FORTHWIND LIMITED

SECTION 36 CONSENT VARIATION PROPOSAL

Implications and Scoping Request

August 2018

Confidentiality Status: For regulatory consideration

SIGNATURES					
A1	27/08/2018	Issued	[redacted]	[redacted]	[redacted]
Rev	**Date**	**Purpose of Issue**	**Prepared by**	**Checked by**	**Approved by**

Contents

1. BACKGROUND

The existing Forthwind Section 36 grants consent under section 36 of the Electricity Act 1989 (as amended) for the construction and operation of the Development; described in Annex 1 as having a permitted generating capacity not exceeding 18 MW and comprising of two wind powered lattice structure electricity generating stations off the coast of Methil, Fife, including:

> *1. Not more than 2 two-bladed lattice structure WTG each with:*
>
> *a) a maximum blade tip height of 198.5 metres (measured from LAT);*
>
> *b) a maximum rotor diameter of 155 metres; and*
>
> *c) a maximum hub height of 121 metres (measured from LAT);*
>
> *2. 3 pin pile foundations per turbine;*
>
> *3. Grid infrastructure including the construction of two subsea cables which will connect the demonstration turbines to the shore; and*
>
> *4. Onshore elements, comprising underground cabling and turbine transformers, comprising medium and low voltage container units to be located within the Fife Energy Park.*
>
> *The Development shall be constructed in accordance with that specified in the Application, the HRA addendum and by the conditions imposed by the Scottish Ministers.*

Forthwind Ltd. are seeking to vary the Annex 1 Project Description of the Forthwind Section 36 consent to retain the existing description and include the following as an alternative installation option:

- Not more than 1 WTG with up to 3 blades with:
    - either a lattice or tower structure;
    - a maximum blade tip height of 260 metres (measured from LAT)
    - a maximum rotor diameter of 220 meters; and
    - a maximum hub height of 160 metres (measured from LAT)

Although not specified in the Section 36 consent, it is considered that the consent was awarded for turbines with a rated capacity of up to 9 MW as detailed in both the Environment Statement which accompanied the Section 36 consent application and as further set out in section 2.2 "*Description of the Works*" in the Marine Licence (05632/17/2) and used in the calculations supporting the Appropriate Assessment.

2. REQUEST ON APPROPRIATENESS OF A VARIATION

The Scottish Government Energy Consents and Deployment Unit guidance on applying for a S36 consent variation State that "*the variation procedure is not intended as a way of authorising any change in a developer's plans that would result in development that would be fundamentally different in terms of character, scale or environmental impacts from what is authorised by the existing consent*"

Forthwind Ltd seeks a determination from Marine Scotland as to whether the proposed project changes are appropriate to consider as a variation to the existing consent or whether there is a need for a new application to address the potential changes in scope.

Forthwind Ltd are proposing the following changes to the project description:

Design Element	Parameter	Consented turbines	Amendment	1 Larger Turbine
Turbine	Rated Capacity	Up to 18MW	No	As consented
	No of turbines	2	1	1
	No of blades per turbine	2	3	2 or 3
	Max hub height (m above LAT)	121m	Yes	135 - 160m
	Max rotor tip height (m above LAT)	198.5m	Yes	245 - 260m
	Max rotor diameter	172m (155m*)	Yes	220m
	Min. blade clearance to HAT	25m**	No	As consented
	Max blade swept area	37,738 m2*	Yes	38,013 m2
	Colour Scheme	Not defined	No	No
Foundations	Foundation Type (per turbine)	3 pin piles	No	4 pin piles
Location	Specified	100m micro siting	No	As consented
Permanent Deposits	Steel/Iron	292 tonnes	No	As consented
	Concrete (pile grout)	472 m^3	No	As consented
	Armour stone (450 mm size range)	2,317 m^3	No	As consented
	Concrete bags/Mattresses	16,480 m^3	No	As consented
	Two cables	1,800 m (each)	No	One cable
Duration	From commissioning	20 years	Yes	25 years
	Validity of licence/consent	5 years – to Dec 2021	Yes – up to Dec 2024	

*Defined in CRM of HRA Addendum **Defined in the ES

2.1. Character of the development changes

The purpose of the Forthwind Offshore Demonstration Project, as described in the original application and Environment Statement, was to provide a facility "*to demonstrate a new model of offshore wind turbine, which will be used to generate clean electricity from a renewable source of energy, the wind*[1]".

The character of the project remains the same, in that the site will be utilised to demonstrate a new model offshore wind turbine technology, not currently available for commercial sale and the purpose of which is to demonstrate the technical and operational abilities of a new form of offshore wind turbine technology.

The technology demonstration character of the project is also reinforced by the limitations of the Forthwind seabed Agreement for Lease granted by the Crown Estate Scotland specifically for Technology Demonstration; which restricts Forthwind to only deploying offshore wind technology for demonstration purposes which is defined within the lease as:

Demonstration Purposes *means demonstrating prototype or series 0 wind turbines and/or novel foundation types and/or the demonstration of technologies and techniques (which have achieved a technology readiness level of between 5 and 9 at the time of intended demonstration as such technology readiness levels are defined in the UK Environmental Transformation Fund Strategy published by the Department for Environment, Food and Rural Affairs, and the Department for Business, Enterprise and Regulatory Reform and a copy of which technology readiness levels are included in Schedule Part 10 (Technology Readiness Levels) that have not previously been deployed commercially and that are intended to reduce the levelized cost of energy of offshore wind generation;"*

Forthwind have been in discussions with the Crown Estate Scotland, who have stated they are content to vary the current seabed lease option agreement and extend the option period pending the outcome of a public consultation exercise currently ongoing. Changes to the nature of the technology intended

[1] Forthwind Offshore Wind Demonstration Project, Methil, Fife, Volume 1: Environment Statement, July 2015, Chapter 1, 1 Introduction, 1.1 Overview, Page 1.

to be deployed on the site cannot happen without prior approval from the Crown Estate Scotland before deployment.

2.2. Scale of the development changes

In addition, Forthwind are not seeking to change the scale of the consented development with a generating capacity not exceeding 18MW and the development consent strictly limited to the installation of up to 2 turbines. All offshore development will be maintained within the consented offshore project 'red line' boundary utilising the existing turbine locations (sites A and B in figure 1), approximately 1.5km from the coast of Methil, Firth of Forth.

The location of the single turbine option will be on the most westerly and southerly turbine location already indicated within the consented development envelope (previously identified as site FWB1 – NGR reference: 336964, 696677; Lat / Long WGS 84 reference: 56°09'30.90"N, 003°00'59.22"W).

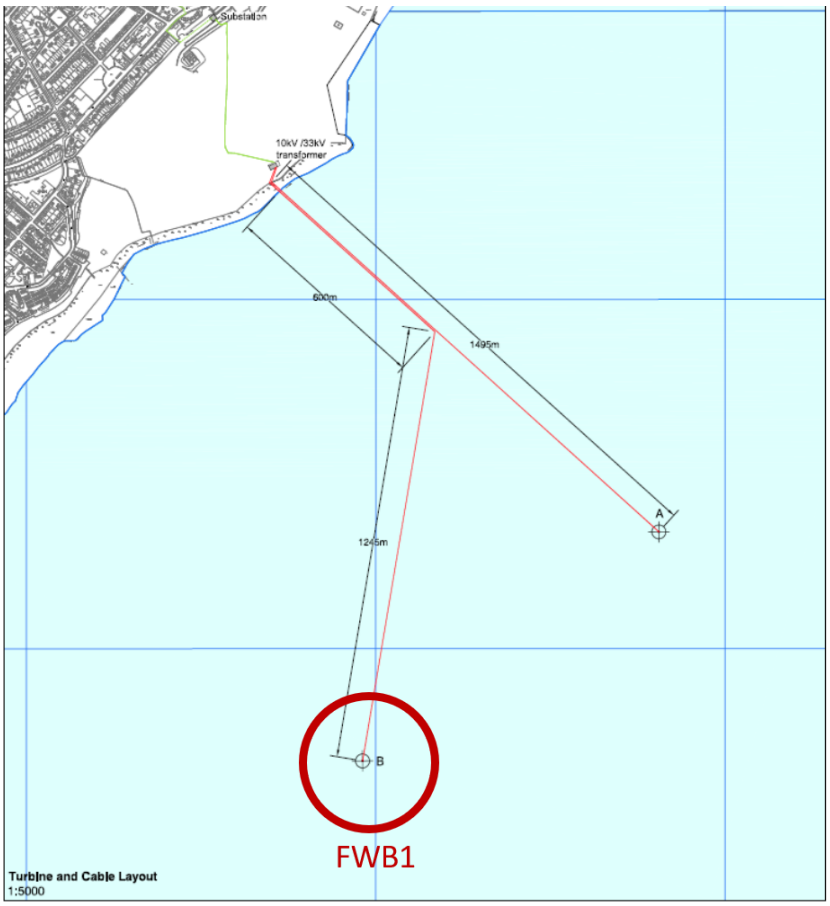

Figure 1 - Single Turbine Option Location

2.3. Environmental Impact of the development changes

Forthwind has undertaken a review of what potential environmental receptors could be affected by the proposed changes, and whether the modified Forthwind project potentially could cause significant environmental effects greater than those effects described in the original Environment Statement and HRA addendum.

The revised project parameters have been reviewed against each topic within the original ES and HRA addendum to identify whether there is the potential for a change to an existing impact, or for a new impact to arise, and whether further assessment is required. The rationale for screening and

identifying the potentially affected aspects is provided in appendix 1 and a summary is presented below:

Changed Parameter	Environmental Aspect																
	Planning Policy	Physical Processes	Landscape and Visual	Ornithology	Marine Mammals	Commercial Fisheries	Benthic Ecology	Archaeology	Cultural Heritage	Fish and Shellfish	Noise	Shipping and Navigation	Socio-economics	Other Marine Users	Terrestrial Ecology	Hydrology, Hydrogeology and Soils	Other Miscellaneous Users
No of turbines	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No	Yes
Blades per turbine	No	No	Yes	Yes	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes
Hub / Tip Height	No	No	Yes	Yes	No	No	No	No	No	No	Yes	No	No	Yes	No	No	Yes
Rotor Diameter	No	No	Yes	Yes	No	No	No	No	No	No	Yes	No	No	Yes	No	No	Yes

No	No additional potential impact on receptor to that already assessed for consented project, no further assessment required.
Yes	Potential for receptor to be further impacted, or there is a degree of uncertainty, therefore further assessment is required.

Forthwind has commissioned independent technical assessments of the identified potential aspects affected (as identified in the table above) of the proposed changes and has sought and provides the following information to support Marine Scotland's decision.

The detailed assessments are provided in:

- Appendix 2 – Noise;
- Appendix 3 – Ornithology;
- Appendix 4 - Joint Radio Communications (JRC); and
- Appendix 5 - Seascape, Landscape and Visual Impact.

However, in summary the technical studies concluded the following:

2.3.1. Noise

As the candidate turbines to be used are demonstration models, the actual noise emission characteristics of the technology cannot be accurately confirmed at this stage. As a consequence, the assessment used the noise emission levels calculated in the original ES and scaled up the dimensions to match the proposed larger turbine size to calculate the variation in sound power level with wind speed. The assessment determined that regardless of the turbine selected for installation, the operation of the varied single turbine in the selected location will have no greater impact in terms of noise than that currently consented.

It has led the consultant, Arcus, to the conclude that the development is considered a suitable location as a test facility, with enough headroom to accommodate a wide range of future turbine technologies.

