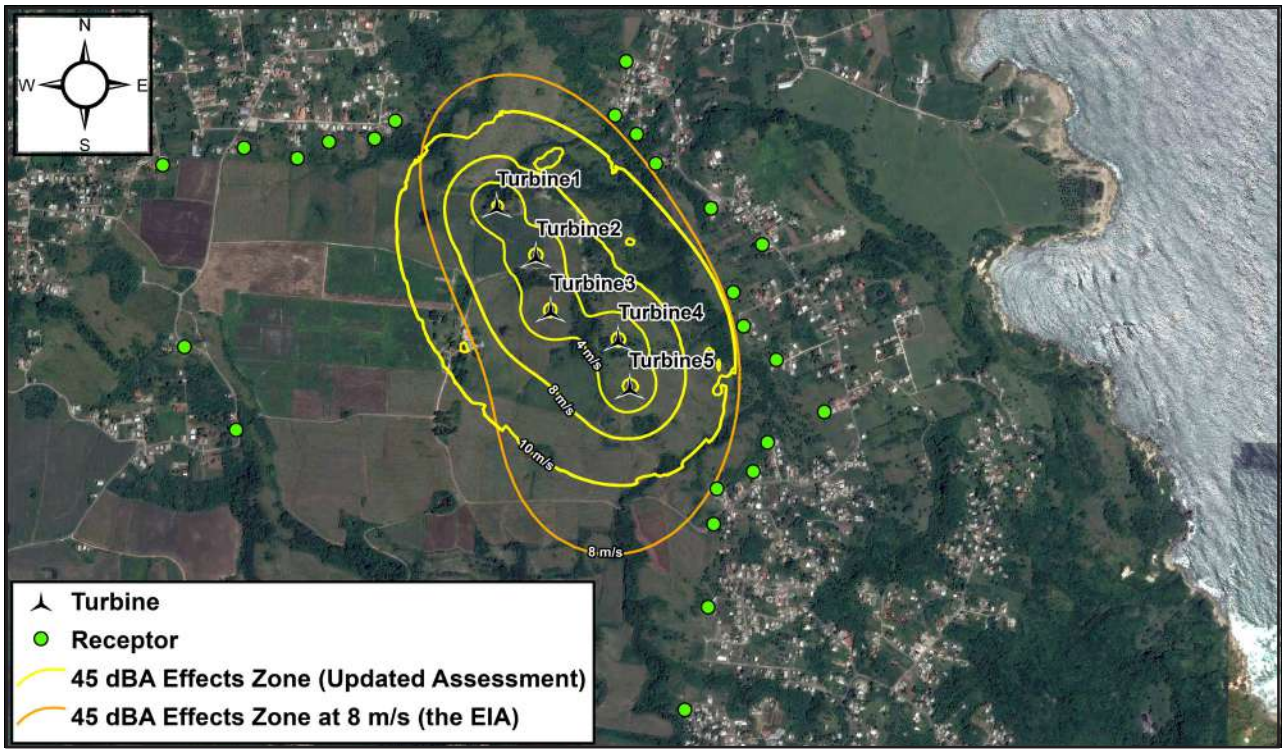
The sound assessment was expanded from the analysis in the EIA (2010) to also evaluate the upper and lower wind speed limits. The technical assessment modeled the 45 dBA effects zone (also known as the area expected to experience these effects) associated with wind speeds of 4 metres per second (m/s), 8 m/s and 10 m/s, and demonstrated that the 45 dBA effects zone at 8 m/s from the EIA (2010) has been significantly reduced as a result of the revised Project layout. The reduction in the number of turbines has resulted in the 45 dBA at 10 m/s effects zone extending to the approximate location of the 45 dBA at 8 m/s effects zone from the EIA (2010). No sound sensitive receptors are located within the 10 m/s effects zone. The results of the sound assessment and comparison between the original Project layout and revised Project layout are shown on the next page.

In comparison to the findings of the EIA (2010), the technical assessment confirmed that the revised Project layout has reduced the effects related to sound.

Typical Sound Levels



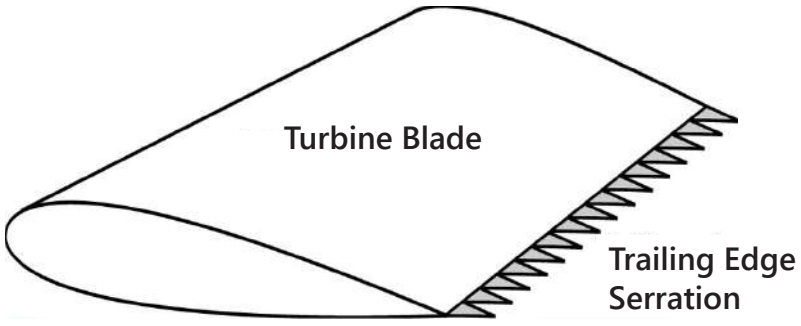
SOUND ASSESSMENT



Mitigation Measures

Specific mitigation measures to reduce sound have been incorporated into the design and structure of the turbine and therefore the wind farm will meet the recommended criteria for sound. One of the main mitigation measures and reasons for choosing the selected turbine model for the project is Trailing-Edge Serration.

What is Trailing-Edge Serration?



Sound generated by wind turbines is primarily produced by two sources – mechanical and aerodynamic. Mechanical sound is produced by the physical movement of components in the nacelle (e.g. gearbox, generator), while aerodynamic sound is caused by air flowing over the blades. As the dominant source of aerodynamic sound is produced by air flowing over the trailing edge of the blade, modifications to the trailing edge has the effect of reducing the sound levels from the wind turbine. This mitigation strategy, commonly known as Trailing-Edge Serrations or TES is a feature of the selected turbines for the Project.

CONCLUSION

As a result of the proposed changes to the Project layout, updated technical assessments were undertaken in support of the EIA (2010) to confirm that the revised Project layout results in similar or improved environmental effects to the original Project layout. The results of the technical assessments (sound, shadow flicker and visual impacts) determined that the revised Project layout will reduce the effects associated with the Project. This is mostly as a result of advancements in turbine technology and the reduction in the number of turbines from eleven (11) to five (5).

Important Links

The following documents are available on BLPC's website:

- Lamberts East Wind Farm Environmental Impact Assessment (2010)
- The Updated Technical Assessments (2019)

Visit:	https://www.blpc.com.bb/index.php/company/our-projects/the-lambert-s-wind-project
Contact Information:	lambertswindfarm@blpc.com.bb (246) 626-4300