2.3.2. Ornithology

Forthwind Ltd commissioned Gavia Environmental Ltd to undertake a review of the potential effects and a Habitats Regulations Assessment (HRA) of the proposed change to the project description in

relation to European (Natura 2000) sites and their qualifying interests. The HRA considered the effects of the proposed variation on the qualifying interests of 4 SPA's (the Firth of Forth SPA and Ramsar site, the Forth Islands SPA, the Loch Levan SPA and Ramsar site and the Cameron Reservoir SPA and Ramsar site) as well as the potential effect on the features of the Outer Firth of Forth and St Andrews Bays Complex pSPA. The assessment considered both displacement effects and collision risk, which is presented in Appendix 3.

To assess the bird collision risk potential posed by the proposed change in turbine parameters, the predicted change in collision risk was examined for one species, Gannet. The result of the Gannet risk assessment was used as a determining factor as to whether further re-modelling was necessary for other species. Gannet was chosen because it had the highest collision risk estimate out of the species assessed previously in the original ES and 2016 HRA addendum. Both the 2 bladed turbine and the 3 bladed turbine options were assessed within the collision risk model.

The CRM predicted that the effects from the proposed variation would be less, regardless of the turbine used. Therefore, all other seabird species at the Forthwind Islands SPA were screened out of further assessment. The assessment also concluded that there would be no Likely Significant Effects (LSE) on any SPA qualifying species because of potential collision risk caused by either of the variation turbine models. As a consequence, the assessment showed no material change from the 2016 assessment.

The review also examined the potential for displacement of key species potentially triggered by the installation of either larger turbine models. The assessment was based on the identification of an appropriate Zone of Influence (ZoI), apportioning the population to the relevant SPA/dSPA according to the SPA population size. The key species examined were those examined in the 2016 Appropriate Assessment; i.e. Common scoter, Long-tailed duck, Red-breasted merganser, Red-throated diver, Velvet scoter and Common eider. The assessment was undertaken based on the assumption of 100% displacement and 100% mortality, which is highly precautionary.

The displacement assessment concluded that, for the key six wintering seaduck/diver species assessed, the changes in potential mortality arising from the proposed Variation would be (in terms of 'whole birds') no greater than or reduced for all species. As a result, Gavia Environmental concluded that the proposed Variation would not adversely affect the site integrity of the Firth of Forth SPA or the Outer Firth of Forth and St Andrews Bay Complex pSPA with respect to displacement for each of the six qualifying interest species assessed.

Overall, Gavia Environmental concluded that the potential effects on the local ornithology population, prompted by the proposed change to the project description, were either the same as, or less than, those of the consented development and that there are no changes to the previous in-combination assessments undertaken.

2.3.3. Joint Radio Company

Forthwind Ltd completed the online JRC wind Farm Detailed Coordination Proforma with the revised turbine characteristics to the JRC Windfarm co-ordinations team. The JRC wrote back on the 14 August 2018 to advise that the proposal was cleared with respect to radio link infrastructure operated by Scottish Power and Scotia Gas Networks. This email is provided in Appendix 3.

2.3.4. Seascape Landscape and Visual Impact

Optimised Environments (OPEN) undertook an independent assessment of the seascape, landscape and visual implications of the proposed change to the Forthwind project description. They compared the current consented project envelope and proposed changes utilizing the Zone of Theoretical Visibility (ZTV) and comparing the significance of potential changes to key viewpoints.

Overall, the ZTVs show that the 245m and 260m single turbine would be visible primarily from the same areas that would already be influenced by views of the consented scheme (areas coloured blue in Figures 2 and 3 of appendix 5– due to the size of the visualisation files, these are provided as a digital copy. Hard copies can be provided on request). The introduction of the larger single 245m or 260m turbine would result in only a very slight, marginal increase in the overall geographic extent of visibility (areas shaded yellow in the ZTVs in Figures 2 and 3 of appendix 5). These areas are limited in extent and generally confined to locations at long distance.

OPEN's analysis of the viewpoints identified that the appearance of a single 2 bladed lattice tower turbine would be most similar to what has already been consented, due to it being the same type of 2 bladed lattice turbine as currently consented. In addition, they identified that the 3 bladed turbine represents the biggest variation from existing consented project, due to the change in appearance of the turbine (3 bladed) and its larger (260m) blade tip height; however, the 3 bladed turbine has the most consistent appearance with the design of existing wind turbines in the baseline, notably the Levenmouth wind turbine.

OPEN concluded that, from a Landscape and Visual perspective, the visual effect of a single larger wind turbine (either the 2 or 3 bladed turbine) appears to have less impact than the two smaller 198.5m 2B Energy turbines. Although larger in scale, the removal of one turbine represents a larger change/reduction in effect than the increase in height of the retained turbine. A single turbine also creates a simpler visual image and is viewed consistently from different viewing locations, as it forms a single focal point in views; meaning that the proposed changes do not add to, or significantly change, the visual character, scale or impact of the project envelope that has been consented previously.

3. POTENTIAL BENEFITS OF THE VARIATION

A total of three valid public objections were received by Marine Scotland from members of the public during the course of both public consultation exercises on the original Forthwind application. As outlined in the Marine Scotland submission to Ministers regarding the original application, none of the three objections were from Levenmouth addresses, and two of the three were from addresses out with Fife. Therefore, it could be considered that the proposed development is uncontentious within the locality and due to the potential socio-economic and supply chain benefits associated with hosting a demonstration of new offshore wind technology, and the proximity of ORE Catapult and BiFab, the local community could be considered as being broadly supportive of the Forthwind project.

The candidate turbines for the proposed development are intended to be offered for future commercial offshore wind projects in Scotland, the UK and internationally. The delivery of this project would not only provide the benefits to the locality as outlined in the socio-economic impact assessment but also could provide the basis for an offshore wind technology development centre and consolidate the local technical knowledge, training and development gains made by the ORE Catapult over recent years at the Levenmouth demonstration turbine.

4. SCOPING OF THE PROPOSED CHANGES OF PROJECT DESCRIPTION

Irrespective of whether the request to amend the Forthwind project description constitutes a variation or new application, Forthwind seek to understand the scope of the environmental assessment required to consider the change to the existing consent. Forthwind believe that sufficient information has been submitted to enable MS-LOT to come to a judgement on the required scope of the environmental assessment to accompany a future variation or new application.

Forthwind request MS-LOT to provide a formal opinion on the scope of the supporting Environmental Information or Environmental Impact Assessment (EIA) required for the additional alternative design option to the current permitted project.

This document, along with its accompanying appendices has been prepared to inform this request. Forthwind Ltd. Seeks an opinion from MS-LOT as whether the information provided within the technical reports provide sufficient information to be included within environmental assessment of the amended project description or if additional information is required for a determination.

APPENDIX 1 - SCREENING/SCOPING OF POTENTIAL IMPACTS OF THE VARIATION PROPOSAL.

Environmental Aspect	Potential Impact	Rationale	Further Assessment?
Planning Policy	All impacts All project phases	It is considered that the changes do not affect any planning policies in effect considered at the time	No
Physical Processes	All impacts All project phases	All aspects of the project design fall within the consented envelope. Although there is additional infrastructure required for a larger 3 bladed turbine (i.e. addition pin pile) the reduction from 2 turbines to one means that there will be a reduction in the construction and operational seabed footprint. Impact significance will be less that that predicted in the ES.	No
Landscape and Visual	All impacts All project phases	The ES assessed a design scenario and considered the effects of installing 2 turbines with 2 blades, a hub height of 121m AOD and maximum tip height of 198.5m AOD. The revised project parameters half the number of turbines from 2 to 1; although the number of blades increases from 2 to 3, the hub height increases by 40m and the tip height by 61.5m.	Yes
Ornithology	All impacts All project phases	The ES assessed a design scenario and considered the effects of installing 2 turbines (2B6) with 2 blades. It is considered that the original ES assessment already captures the potential effects associated with the project design updates as: • Displacement – although the single turbine will be bigger, the reduction of the number of turbines will reduce the footprint of the presence of the turbine and the associated M&O activities around the turbine. • Collision Risk Assessment – the difference between the total blade swept area between the two 2B6 turbines originally assessed and a revised larger single 3 bladed turbine is minimal (37,738 m^2 as opposed to 38,000 m^2). In addition, the chord width and number of rotations per minute from a 3 bladed machine will also be less than two 2B6 turbines, meaning that Impact significance will be no greater than that predicted in the ES.	Yes
Marine Mammals	All impacts All project phases	All aspects of the project design fall within the consented envelope. Although there is additional infrastructure required for a larger 3 bladed turbine (i.e. additional pin pile) the reduction from 2 turbines to one means that there will be a reduction in the construction and operational seabed footprint.	No
Commercial Fisheries	All impacts All project phases	All aspects of the project design fall within the consented envelope. Although there is additional infrastructure required for a larger 3 bladed turbine (i.e. additional pin pile) the reduction from 2 turbines to one means that there will be a	No

Environmental Aspect	Potential Impact	Rationale	Further Assessment?
		reduction in the construction and operational seabed footprint.	
Benthic Ecology	All impacts All project phases	All aspects of the project design fall within the consented envelope. Although there is additional infrastructure required for a larger 3 bladed turbine (i.e. additional pin pile) the reduction from 2 turbines to one means that there will be a reduction in the construction and operational seabed footprint.	No
Archaeology	All impacts All project phases	All aspects of the project design fall within the consented envelope. Although there is additional infrastructure required for a larger 3 bladed turbine (i.e. addition pin pile) the reduction from 2 turbines to one means that there will be a reduction in the construction and operational seabed footprint.	No
Cultural Heritage	All impacts All project phases	The ES assessed a design scenario and considered the effects of installing 2 turbines with 2 blades, a hub height of 121m AOD and maximum tip height of 198.5m AOD. The revised project parameters half the number of turbines from 2 to 1; although the number of blades increases from 2 to 3, the hub height increases by 40m and the tip height by 61.5m. All aspects of the project design fall within the consented envelope for direct effects. In addition, it is not thought that the increase in the project parameters will result in a change to the indirect effects to any setting of cultural heritage assets as assessed within the ES.	No
Fish and Shellfish	All impacts All project phases	All aspects of the project design fall within the consented envelope. Although there is additional infrastructure required for a larger 3 bladed turbine (i.e. additional pin pile) the reduction from 2 turbines to one means that there will be a reduction in the construction and operational seabed footprint.	No
Noise	All impacts All project phases	The original ES only identified a noise issue for the 2 turbines when considered cumulatively with the Levenmouth turbine. Although there is a reduction in the number of turbines from two to one and the location of the single turbine is furthest away from the Levenmouth turbine, the change in parameters of the turbine envelope from 2 blades to 3 and increase in hub height and blade length will require a reassessment of the potential to create a noise impact for the locality.	Yes
Shipping and Navigation	All impacts All project phases	All aspects of the project design fall within the consented envelope. Although there is additional infrastructure required for a larger 3 bladed turbine (i.e. additional pin pile) the reduction from	No

Environmental Aspect	Potential Impact	Rationale	Further Assessment?
		2 turbines to one means that there will be a reduction in the construction and operational seabed footprint.	
Socio-Economics, Tourism and Land Use	All impacts All project phases	There is little to no change in the socio-economic case, as the need for offshore wind demonstration project still exists which will benefit the economic potential around the area. No additional significant effects beyond the consented envelope from the proposed changes to the tourism, recreation and land use resources.	No
Other Marine Users	All impacts All project phases	All aspects of the project design fall within the consented envelope. Although there is additional infrastructure required for a larger 3 bladed turbine (i.e. additional pin pile) the reduction from 2 turbines to one means that there will be a reduction in the construction and operational seabed footprint. The area has already been cleared for air traffic issues, as identified in the Forthwind Offshore Wind Technology Demonstration Array Scoping Report. The larger rotor size and hub height may provide a potential challenge to Joint Radio Communications. The DIO safeguarding unit will be informed of the larger rotor parameters to ensure that there is no issue posed to military operations.	No for most issues; although the turbine parameters will need to be re-assessed by: (a) the JRC; and (b) The Defence Infrastructure Organisation (DIO) safeguarding to ensure that there are no additional challenges to radio communications and/or military activities.
Terrestrial Ecology	All impacts All project phases	All aspects of the project design fall within the consented envelope.	No
Hydrology, Hydrogeology and Soils	All impacts All project phases	All aspects of the project design fall within the consented envelope.	No
Other Miscellaneous Users	All impacts All project phases	Miscellaneous issues covered within the original ES covered the following aspects: • Access and transport • Air Quality • Climate and Carbon Balance • Health and Safety Considerations • Waste Management • Radio Links • Shadow Flicker Most aspects of the project design fall within the consented envelope. Although there is additional infrastructure required for a larger 3 bladed turbine (i.e. additional pin pile) the reduction from 2 turbines to one means that there will be a reduction in the construction and operational seabed footprint. The two exceptions are related to radio links and shadow flicker, with both aspects proposed for further consideration in a variation/reconsent application.	No for most issues; although the turbine parameters will need to be re-assessed for: (a) Radio links; and (b) Shadow Flicker

Environmental Aspect	Potential Impact	Rationale	Further Assessment?
Climate Impact and Change	All impacts All project phases	Although a new requirement introduced by the 2017 EIA regulations (The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017); this aspect was addressed under the "*Miscellaneous Users*" chapter within the Forthwind ES. As stated in the Forthwind ES, the development will be an offshore wind turbine demonstration facility and as such it is not possible to predict the energy that will be produced by the Development over its lifespan; meaning a calculation of displacement of CO_2 cannot be made. It can however be stated that any energy generation from the site will result in the displacement of CO_2 generated from non-renewable sources and that the aim of the project, to further the development of the UK offshore wind industry, will contribute to the reduction of CO2 emissions from UK power generation in the long term. Overall the proposed development will lead to the removal of more carbon emissions from the atmosphere that it creates (i.e. it is a carbon negative development). In addition, the reduction of physical infrastructure and the larger power generation of the single turbine indicate that the new option within the variation proposal would lead to slightly less CO_2 emissions in the manufacturing and installation phase. With respect to climate change adaptation, this is largely a project specific consideration, i.e. consideration of the resilience of the project to climate change and the extent to which climate change could alter the predicted effect on operational production levels and associated carbon reduction. As this is a test and demonstration facility for one turbine (i.e. small scale), it is regarded that from a proportional point of view, this aspect is not a significant consideration and it is therefore proposed that this issue is scoped out.	No
Major Accidents and Disasters	All impacts All project phases	Although a new specific requirement introduced by the 2017 EIA regulations (The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017), major accident and disaster aspects have previously been addressed elsewhere in the Forthwind ES. Specifically, through a navigational risk assessment (NRA), considered in the shipping and navigation chapter and the assessment of potential impact on military and civilian aviation activities within the "*Other Marine Users*" chapter. It is not anticipated that the proposed variation will have additional impact to what has already been consented, although the DIO Safeguarding unit will be informed of the revised turbine parameters. In addition, as previously advised in the Access and Transport section within the "*Miscellaneous*	No

Environmental Aspect	Potential Impact	Rationale	Further Assessment?
		Issues" chapter, the majority of turbine components will be assembled on site or delivered to the site by sea, with construction/ decommissioning traffic being essentially limited to the transportation of the equipment required for landfall and the delivery of a number of onshore elements to the Fife Energy Park. During operation the movement of traffic associated with the project is primarily associated with personnel movement. Overall the potential for a major accident on the project is considered not be significant and is it proposed that this aspect is scoped out.	
Human Health	All impacts All project phases	Although new requirement introduced by the 2017 EIA regulations (The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017), aspects of human health have been considered throughout the original Forthwind ES; specifically: • Water Quality (chapter 6); • Construction and operational noise (chapter 14); • Access and impact on recreation (chapter 16); • Effects of construction dust (17); and • Shadow Flicker (chapter 17); For most aspects of human health previously considered within the Forthwind ES, the impacts of the proposed variation fall within the current consent envelope. However as indicated earlier, the shadow flicker will be brought forward for further consideration in a variation/reconsent application. It is proposed to scope out any further considerations of human health based on the adoption of a proportionate approach and the fact that most elements fall within the existing consent envelope.	No for most issues; although shadow flicker will be considered further.

APPENDIX 2 – NOISE ASSESSMENT UNDERTAKEN BY ARCUS

NOISE IMPACT ASSESSMENT

FORTHWIND OFFSHORE WIND TURBINE TEST FACILITY

FOR
CIERCO LTD

JULY 2018

Prepared By:

Arcus Consultancy Services

7th Floor
145 St. Vincent Street
Glasgow
G25JF

T +44 (0)141 221 9997 l **E** info@arcusconsulting.co.uk
w www.arcusconsulting.co.uk

Registered in England & Wales No. 5644976

TABLE OF CONTENTS

1 INTRODUCTION

Arcus Consultancy Services Ltd (Arcus) has been commissioned by Cierco Ltd (the Client) to undertake a noise assessment in relation to an application to vary the existing planning permission for the Forthwind Offshore Wind Farm Demonstration Project.

The current permission, dated 21st December 2016, relates to the construction and operation of two, 2-B turbines, approximately 1.5 km off the shore of Methil, Fife. The Client wishes to vary this consent, reducing the number of turbines to one, and to allow flexibility for the installation of alternative turbine types.

The aim of this assessment is therefore to assess the impact associated with the proposed variation, in order to ensure that the level of impact is no greater than that already consented.

2 RELEVANT GUIDANCE

The following guidance, legislation and information sources have been considered in carrying out this assessment:

- The Scottish Government's web-based planning information on onshore wind turbines (last updated May, 2014)[1];
- Planning Advice Note 1/2011 (PAN1/2011): Planning and Noise[2];
- ETSU-R-97: The Assessment and Rating of Noise from Wind Farms[3]; and
- A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (the GPG), and its Supplementary Guidance Notes[4];

Current guidance in the assessment of wind turbines noise remains the same as that considered in the Development's original application, and has been applied as applicable throughout this assessment. Further details on the above guidance can be found in the Development's Environmental Statement[5].

3 EXISTING NOISE LIMITS

The Development currently has a set of noise limits developed in collaboration with the operators of the Fife Energy Park Offshore Demonstration Wind Turbine (FEPODWT), through a Noise Limit Protocol Agreement. This agreement apportions the ETSU-R-97 noise limit for daytime (0700-2300) and night-time (2300-0700) between the FEPODWT and the Development, to ensure noise limits are not exceeded when both developments operate simultaneously. The noise limits presented in the Noise Limit Protocol Agreement are reproduced in full in Appendix 1.

As the FEPODWT is subject to restricted a 5-year consent period, this assessment considers both the apportioned noise limit applicable to the Development, and the 'full' ETSU-R-97 noise limit, which would become available to the Development following decommissioning of the FEPODWT. These noise limits are presented in Tables 1 and 2, overleaf.

[1] Scottish Government (2014) Onshore wind turbines [Online] Available at: http://www.gov.scot/Resource/0045/00451413.pdf

[2] Scottish Government (2011) Planning Advice Note 1/2011: Planning and Noise

[3] ETSU-R-97 (1996) The Assessment and Rating of Noise from Wind Farms

[4] Institute of Acoustics (2013) A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise.

[5] Forthwind Offshore Turbines Environmental Statement, Chapter 10, Section 10.4.1.

Table 1: Forthwind Apportioned Noise Limits (Reproduced from Table 2 of Appendix 1)

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Noise Limit, dB, $L_{A90,10min}$								
Daytime (0700-2300)										
20 Wellesley Road	20-190	36.5	38.9	41.1	49.8	50.0	51.8	51.1	51.0	53.5
94 Wellesley Road	20-190	34.9	35.9	38.2	45.7	44.4	45.8	45.4	47.2	49.7
12 Erskine Street	20-190	39.0	41.5	43.1	51.2	52.4	53.4	53.6	55.5	56.7
20 Wellesley Road	190-20	39.0	39.8	40.5	41.1	42.4	42.4	43.0	43.0	43.0
94 Wellesley Road	190-20	37.1	38.4	39.7	42.0	42.8	43.6	44.7	45.4	46.8
12 Erskine Street	190-20	37.7	38.0	38.6	42.8	46.4	49.9	50.3	50.3	50.3
Night-time (2300-0700)										
20 Wellesley Road	20-190	34.8	34.6	43.8	51.0	47.1	47.7	47.8	47.6	47.6
94 Wellesley Road	20-190	34.6	34.4	42.6	43.1	40.4	41.7	42.7	44.2	42.0
12 Erskine Street	20-190	37.3	38.8	45.4	51.7	50.5	51.9	53.6	53.9	53.9
20 Wellesley Road	190-20	37.9	37.8	37.8	38.4	38.9	40.6	40.7	40.7	40.7
94 Wellesley Road	190-20	36.5	36.3	36.3	38.3	39.1	39.9	41.0	42.4	44.3
12 Erskine Street	190-20	38.0	37.9	37.9	38.6	39.0	51.2	51.2	51.2	51.2

Table 2: Full ETSU-R-97 Noise Limits (Reproduced from Table A2 of Appendix 1)

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Noise Limit, dB, $L_{A90,10min}$								
Daytime (0700-2300)										
20 Wellesley Road	20-190	44.7	47.3	49.5	50.2	50.4	58.9	58.6	58.5	61.0
94 Wellesley Road	20-190	43.3	44.5	46.8	46.1	44.8	53.1	53.1	54.9	57.4
12 Erskine Street	20-190	45.3	47.9	49.5	51.6	52.8	58.7	59.3	61.2	62.4
20 Wellesley Road	190-20	44.1	45.0	45.7	45.7	46.5	46.6	47.6	47.6	47.6
94 Wellesley Road	190-20	43.6	45.1	46.4	47.9	48.2	49.1	50.6	51.3	52.7
12 Erskine Street	190-20	42.7	43.1	43.7	47.2	50.4	54.0	54.7	54.7	54.7
Night-time (2300-0700)										
20 Wellesley Road	20-190	43.0	43.0	44.2	51.4	54.1	54.8	55.3	55.1	55.1
94 Wellesley Road	20-190	43.0	43.0	43.0	43.5	47.5	49.0	50.4	51.9	49.7
12 Erskine Street	20-190	43.6	45.2	45.8	52.1	55.7	57.2	59.3	59.6	59.6
20 Wellesley Road	190-20	43.0	43.0	43.0	43.0	43.0	44.8	45.3	45.3	45.3
94 Wellesley Road	190-20	43.0	43.0	43.0	43.0	43.9	45.4	46.9	48.3	50.2
12 Erskine Street	190-20	43.0	43.0	43.0	43.0	43.0	55.3	55.6	55.6	55.6

4 METHODOLGOY

The varied Development will consist of a single wind turbine with a maximum rotor diameter of 220 m and a tip height of 245 m above the Highest Astronomical Tide (HAT). The proposed turbine location is the northernmost of the currently consented pair, grid reference 336964, 696677.

Due to the nature of the Development as a test facility for new turbine models, the noise emission characteristics of the turbine cannot be confirmed at the time of writing. The maximum permissible turbine noise emissions have therefore been calculated for wind speeds between 4 and 12 ms^{-1}, based upon the noise limits presented above. This approach ensures that regardless of the turbine selected for installation, the operation of varied Development will have no greater impact in terms of noise than that currently consented, and provides a set of maximum sound power levels for the selected turbine type.

In order to predict the noise level at the respective residential dwellings, the noise propagation model recommended by the GPG[6] requires the use of a spectrum detailing the distribution of sound at different frequencies. Due to the Development's use as a test facility, specific frequency spectrum is not available. Therefore, the frequency spectrum

[6] ISO 9613-2:1996 Acoustics: Attenuation of sound propagation outdoors. General Method of Calculation.

used in the Development's original ES has been utilised, and scaled accordingly for the variation in sound power level with wind speed.

This spectrum is presented in Table 3.

Table 3: Reference Octave Band Spectrum

	Octave-band Centre Frequency, f, Hz								Sum
	63	125	250	500	1000	2000	4000	8000	
	Octave-band Sound Power Level, dB, $L_{WA,f}$								
Reference Spectrum	86.0	95.0	102.0	103.0	99.0	95.0	90.0	85.0	107.1

In order to determine the maximum permissible sound power levels, predictions were first made on the basis of a nominal sound power level of 100 dB,L_{WA} at all assessed wind speeds.

The sound power level at each wind speed was then adjusted based upon the minimum difference between the predicted noise level and the respective noise limit at each assessed property, for day time and night-time periods.

5 ASSESSMENT

5.1 Maximum Noise Emission Levels

Tables 4 and 5 present the Development's maximum permitted noise emission levels resulting from the above procedure. Table 4 presents the maximum levels during FEPODWT consent period (i.e. in relation to the apportioned noise limits in Table 1), and Table 5 presents the maximum levels following the end of the FEPODWT consent period (i.e. in relation to the full ETSU-R-97 noise limits presented in Table 2).

It should be noted that the the sound power levels of any turbine chosen for installation are not to exceed the stated values, after incorporating any allowance for measurement uncertainty.

Table 4: Maximum Noise Emission Levels During FEPODWT Consent Period

Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
	4	5	6	7	8	9	10	11	12
	Sound Power Level, dB, L_{WA}								
Daytime (0700-2300)									
20-190	112.9	113.9	116.2	123.7	122.4	123.8	123.4	125.2	127.7
190-20	114.8	115.1	115.7	119.6	120.8	120.9	121.5	121.5	121.5
Night-time (2300-0700)									
20-190	112.6	112.4	120.6	121.1	118.4	119.7	120.7	122.2	120.0
190-20	114.5	114.3	114.3	115.7	116.1	117.9	119.0	119.2	119.2

Table 5: Maximum Noise Emission Levels Following FEPODWT Consent Period End

Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
	4	5	6	7	8	9	10	11	12
	Sound Power Level, dB, L_{WA}								
Daytime (0700-2300)									
20-190	121.3	122.5	124.8	124.1	122.8	131.1	131.1	132.9	135.4
190-20	119.8	120.2	120.8	124.2	125.0	125.1	126.1	126.1	126.1
Night-time (2300-0700)									
20-190	112.6	112.4	120.6	121.1	118.4	119.7	120.7	122.2	120.0
190-20	120.7	121.0	121.0	121.5	125.5	127.0	128.4	129.9	127.7

In Arcus' experience, the maximum noise emission levels presented in Tables 4 and 5 are substantially greater than those of currently-available onshore and offshore wind turbines. The Development is therefore considered suitable as a test facility, with sufficient headroom to accommodate a wide range of future turbine technologies.

In the interest of completeness, Appendix 2 presents an assessment against the existing noise limits, detailing the margin between the predicted noise levels arising from the maximum permitted sound power levels and the respective noise limits. As can be seen, the maximum permissible sound power levels presented above result in the noise limits being met in all cases.

6 CONCLUSION

Arcus has been commissioned by Cierco Ltd to undertake a noise assessment in relation to an application to vary the existing planning permission for the Forthwind Offshore Wind Farm Demonstration Project.

Due to the nature of the Development as a test facility for new turbine models, the noise emission characteristics of the turbine cannot be confirmed at this stage. The maximum permissible turbine noise emissions (after incorporating any allowance for measurement uncertainty) have therefore been calculated for wind speeds between 4 and 12 ms^{-1}, ensuring that regardless of the turbine selected for installation, the operation of Development will have no greater impact in terms of noise than that currently consented.

In Arcus' experience, the maximum noise emission levels are substantially greater than those of currently-available turbines, and as such, the Development is considered suitable as a test facility, with sufficient headroom to accommodate a wide range of future turbine technologies.

7 GLOSSARY OF TERMS

AGL: Above Ground Level

Background Noise: The background noise level is the under lying level of noise present at a particular location for the majority (usually 90%) of a period of time. As such it excludes any short-duration noises, such as individual passing cars (but not continuous traffic), dogs barking or passers-by. Sources of background noise typically include such things as wind noise, traffic and continuously operating machinery (e.g. air conditioning or generators).

Decibel (dB): The decibel is the basic unit of noise measurement. It relates to the pressure created by the sound (Sound Pressure) and operates on a logarithmic scale, ranging upwards from 0dB. 0dB is equivalent to the normal threshold of hearing at a *frequency* of 1000Hz (20 micro Pascals). Each increase of 3dB on the scale represents a doubling in the Sound Pressure, and is typically the minimum noticeable change in environmental sound level under normal listening conditions. For example, while an increase in noise level from 32dB to 35dB represents a doubling in sound pressure, this change would only just be noticeable to the majority of listeners.

dB(A): Environmental noise levels are usually discussed in terms of dB(A). This is known as the A-weighted sound pressure level, and indicates that a correction factor has been applied, which corresponds to the human ear's response to sound across the range of audible *frequencies*. The ear is most sensitive in the middle range of frequencies (around 1000-3000 Hertz (Hz)), and less sensitive at lower and higher frequencies. The A-weighted noise level is derived by analysing the level of a sound at a range of frequencies and applying a specific correction factor for each frequency before calculating the overall level. In practice this is carried out automatically within noise measuring equipment by the use of electronic filters, which adjust the frequency response of the instrument to mimic that of the ear.

Emission: The sound given (emitted) out by a source.

Frequency: The frequency of a sound is equivalent to its pitch in musical terms. The units of frequency are Hertz (Hz), which represents the number of cycles (vibrations) per second.

HAT: Highest Astronomical Tide

Immission: The sound arriving at a particular location, e.g. a *noise sensitive receptor.*

$LA_{90,t}$: This term is used to represent the *A-weighted* sound pressure level that is exceeded for 90% of a period of time, t. This is used as a measure of the *background noise* level.

$LA_{eq,t}$: This term is known as the *A-weighted* equivalent, continuous sound pressure level for a period of time, t. It is similar to an average, and represents the sound pressure level of a sound of continuous intensity that would result in an equal quantity of sound energy as a sound which varies in intensity.

Noise: Unwanted sound. May refer to both natural (e.g. wind, birdsong etc) and artificial sounds (e.g. traffic, noise from wind turbines, etc)

Noise sensitive receptors: Locations that may potentially be adversely affected by the addition of a new source of noise. Can include residential properties, outdoor areas and sensitive species.

Sound power (W): The sound energy radiated per unit time by a sound source, measured in watts (W).

Sound power level (L_W): Sound power measured on the decibel scale, relative to a reference value (W_o) of 10^{-12}W.

Sound pressure (P): The fluctuations in atmospheric pressure relative to atmospheric pressure, measured in Pascals (Pa).

Sound pressure level (L_p): Sound pressure measured on the decibel scale, relative to a sound pressure of 2×10^{-5} Pa (20 micro Pascals).

APPENDIX 1 – ANNEX A OF NOISE LIMIT PROTOCOL AGREEMENT

Technical Note: Proposed approach to ETSU-R-97 noise limit sharing between ORE Catapult and 2-B developments

18th March 2016

Following the conference call between Arcus, 2-B, ORE Catapult (OREC) and Hoare Lea on Thursday 10th of March, this document presents a methodology for the apportioning of the ETSU-R-97 noise limit, such that the overall cumulative noise limit will be met.

In the interest of completeness, Appendix A presents the contents of the *Limits and Predictions Summary Table March 2016* spreadsheet as provided by Arcus by email on the 11th March 2016. This contains:

- Background noise levels;
- Cumulative noise limits (i.e. total ETSU-R-97 noise limits);
- OREC predicted noise levels;
- 2-B predicted noise levels;
- Cumulative noise levels; and
- Headroom above/below noise limits for each development in isolation and cumulatively (a positive number denotes an exceedance of the limit).

It should be noted that noise limits below wind speeds[1] of 4 ms^{-1} have been discounted in this technical note as no noise emission data is available for the 2-B wind turbine at these wind speeds. In addition, the noise limit range 4-12 ms^{-1} accords with the noise limits in the current OREC planning consent, and is therefore considered the most appropriate wind speed range over which to determine apportioned limits.

As can be seen from Tables A6 and A7 of Appendix A, when considered in isolation, the 2-B development is compliant with noise limits in all wind conditions, while noise from the OREC development exceeds noise limits under certain conditions. As a first step in the sharing of noise limits (hereafter referred to as 'Stage 1'), it is anticipated that noise due to the OREC turbine will be capped to ensure no exceedance of the cumulative noise limit when considered in isolation, as this mitigation would be necessary without the presence of the 2-B development. The amount of mitigation, and wind conditions under which it is required can be seen in Table A6 of Appendix A.

Following Stage 1, the available headroom is then apportioned equally between OREC and 2-B. The following bullet points describe the apportionment process in full:

- Identification of the ETSU-R-97 cumulative noise limit applicable at each receptor and for each wind direction sector, applying fixed lower limits of 35 dB(A) during both daytime[2] periods, and 43 dB(A) during night-time[3] periods, in accordance with ETSU-R-97 (Table A2 of Appendix A);

[1] All references to wind speed in this proposal relate to a standardised 10 m height wind speed, unless specified otherwise.
[2] 0700-2300 hrs
[3] 2300-0700 hrs

- Capping of the OREC turbine predictions to equal the cumulative noise limit for periods where it is in exceedance of the cumulative noise limit in isolation (i.e. Stage 1);
- Calculation of the cumulative noise levels following Stage 1, i.e. the logarithmic addition of the noise levels from each development;
- Calculation of the margin (headroom) between the resulting cumulative noise levels and the cumulative noise limit, i.e. the arithmetic subtraction of the predicted level from the limit;
- Adding any available headroom to, and subtracting any exceedances from the original predicted noise levels from each Development to define the apportioned noise limits; and
- Reduction of the OREC apportioned limit where applicable, to account for the capping identified during Stage 1 (see bullet point 2).

It is understood that the OREC turbine will not operate under onshore winds (20-190 degrees) where it has been found to individually exceed the ETSU-R-97 noise limit. Examination of Table A6 of Appendix A shows that this is applicable during daytime periods at wind speeds[4] of 7-8 ms^{-1}, and during night-time periods at wind speeds of 6-7 ms^{-1}.

For the non-operational periods identified above, and as a final step, the apportioned noise limits have been amended such that the OREC turbine is given a noise limit 10 dB below the cumulative noise limit (this ensures a complete table of limits for both developments). The respective cells for the 2-B Development have been adjusted to equal to the cumulative noise limit, minus 0.4 dB (to ensure apportioned limits total the cumulative limit under all wind conditions).

Tables 1 and 2 present the noise limits apportioned in accordance with the above process, for the OREC and 2-B developments respectively. The cells which have been affected by the OREC non-operational periods are highlighted in bold for clarity.

Table 1: Apportioned Noise Limits (OREC)

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Noise Limit, dB, $L_{A90,10min}$								
Daytime (0700-2300)										
20 Wellesley Road	20-190	44.0	46.6	48.8	**40.2**	**40.4**	58.0	57.8	57.7	60.2
94 Wellesley Road	20-190	42.6	43.8	46.1	**36.1**	**34.8**	52.2	52.3	54.1	56.6
12 Erskine Street	20-190	44.1	46.8	48.4	**41.6**	**42.8**	57.2	57.9	59.8	61.0
20 Wellesley Road	190-20	42.5	43.5	44.2	43.8	44.4	44.6	45.7	43.0	43.0
94 Wellesley Road	190-20	42.5	44.0	45.3	46.6	46.7	47.7	49.3	50.0	51.4
12 Erskine Street	190-20	41.0	41.5	42.1	45.3	48.2	51.9	52.8	42.5	42.5
Night-time (2300-0700)										
20 Wellesley Road	20-190	42.3	42.3	**34.2**	**41.4**	53.1	53.9	54.5	54.3	54.3
94 Wellesley Road	20-190	42.3	42.3	**33.0**	**33.5**	46.6	48.1	49.6	51.1	48.9
12 Erskine Street	20-190	42.4	44.1	**35.8**	**42.1**	54.1	55.7	57.9	58.2	58.2
20 Wellesley Road	190-20	41.4	41.5	41.5	41.1	40.9	42.8	43.4	43.4	43.4
94 Wellesley Road	190-20	41.9	41.9	41.9	41.7	42.2	44.0	45.6	47.0	48.9
12 Erskine Street	190-20	41.3	41.4	41.4	41.1	40.8	53.2	53.7	53.7	53.7

Table 2: Apportioned Noise Limits (2-B)

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Noise Limit, dB, $L_{A90,10min}$								
Daytime (0700-2300)										
20 Wellesley Road	20-190	36.5	38.9	41.1	**49.8**	**50.0**	51.8	51.1	51.0	53.5
94 Wellesley Road	20-190	34.9	35.9	38.2	**45.7**	**44.4**	45.8	45.4	47.2	49.7
12 Erskine Street	20-190	39.0	41.5	43.1	**51.2**	**52.4**	53.4	53.6	55.5	56.7
20 Wellesley Road	190-20	39.0	39.8	40.5	41.1	42.4	42.4	43.0	43.0	43.0
94 Wellesley Road	190-20	37.1	38.4	39.7	42.0	42.8	43.6	44.7	45.4	46.8
12 Erskine Street	190-20	37.7	38.0	38.6	42.8	46.4	49.9	50.3	50.3	50.3
Night-time (2300-0700)										
20 Wellesley Road	20-190	34.8	34.6	**43.8**	**51.0**	47.1	47.7	47.8	47.6	47.6
94 Wellesley Road	20-190	34.6	34.4	**42.6**	**43.1**	40.4	41.7	42.7	44.2	42.0
12 Erskine Street	20-190	37.3	38.8	**45.4**	**51.7**	50.5	51.9	53.6	53.9	53.9
20 Wellesley Road	190-20	37.9	37.8	37.8	38.4	38.9	40.6	40.7	40.7	40.7
94 Wellesley Road	190-20	36.5	36.3	36.3	38.3	39.1	39.9	41.0	42.4	44.3
12 Erskine Street	190-20	38.0	37.9	37.9	38.6	39.0	51.2	51.2	51.2	51.2

Tables 3 and 4 (over) present the headroom between the predicted levels and the apportioned noise limits for each development respectively. Empty cells in Table 3 are those where the OREC turbine will not be operational, as discussed above. Exceedances of the apportioned limit are highlighted in red.

Table 3: Headroom Relative to Apportioned Noise Limits (OREC)

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Headroom (dB)								
Daytime (0700-2300)										
20 Wellesley Road	20-190	-5.2	-4.6	-3.8	-	-	-11.0	-10.8	-10.7	-13.2
94 Wellesley Road	20-190	-3.4	-1.4	-0.7	-	-	-4.8	-4.9	-6.7	-9.2
12 Erskine Street	20-190	-7.0	-6.5	-5.1	-	-	-11.9	-12.6	-14.5	-15.7
20 Wellesley Road	190-20	-7.7	-5.5	-3.2	-0.8	-1.4	-1.6	-2.7	-2.7	-2.7
94 Wellesley Road	190-20	-6.0	-4.3	-2.6	-1.9	-2.0	-3.0	-4.6	-5.3	-6.7
12 Erskine Street	190-20	-6.7	-4.0	-1.6	-2.8	-5.7	-9.4	-10.3	-10.3	-10.3
Night-time (2300-0700)										
20 Wellesley Road	20-190	-3.5	-0.3	-	-	-6.1	-6.9	-7.5	-7.3	-7.3
94 Wellesley Road	20-190	-3.1	0.1	-	-	0.8	-0.7	-2.2	-3.7	-1.5
12 Erskine Street	20-190	-5.3	-3.8	-	-	-8.8	-10.4	-12.6	-12.9	-12.9
20 Wellesley Road	190-20	-6.6	-3.5	-0.5	1.9	2.1	0.2	-0.4	-0.4	-0.4
94 Wellesley Road	190-20	-5.4	-2.2	0.8	3.5	2.5	0.7	-0.9	-2.3	-4.2
12 Erskine Street	190-20	-7.0	-3.9	-0.9	1.4	1.7	-10.7	-11.2	-11.2	-11.2

Table 4: Headroom Relative to Apportioned Noise Limits (2-B)

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Headroom (dB)								
Daytime (0700-2300)										
20 Wellesley Road	20-190	-5.2	-4.6	-3.8	-9.5	-9.0	-11.0	-10.8	-10.7	-13.2
94 Wellesley Road	20-190	-3.4	-1.4	-0.7	-5.2	-3.2	-4.8	-4.9	-6.7	-9.2
12 Erskine Street	20-190	-7.0	-6.5	-5.1	-10.2	-10.7	-11.9	-12.6	-14.5	-15.7
20 Wellesley Road	190-20	-7.7	-5.5	-3.2	-0.8	-1.4	-1.6	-2.7	-2.7	-2.7
94 Wellesley Road	190-20	-6.0	-4.3	-2.6	-1.9	-2.0	-3.0	-4.6	-5.3	-6.7
12 Erskine Street	190-20	-6.7	-4.0	-1.6	-2.8	-5.7	-9.4	-10.3	-10.3	-10.3
Night-time (2300-0700)										
20 Wellesley Road	20-190	-3.5	-0.3	-6.5	-10.7	-6.1	-6.9	-7.5	-7.3	-7.3
94 Wellesley Road	20-190	-3.1	0.1	-5.1	-2.6	0.8	-0.7	-2.2	-3.7	-1.5
12 Erskine Street	20-190	-5.3	-3.8	-7.4	-10.7	-8.8	-10.4	-12.6	-12.9	-12.9
20 Wellesley Road	190-20	-6.6	-3.5	-0.5	1.9	2.1	0.2	-0.4	-0.4	-0.4
94 Wellesley Road	190-20	-5.4	-2.2	0.8	1.8	1.7	0.7	-0.9	-2.3	-4.2
12 Erskine Street	190-20	-7.0	-3.9	-0.9	1.4	1.7	-10.7	-11.2	-11.2	-11.2

It should be noted that as previously discussed, the predicted noise levels within each of the wind direction sectors are worst-case predictions. As such, any identified exceedances do not necessarily require that development to mitigate by the amount presented for the entire wind direction sector under which the exceedance occurs.

Compliance with the apportioned limits detailed in this technical note will ensure that cumulative noise levels do not exceed the overall ETSU-R-97 noise limit. This can be demonstrated by the logarithmic addition of the apportioned noise limits, which are found to equal the agreed cumulative noise limits.

APPENDIX A: TABLES EXTRACTED FROM *'LIMITS AND PREDICTIONS SUMMARY TABLE MARCH 2016'*

Table A1: Background Noise Levels

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Background Noise Level, dB, $L_{A90,10min}$								
Daytime (0700-2300)										
20 Wellesley Road	20-190	39.7	42.3	44.5	45.2	45.4	53.9	53.6	53.5	56.0
94 Wellesley Road	20-190	38.3	39.5	41.8	41.1	39.8	48.1	48.1	49.9	52.4
12 Erskine Street	20-190	40.3	42.9	44.5	46.6	47.8	53.7	54.3	56.2	57.4
20 Wellesley Road	190-20	39.1	40.0	40.7	40.7	41.5	41.6	42.6	-	-
94 Wellesley Road	190-20	38.6	40.1	41.4	42.9	43.2	44.1	45.6	46.3	47.7
12 Erskine Street	190-20	37.7	38.1	38.7	42.2	45.4	49.0	49.7	-	-
Night-time (2300-0700)										
20 Wellesley Road	20-190	33.8	36.7	39.2	46.4	49.1	49.8	50.3	50.1	-
94 Wellesley Road	20-190	34.7	37.6	36.9	38.5	42.5	44.0	45.4	46.9	44.7
12 Erskine Street	20-190	38.6	40.2	40.8	47.1	50.7	52.2	54.3	54.6	-
20 Wellesley Road	190-20	36.1	36.0	34.3	36.8	36.2	39.8	40.3	-	-
94 Wellesley Road	190-20	31.8	31.9	33.9	36.1	38.9	40.4	41.9	43.3	45.2
12 Erskine Street	190-20	33.6	34.2	36.6	37.4	37.9	50.3	50.6	-	-

Table A2: Cumulative Noise Limits

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Background Noise Level, dB, $L_{A90,10min}$								
Daytime (0700-2300)										
20 Wellesley Road	20-190	44.7	47.3	49.5	50.2	50.4	58.9	58.6	58.5	61.0
94 Wellesley Road	20-190	43.3	44.5	46.8	46.1	44.8	53.1	53.1	54.9	57.4
12 Erskine Street	20-190	45.3	47.9	49.5	51.6	52.8	58.7	59.3	61.2	62.4
20 Wellesley Road	190-20	44.1	45.0	45.7	45.7	46.5	46.6	47.6	47.6	47.6
94 Wellesley Road	190-20	43.6	45.1	46.4	47.9	48.2	49.1	50.6	51.3	52.7
12 Erskine Street	190-20	42.7	43.1	43.7	47.2	50.4	54.0	54.7	54.7	54.7
Night-time (2300-0700)										
20 Wellesley Road	20-190	43.0	43.0	44.2	51.4	54.1	54.8	55.3	55.1	55.1
94 Wellesley Road	20-190	43.0	43.0	43.0	43.5	47.5	49.0	50.4	51.9	49.7
12 Erskine Street	20-190	43.6	45.2	45.8	52.1	55.7	57.2	59.3	59.6	59.6
20 Wellesley Road	190-20	43.0	43.0	43.0	43.0	43.0	44.8	45.3	45.3	45.3
94 Wellesley Road	190-20	43.0	43.0	43.0	43.0	43.9	45.4	46.9	48.3	50.2
12 Erskine Street	190-20	43.0	43.0	43.0	43.0	43.0	55.3	55.6	55.6	55.6

Table A3: OREC Predicted Noise Levels

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Predicted Noise Level, dB, $L_{A90,10min}$								
Daytime (0700-2300)										
20 Wellesley Road	20-190	38.8	42.0	45.0	47.0	47.0	47.0	47.0	47.0	47.0
94 Wellesley Road	20-190	39.2	42.4	45.4	47.4	47.4	47.4	47.4	47.4	47.4
12 Erskine Street	20-190	37.1	40.3	43.3	45.3	45.3	45.3	45.3	45.3	45.3
20 Wellesley Road	190-20	34.8	38.0	41.0	43.0	43.0	43.0	43.0	43.0	43.0
94 Wellesley Road	190-20	36.5	39.7	42.7	44.7	44.7	44.7	44.7	44.7	44.7
12 Erskine Street	190-20	34.3	37.5	40.5	42.5	42.5	42.5	42.5	42.5	42.5

Table A4: 2-B Predicted Noise Levels

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Predicted Noise Level, dB, $L_{A90,10min}$								
Daytime (0700-2300)										
20 Wellesley Road	20-190	31.3	34.3	37.3	40.3	41.0	40.8	40.3	40.3	40.3
94 Wellesley Road	20-190	31.5	34.5	37.5	40.5	41.2	41.0	40.5	40.5	40.5
12 Erskine Street	20-190	32.0	35.0	38.0	41.0	41.7	41.5	41.0	41.0	41.0
20 Wellesley Road	190-20	31.3	34.3	37.3	40.3	41.0	40.8	40.3	40.3	40.3
94 Wellesley Road	190-20	31.1	34.1	37.1	40.1	40.8	40.6	40.1	40.1	40.1
12 Erskine Street	190-20	31.0	34.0	37.0	40.0	40.7	40.5	40.0	40.0	40.0

Table A5: Cumulative Predicted Noise Levels

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Predicted Noise Level, dB, $L_{A90,10min}$								
Daytime (0700-2300)										
20 Wellesley Road	20-190	39.5	42.7	45.7	47.8	48.0	47.9	47.8	47.8	47.8
94 Wellesley Road	20-190	39.9	43.1	46.1	48.2	48.3	48.3	48.2	48.2	48.2
12 Erskine Street	20-190	38.3	41.4	44.4	46.7	46.9	46.8	46.7	46.7	46.7
20 Wellesley Road	190-20	36.4	39.5	42.5	44.9	45.1	45.0	44.9	44.9	44.9
94 Wellesley Road	190-20	37.6	40.8	43.8	46.0	46.2	46.1	46.0	46.0	46.0
12 Erskine Street	190-20	36.0	39.1	42.1	44.4	44.7	44.6	44.4	44.4	44.4

Table A6: OREC Headroom against Cumulative Noise Limit

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Background Noise Level, dB, $L_{A90,10min}$								
Daytime (0700-2300)										
20 Wellesley Road	20-190	-5.9	-5.3	-4.5	-3.2	-3.4	-11.9	-11.6	-11.5	-14.0
94 Wellesley Road	20-190	-4.1	-2.1	-1.4	1.3	2.6	-5.7	-5.7	-7.5	-10.0
12 Erskine Street	20-190	-8.2	-7.6	-6.2	-6.3	-7.5	-13.4	-14.0	-15.9	-17.1
20 Wellesley Road	190-20	-9.3	-7.0	-4.7	-2.7	-3.5	-3.6	-4.6	-4.6	-4.6
94 Wellesley Road	190-20	-7.1	-5.4	-3.7	-3.2	-3.5	-4.4	-5.9	-6.6	-8.0
12 Erskine Street	190-20	-8.4	-5.6	-3.2	-4.7	-7.9	-11.5	-12.2	-12.2	-12.2
Night-time (2300-0700)										
20 Wellesley Road	20-190	-4.2	-1.0	0.8	-4.4	-7.1	-7.8	-8.3	-8.1	-8.1
94 Wellesley Road	20-190	-3.8	-0.6	2.4	3.9	-0.1	-1.6	-3.0	-4.5	-2.3
12 Erskine Street	20-190	-6.5	-4.9	-2.5	-6.8	-10.4	-11.9	-14.0	-14.3	-14.3
20 Wellesley Road	190-20	-8.2	-5.0	-2.0	0.0	0.0	-1.8	-2.3	-2.3	-2.3
94 Wellesley Road	190-20	-6.5	-3.3	-0.3	1.7	0.8	-0.7	-2.2	-3.6	-5.5
12 Erskine Street	190-20	-8.7	-5.5	-2.5	-0.5	-0.5	-12.8	-13.1	-13.1	-13.1

Table A7: 2-B Headroom against Cumulative Noise Limit

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Background Noise Level, dB, $L_{A90,10min}$								
Daytime (0700-2300)										
20 Wellesley Road	20-190	-13.4	-13.0	-12.2	-9.9	-9.4	-18.1	-18.3	-18.2	-20.7
94 Wellesley Road	20-190	-11.8	-10.0	-9.3	-5.6	-3.6	-12.1	-12.6	-14.4	-16.9
12 Erskine Street	20-190	-13.3	-12.9	-11.5	-10.6	-11.1	-17.2	-18.3	-20.2	-21.4
20 Wellesley Road	190-20	-12.8	-10.7	-8.4	-5.4	-5.5	-5.8	-7.3	-7.3	-7.3
94 Wellesley Road	190-20	-12.5	-11.0	-9.3	-7.8	-7.4	-8.5	-10.5	-11.2	-12.6
12 Erskine Street	190-20	-11.7	-9.1	-6.7	-7.2	-9.7	-13.5	-14.7	-14.7	-14.7
Night-time (2300-0700)										
20 Wellesley Road	20-190	-11.7	-8.7	-6.9	-11.1	-13.1	-14.0	-15.0	-14.8	-14.8
94 Wellesley Road	20-190	-11.5	-8.5	-5.5	-3.0	-6.3	-8.0	-9.9	-11.4	-9.2
12 Erskine Street	20-190	-11.6	-10.2	-7.8	-11.1	-14.0	-15.7	-18.3	-18.6	-18.6
20 Wellesley Road	190-20	-11.7	-8.7	-5.7	-2.7	-2.0	-4.0	-5.0	-5.0	-5.0
94 Wellesley Road	190-20	-11.9	-8.9	-5.9	-2.9	-3.1	-4.8	-6.8	-8.2	-10.1
12 Erskine Street	190-20	-12.0	-9.0	-6.0	-3.0	-2.3	-14.8	-15.6	-15.6	-15.6

Table A8: Cumulative Headroom against Cumulative Noise Limit

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Background Noise Level, dB, $L_{A90,10min}$								
Daytime (0700-2300)										
20 Wellesley Road	20-190	-5.2	-4.6	-3.8	-2.4	-2.4	-11.0	-10.8	-10.7	-13.2
94 Wellesley Road	20-190	-3.4	-1.4	-0.7	2.1	3.5	-4.8	-4.9	-6.7	-9.2
12 Erskine Street	20-190	-7.0	-6.5	-5.1	-4.9	-5.9	-11.9	-12.6	-14.5	-15.7
20 Wellesley Road	190-20	-7.7	-5.5	-3.2	-0.8	-1.4	-1.6	-2.7	-2.7	-2.7
94 Wellesley Road	190-20	-6.0	-4.3	-2.6	-1.9	-2.0	-3.0	-4.6	-5.3	-6.7
12 Erskine Street	190-20	-6.7	-4.0	-1.6	-2.8	-5.7	-9.4	-10.3	-10.3	-10.3
Night-time (2300-0700)										
20 Wellesley Road	20-190	-3.5	-0.3	1.5	-3.6	-6.1	-6.9	-7.5	-7.3	-7.3
94 Wellesley Road	20-190	-3.1	0.1	3.1	4.7	0.8	-0.7	-2.2	-3.7	-1.5
12 Erskine Street	20-190	-5.3	-3.8	-1.4	-5.4	-8.8	-10.4	-12.6	-12.9	-12.9
20 Wellesley Road	190-20	-6.6	-3.5	-0.5	1.9	2.1	0.2	-0.4	-0.4	-0.4
94 Wellesley Road	190-20	-5.4	-2.2	0.8	3.0	2.3	0.7	-0.9	-2.3	-4.2
12 Erskine Street	190-20	-7.0	-3.9	-0.9	1.4	1.7	-10.7	-11.2	-11.2	-11.2

APPENDIX 2 – ASSESSMENT OF MAXIMUM PERMISSABLE NOISE EMISSION LEVELS AGAINST NOISE LIMITS

Table A2.1: Headroom Resulting from Maximum Permitted Noise Emission Levels during FEPODWT Consent Period

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Margin, dB								
Daytime (0700-2300)										
20 Wellesley Road	20-190	-2.1	-3.5	-3.4	-4.6	-6.1	-6.5	-6.2	-4.3	-4.3
94 Wellesley Road	20-190	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12 Erskine Street	20-190	-3.2	-4.7	-4.0	-4.6	-7.1	-6.7	-7.3	-7.4	-6.1
20 Wellesley Road	190-20	-2.7	-3.2	-3.3	0.0	-0.1	0.0	0.0	0.0	0.0
94 Wellesley Road	190-20	-0.3	-1.3	-2.0	-0.4	0.0	-0.7	-1.2	-1.9	-3.3
12 Erskine Street	190-20	0.0	0.0	0.0	-0.3	-2.7	-6.1	-5.9	-5.9	-5.9
Night-time (2300-0700)										
20 Wellesley Road	20-190	-0.7	-0.7	-1.7	-8.4	-7.2	-6.5	-5.6	-3.9	-6.1
94 Wellesley Road	20-190	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12 Erskine Street	20-190	-1.8	-3.5	-1.9	-7.7	-9.2	-9.3	-10.0	-8.8	-11.0
20 Wellesley Road	190-20	-1.9	-2.0	-2.0	-1.2	-1.3	-1.2	-0.2	0.0	0.0
94 Wellesley Road	190-20	0.0	0.0	0.0	-0.6	-1.0	0.0	0.0	-1.2	-3.1
12 Erskine Street	190-20	-0.6	-0.7	-0.7	0.0	0.0	-10.4	-9.3	-9.1	-9.1

Table A2.2: Headroom Resulting from Maximum Permitted Noise Emission Levels following FEPODWT Consent Period End

Receptor	Wind Direction (Deg.)	Standardised Wind Speed at 10 m AGL, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Margin, dB								
Daytime (0700-2300)										
20 Wellesley Road	20-190	-1.9	-3.3	-3.2	-4.6	-6.1	-6.3	-6.0	-4.1	-4.1
94 Wellesley Road	20-190	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12 Erskine Street	20-190	-1.1	-2.5	-1.8	-4.6	-7.1	-4.7	-5.3	-5.4	-4.1
20 Wellesley Road	190-20	-2.8	-3.3	-3.4	0.0	0.0	0.0	0.0	0.0	0.0
94 Wellesley Road	190-20	-1.8	-2.9	-3.6	-1.7	-1.2	-2.0	-2.5	-3.2	-4.6
12 Erskine Street	190-20	0.0	0.0	0.0	-0.1	-2.5	-6.0	-5.7	-5.7	-5.7
Night-time (2300-0700)										
20 Wellesley Road	20-190	-0.8	-0.5	-1.7	-8.4	-7.1	-6.3	-5.4	-3.7	-5.9
94 Wellesley Road	20-190	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12 Erskine Street	20-190	0.0	-1.3	-1.9	-7.7	-7.3	-7.3	-8.0	-6.8	-9.0
20 Wellesley Road	190-20	-1.4	-1.4	-1.4	-1.4	-1.4	0.0	0.0	0.0	0.0
94 Wellesley Road	190-20	-0.9	-0.9	-0.9	-0.9	-1.8	-0.1	-1.1	-2.5	-4.4
12 Erskine Street	190-20	0.0	0.0	0.0	0.0	0.0	-9.1	-8.9	-8.9	-8.9

APPENDIX 3 – ORNITHOLOGY ASSESSMENT UNDERTAKEN BY GAVIA ENVIRONMENTAL

FORTHWIND REVISED ORNITHOLOGY ASSESSMENT FOR VARIATION TO EXISTING CONSENT

FORTHWIND

PROJECT GEL18105

QUALITY MANAGEMENT

Prepared by:	Name	[redacted]	Title	Mr
	Signature	[redacted]		
Authorised by:	Name	[redacted]	Title	Mr
	Signature	[redacted]		
Current Status:	Draft			
Issue Date:		Revision number:	1b	
		Revision notes:		

Gavia Environmental Ltd
Inveralmond Industrial Estate
Auld Bond Road
Perth
PH1 3FX

Tel: 01738 646741

Email: info@gavia-environmental.co.uk

Table of Contents

1 INTRODUCTION

Gavia Environmental Ltd (GEL) was commissioned by Forthwind Ltd to undertake a review of the potential effects and a Habitats Regulations Assessment (HRA) of a variation to the consent of the Forthwind Test Site (hereafter, 'the Variation') in relation to European (Natura 2000) sites and their qualifying interests.

1.1 The Variation

The Forthwind Test Site is located in the Firth of Forth approximately 1.5 km offshore from the Fife Energy Park near Methil. The consented two-turbine Development is hereafter referred to as 'the consented Development'.

The Variation comprises a change from the consented Development of two offshore, two-bladed lattice structure wind turbines (and associated infrastructure) to the installation of a single, larger, wind turbine (and associated infrastructure), in the same location as the north-easterly turbine of the consented Development. The Variation is considering two candidate turbines: a 2-bladed model, which has a lattice structure tower, a two-bladed rotor with 220 m rotor diameter and 135 m hub-height above HAT; and a 3-bladed rotor alternative, with tubular tower, also hub-height of 135 m[1] and rotor diameter of 220 m. Table 1 provides comparison of key parameters between the consented Development and the Variation that are of relevance to the revised HRA.

Table 1: Comparison between the consented Development parameters and the Variation parameters

Parameter	Consented Development	Variation 1 (2-bladed turbine model)	Variation 2 (3-bladed alternative turbine model)
Number of turbines	2	1	1
Location of turbines* (grid reference)	NT 36964 96677 NT 37812 97333	NT 37812 97333	NT 37812 97333
Hub height	109-121 m	135 m	135 m
Number of rotor blades	2	2	3
Maximum tip height	198.5 m	245 m	245 m
Maximum rotor diameter	155 m	220 m	220 m

** with 100 m micro-siting allowance*

Installation of the consented Development was expected to take approximately eight weeks. The duration of construction is expected to be shorter for the Variation because there is only one turbine to install, rather than two.

1.2 Consented Development HRA

This Section provides a summary of the assessments undertaken for the consented Development in order to provide context for the assessment of the potential effects of the Variation, because the approach taken to this assessment is to make a like-for-like comparison between the magnitude/character of the potential effects of the consented Development and the potential effects of the Variation. The assessment for the consented Development of two turbines culminated in the submission of a HRA Addendum in March 2016 (hereafter referred to as the '2016 HRA Addendum'), which superseded the previous HRA submitted with the Environmental Statement in July 2015. On the basis of the information provided, Marine Scotland Licensing Operations Team (MS-LOT) and Marine Scotland Science (MSS) undertook an Appropriate Assessment (hereafter, the '2016 AA') on

[1] The candidate turbine is in development and full technical specifications are currently unavailable; for the purposes of this assessment, it is assumed that height parameters refer to distance above HAT.

behalf of the Scottish Ministers, as required under the Habitats Regulations[2]. The findings of the AA were documented in December 2016[3]. Detailed advice to inform the AA was provided to MS-LOT via consultation by Scottish Natural Heritage (SNH) in May 2016.

1.2.1 2016 HRA Addendum

The 2016 HRA Addendum set out the European Sites for consideration, along with details of their qualifying interests and conservation objectives. Four Special Protection Areas (SPAs) and/or Ramsar sites were identified for consideration in the HRA (Figure 1):

- Firth of Forth SPA and Ramsar site;
- Forth Islands SPA;
- Loch Leven SPA and Ramsar site; and
- Cameron Reservoir SPA and Ramsar site.

In addition, consultees advised that further information was necessary to allow consideration of the Outer Firth of Forth and St Andrews Bay Complex draft SPA (dSPA). Such information was provided in the 2016 HRA Addendum. During the post-application process, the dSPA entered a public consultation phase and became a proposed SPA (pSPA). Proposed SPAs receive policy protection, which effectively puts such sites in the same position as designated sites from that point forward, until a decision on classification of the site is made. The Outer Firth of Forth and St Andrews Bay Complex pSPA (Figure 1) was therefore included in the AA.

The 2016 HRA Addendum reviewed the qualifying interest features of each of the European Sites in relation to the baseline data collected for the assessment. Species taken forward for detailed assessment in the 2016 HRA Addendum included:

- Wintering duck and diver species associated with the Firth of Forth SPA and Outer Firth of Forth and St Andrews Bay Complex pSPA:
    - Common scoter;
    - Eider;
    - Long-tailed duck;
    - Red-breasted merganser;
    - Red-throated diver; and
    - Velvet scoter.
- Breeding species associated with the Forth Islands SPA, with the exception of terns (due to very low numbers observed flying at risk height):
    - Cormorant;
    - Fulmar;

[2] The Appropriate Assessment was required to be undertaken under Council Directive 92/43/EEC on the conservation of natural habitats of wild fauna and flora (the Habitats Directive) as implemented, in particular, by Regulation 61 of the Conservation of Habitats and Species Regulations 2010 (now superseded by the Conservation of Habitats and Species Regulations 2017) for section 36 consents and Regulation 48 of the Conservation (Natural Habitats, &c.) Regulations 1994 (the 1994 Regulations) for marine licence applications for projects within 12 nautical miles of the mainland before the Scottish Ministers may decide to give consent to the development. As the Forthwind development requires both a Section 36 consent and a marine licence, both sets of regulations (the Habitats Regulations) apply to this assessment.

[3] https://www.gov.scot/Topics/marine/Licensing/marine/scoping/FW-Methil/forthwind-aa accessed 01/08/2018.

- Gannet;
- Herring gull;
- Kittiwake;
- Lesser black-backed gull;
- Guillemot;
- Puffin;
- Razorbill; and
- Shag.

All other European Sites and a number of qualifying species associated with the Firth of Forth SPA, Outer Firth of Forth and St Andrews Bay Complex dSPA and Forth Islands SPA were screened out of further consideration in the 2016 HRA Addendum because baseline data indicated that there was no connectivity between the consented Development and the European Sites, or that the potential effects would be *de minimis.*

The potential effects considered in detail were displacement during construction, operation and decommissioning, and collision during operation. Other potential effects, such as barrier to movement and indirect effects (e.g. on prey), were screened out.

The potential effects of collision mortality were examined using collision risk models based on the baseline flight activity survey data collected for the assessment. The potential effects of displacement were examined using displacement vs mortality matrices for birds within the consented Development's Zone of Influence (ZoI, defined as a buffer of 1 km around the turbine locations), based on the bird densities estimated from the baseline activity summary surveys (counts of birds within the survey area).

Species accounts were provided for each species and the effects of displacement and collision were considered for the consented Development alone and in-combination with other relevant wind energy developments in the Firth of Forth with respect to the European sites.

The assessment concluded that the effects of the Forthwind test Site, both alone and in-combination with other projects within the region, were not significant for all species considered. The HRA therefore concluded that there were no adverse effects on the integrity of the:

- Forth Islands SPA;
- Firth of Forth SPA; and
- Outer Firth of Forth and St Andrews Bay Complex draft (now proposed) SPA.

1.2.2 MS-LOT/MSS Appropriate Assessment (2016 AA)

Having concluded that the Forthwind Test Site was not connected with or necessary to the conservation management of any of the European Sites, SNH provided advice to MS-LOT in May 2016 on whether there was likely to be a significant effect on the qualifying interests of the SPAs identified above.

SNH advised that there would be no likely significant effect (LSE) for the qualifying interests of Forth Islands, Loch Leven and Cameron Reservoir SPAs. The reason given for no LSE was '*low numbers of relevant species recorded, or a low proportion recorded flying at collision risk height or collision risk mortality is not significant or project area is not considered important for these species.*'

For the Firth of Forth SPA, SNH advised there would be no LSE on the majority of the qualifying interests (for the same reasons given above) but there would be a LSE on the following species:

- Common scoter (wintering);
- Eider (wintering;
- Long-tailed duck (wintering);
- Red-breasted merganser (wintering);
- Red-throated diver (wintering); and
- Velvet scoter (wintering).

The reason given for consideration of LSE on these species was that '*the project area is within the wintering foraging range; the species were recorded during site surveys and are sensitive to potential impacts.*'

MS-LOT and MSS agreed with the identification of LSE on these six species from the Firth of Forth SPA and completed the 2016 AA in that regard. They also identified that these six species are qualifying interests of the Outer Firth of Forth and St Andrews Bay Complex pSPA and therefore gave them consideration within the 2016 AA.

The 2016 AA concluded that '*the development* [the consented Development] *will not, on its own or in combination with other projects, adversely affect the integrity of the Firth of Forth SPA or the Outer Firth of Forth and St Andrews Bay Complex, where the SPAs are taken as a whole'.*

The project was awarded consent in December 2016.

2 CONSULTATION

With regard to the proposed Variation a project meeting was held between Forthwind, SNH and Marine Scotland on 25th May 2018 to consult on the requirements for further information. Further to this meeting SNH were contacted by email on 20th August to outline the proposed approach to the variation and to request information relating to displacement and mortality rates for ducks and divers, and reference population data for the Firth of Forth SPA and Outer Firth of Forth and St Andrews Bay Complex Proposed Special Protection Area (pSPA). It should be noted that through subsequent communications with Forthwind the maximum turbine tip height for the variation is now 245 m as opposed to 260 m. Accordingly this has reduced our worst case ZoI to 1.23 km around the variation turbine. Table 2 provides a summary of the advice received and how this has been accommodated in this revised assessment for the Variation.

Table 2: Summary of consultation advice relating to Ornithology

ITEM	Action
Need to consider the changes to the 2016 HRA Addendum, specifically how a revised single 3 bladed turbine proposal compares to the originally two 2 bladed turbine consent.	This revised assessment reviews the different parameters of the Variation and consented Developments and presents a comparison and re-assessment of the potential effects.
Raised the issue of the parameters that needed to be tweaked in the Collision Risk Model (CRM) and to highlight where changes have been made (especially different turbine considerations). Of importance was to understand where assumptions have been made to make the worst-case scenario and the specifications of the turbines under consideration.	All of the varied parameters have been presented in this report to demonstrate how the collision risk and displacement effects change for the proposed Variation turbine(s).

ITEM	Action
Highlighted the need to consider the greater displacement radius of a larger turbine.	A larger displacement distance has been applied for the larger turbine to present a precautionary assessment.
Advised the need to provide good justification on the assessment to be undertaken taken and why as significant issues regarding methodology had been raised previously for this site and will be increased with the larger turbine.	Justification for the approach taken to the revised assessment has been presented in relation to the estimation of potential collision risk and displacement effects. The Variation does not present a material change from the consented Development and therefore the same methods of assessment have been applied for the Variation.
Scope of cumulative assessment.	The same scope for the cumulative assessment has effectively been applied as in the consented Development assessment, because the approach taken in this assessment is simply to make comparison between the magnitude of effects of the consented Development and the Variation.
Inclusion of the Outer Firth of Forth and St Andrews Bay Complex pSPA in the assessment.	The 2016 assessment included the Outer Firth of Forth and St Andrews Bay Complex when it had the status of dSPA. It is now a pSPA and this has been included in the revised assessment, with updated population sizes of wintering birds where required.

3 SCREENING AND APPROACH TO HRA FOR THE VARIATION

The approach taken in this HRA for the Variation is to examine the changes in scale of effects resulting from the differences in physical parameters between the proposed Variation and the consented Development and to put that in the context of the previous 2016 HRA Addendum and 2016 AA. In light of the conclusions of the 2016 AA, it is considered that this simple approach is proportionate to the scale of the project and the likely magnitude and significance of any potential changes in effects.

3.1.1 Screening of Potential Effects

Seabirds, including divers and seaduck, are susceptible to different effects from the development of offshore wind energy during construction, operation and decommissioning, depending on their ecology and behaviour. The four main types of effect are:

- Collision with operational turbine blades;
- Disturbance/displacement during construction, operation and decommissioning;
- Barrier effects during operation; and
- Indirect effects e.g. on prey distribution, during construction, operation and decommissioning.

Seabird vulnerability to these effects has been assessed by Furness *et al*. (2013) and updated by Wade *et al.* (2016) taking into account the species' conservation importance. Based on this and the fact that the project would comprise a single turbine, the main effects considered in this HRA are operational collision and displacement during construction, operation and decommissioning.

Barrier effects are not considered further in this assessment because work by Masden *et al*. (2009) showed that flight deviations, in this case of eiders, around a relatively large constructed offshore wind farm had minimal effect on bird energetics which would be undetectable at the population level. Although these effects may be greater for breeding seabirds which are central place foragers (Masden *et al*., 2010), the location of the Variation at 23 – 27 km from the largest SPA breeding colonies of the

Forth Islands SPA: the Isle of May and Bass Rock, and the single turbine scale of the project means that barrier effects are considered not significant for all species.

Indirect effects on prey species and their distribution are also assessed as not significant owing to the limited timescale of project construction and decommissioning and the small scale of the Variation footprint compared with the large foraging area available to breeding seabirds and wintering waterbirds.

The effect of additional mortality in bird populations due to collision risk was assessed and presented in the 2016 HRA Addendum for a number of the qualifying interest species of the Forth Islands SPA, the Firth of Forth SPA and Outer Firth of Forth and St Andrews Bay Complex dSPA (now pSPA). LSEs of collision risk on any qualifying interests of any of the European Sites were scoped out of the AA completed by MS-LOT and MSS under advice from SNH. In order to consider if the Variation presents any predicted increase to collision risk, collision risk has been examined for one species, gannet, to demonstrate the predicted effect arising from the different physical parameters of the Variation and to determine whether further re-modelling was necessary for other species. Gannet was chosen because it had the highest collision risk estimate out of the species assessed previously.

The potential effects of displacement were previously screened into the assessment in the 2016 HRA Addendum and LSE with respect to displacement was confirmed by SNH and MS-LOT/MSS in the 2016 AA for six wintering diver/seaduck species (see Section 1.2.2). Displacement is therefore screened in to further assessment for the Variation. Revised displacement matrices have not been presented in this HRA; instead, previous results have been proportionately increased to reflect the revised area of the ZoI (increased from 1 km to 1.23 km around the variation turbine, which is directly proportionate to the increase to a maximum tip height of 245 m) and thus ensuring consistency with the assessment for the previous 2016 AA for the consented Development, with respect to the six wintering diver/seaduck species that were screened in to the 2016 AA.

3.1.2 SPA and Species Screening

As was completed for the previous 2016 HRA Addendum, the Screening for LSEs in this HRA examines the potential for impacts on European sites within a range across which there could be meaningful connectivity:

- Firth of Forth SPA and Ramsar site;
- Forth Islands SPA;
- Outer Firth of Forth and St Andrews Bay Complex pSPA;
- Loch Leven SPA and Ramsar site; and
- Cameron Reservoir SPA and Ramsar site.

3.1.2.1 Loch Leven and Cameron Reservoir SPAs

These two SPAs have been screened out of further assessment in this HRA as no LSEs were predicted in the 2016 HRA Addendum and the 2016 AA. For completeness, the reasoning is summarised below.

Loch Leven and Cameron Reservoir SPAs are designated for wintering waterfowl, in particular, pink-footed goose *Anser brachyrhynchus* which may migrate through the site and be subject to collision risk.

Baseline surveys demonstrated that pink-footed geese very infrequently flew across the survey area during the autumn and spring migration periods. This species has been demonstrated to show strong avoidance of offshore wind turbines (e.g. Plonczkier & Simms, 2012) and has high turbine avoidance rates (99.8%; SNH, 2013). Cumulative modelling of collision risk from all UK wind farms predicted no

significant effects on the population (Natural England, 2015). As a result of the low numbers recorded on passage during the baseline surveys and the high avoidance rate, the magnitude of the potential effect of the Variation is predicted to be negligible.

Other waterbirds which are qualifying features of the Loch Leven SPA which could potentially pass through the site are screened out of further assessment based on limited connectivity and, with regard to collision, because SNH have advised no LSE on these species based on the strategic collision risk assessment of migrating waterfowl and waders commissioned by Marine Scotland (WWT & MacArthur Green, 2014).

In relation to the Variation, the above information would remain unchanged with respect to the qualifying interest features of Loch Leven SPA and Cameron Reservoir SPA, which remain unchanged, therefore no LSEs are predicted. These two SPAs and their qualifying features are therefore screened out of further assessment.

3.1.2.2 Forth Islands SPA

The Forth Islands SPA is designated for breeding seabirds. All species were taken forward for further assessment in the 2016 HRA Addendum, except tern species which were screened out during consultation owing to the relatively low numbers of individuals recorded at risk height. The 2016 AA screened out all effects on the Forth Islands SPA, because it was ascertained that there was a low risk of collision mortality and/or that the project area was not a key foraging area for any of the qualifying interest species.

The Variation is in the same location as the consented Development and has a similar or smaller buffer area therefore the same conclusion would apply with regard to its importance as a foraging area (see Figure 2). As a result, it is concluded that the Variation will not result in any LSEs with respect to potential displacement effects on the qualifying interest species of the Forth Islands SPA.

As described in Section 3.1.1, the Variation may result in a change in the magnitude of collision risk. This SPA and its component breeding seabird species (in alphabetical order: cormorant, fulmar, gannet herring gull, kittiwake and lesser black-backed gull) are taken forward for further assessment to investigate the scale of change in risk from collision. Initially, the assessment will be carried out for the species previously identified as being at greatest risk i.e. gannet (Section 4). Should the risk of the Variation prove to be less than for the consented project, all other species, which are at lower risk of collision will be screened out of further assessment.

3.1.2.3 Firth of Forth SPA

The Firth of Forth SPA is designated mainly for wintering waterbirds. For species such as waders which utilise the shoreline and intertidal area, the main potential effect would arise from the disturbance or displacement of feeding or roosting birds during the installation or decommissioning of the export cable. However, there is little in the way of foraging habitat (i.e. tidal mud) favoured by wading birds present at the site. In addition, the intertidal habitat in the region of the cable landfall provides limited opportunities for feeding waders, being composed of rock armour. Wading species were therefore rarely recorded on survey owing to lack of suitable habitat.

With regard to collision, SNH advised no Likely Significant Effect on migratory waders based on the strategic collision risk assessment of migrating waders and waterfowl commissioned by Marine Scotland (WWT & MacArthur Green, 2014).

For these reasons and the limited duration of works, wading birds are screened out of this assessment (no LSE).

In addition, certain grebe and duck species which were not recorded or recorded in very low numbers have been screened out due to lack of connectivity with the Development site.

Species taken forward for assessment are the wintering seaduck and diver species known to be sensitive to disturbance/displacement and which were included in the 2016 AA:

- Common scoter;
- Common eider;
- Long-tailed duck;
- Red-breasted merganser;
- Red-throated diver; and
- Velvet scoter.

3.1.2.4 The Outer Firth of Forth and St Andrews Bay Complex pSPA

Species taken forward for assessment of displacement in this HRA are those same six wintering seaduck and diver species which are also features of the Firth of Forth SPA (Section 3.1.2.3).

Breeding species that are qualifying interests of the pSPA are considered in the assessment as part of the larger 'parent' population of the Forth Islands SPA. These are therefore considered in the same way as for the Forth Islands SPA - collision risk is examined further by investigating the scale of change in risk to gannet (Section 4), whilst displacement effects are screened out because the Variation location does not form an important foraging area for those species.

Breeding tern species from the pSPA are screened out of the assessment on the same basis as for the Forth Islands SPA – because very low numbers were recorded at potential collision height and the location of the Variation does not form an important foraging area.

Wintering species not recorded during baseline surveys or which occurred in very low numbers were screened out based on the assumption that this part of the pSPA is not important foraging habitat. These included Slavonian grebe, goldeneye, little gull, Manx shearwater and wintering common guillemot.

Species mainly recorded in flight but rarely at collision height were also screened out owing to their low risk of collision from the single turbine Variation. Those species included black-headed gull and common gull.

3.1.2.5 Summary

The SPAs and features taken forward for assessment shown in Table 3.

Table 3: Sites, species and effects for assessment

SPA/Species	Season	SPA Population (individuals)		Effect to be assessed
		Citation	Cycle 2	
Firth of Forth SPA				
Common scoter	Winter	2,880	988	Displacement
Common eider	Winter	9,400	5,184	Displacement
Long-tailed duck	Winter	1,045	205	Displacement
Red-breasted merganser	Winter	670	369	Displacement
Red-throated diver	Winter	90	81	Displacement
Velvet scoter	Winter	635	731	Displacement
Outer Firth of Forth and St Andrews Bay Complex pSPA[4]				
Common scoter	Winter		4,677	Displacement

[4] Breeding species considered as part of parent Forth Islands SPA population.

SPA/Species	Season	SPA Population (individuals)	Effect to be assessed
Common eider	Winter	21,546	Displacement
Long-tailed duck	Winter	1,948	Displacement
Red-breasted merganser	Winter	431	Displacement
Red-throated diver	Winter	851	Displacement
Velvet scoter	Winter	579	Displacement
Forth Islands SPA			
Cormorant	Breeding	400	Collision
Fulmar	Breeding	1,596	Collision
Gannet*	Breeding	110,964	Collision
Herring gull	Breeding	13,200	Collision
Kittiwake	Breeding	7,552	Collision
Lesser black-backed gull	Breeding	4,026	Collision

*Species identified for initial indicative assessment

Data supporting these decisions including lists of all species recorded, numbers of birds seen during sea-use surveys and tables of flight activity providing the number of birds at risk height can be found in the original Forthwind ES Volume 3: Technical Appendices A7.1 *Ornithology*, with further analysis and justification for screening decisions made in the 2016 HRA Addendum and 2016 AA.

4 COLLISION RISK

The 2016 HRA Addendum calculated potential mortality due to collision for birds in flight using the Band onshore collision risk model (Band *et al.*, 2007). This method was considered most suitable because the VP surveys recorded bird flight lines and duration according to onshore protocols rather than the density of birds in flight as required for the Band offshore model (Band, 2012). Most flights recorded were directional and parallel to the shore, therefore the predictable flight movement 'risk-window' version of the model was used. The models used flight height estimates from two sources: (i) flight activity baseline data; and (ii) the Johnson *et al.* (2014) corrigendum and both were presented in the assessment; this was done because the proportion of birds recorded as at 'risk height' during flight activity surveys were those recorded as flying above 40 m above sea level compared to the lowest sweep of the consented Development turbine rotors which was 25 m above Highest Astronomical Tide.

To enable a direct comparison between the collision risk presented by the consented Development turbines and the Variation turbine, the same method was repeated for the revised collision risk estimates for the two Variation options. As described above, the revised collision risk has only been estimated for gannet as that was the species with the highest predicted risk (which was not significant) for the consented Development.

For the Variation turbine, there are a number of parameter changes which affect collision risk modelling. These are:

- the size of the risk window: the risk window will have the same width as in the 2016 assessment, as it is represented by the width of the survey area used during the flight activity surveys, but will have a larger height owing to the increased diameter of the rotors;
- the size of the rotor swept area within the risk window;
- the hub height; and
- the number of rotor blades, turbine rotation speed, maximum chord width and size of the rotor blades.

There are two candidate turbines under consideration for the Variation: one is a 2-bladed model (Variation 1), which has a 2-bladed rotor, 220 m rotor diameter and hub-height of 135 m; the other is an alternative 3-bladed model (Variation 2) which has a 3-bladed rotor, 220 m rotor diameter and hub-height of 135 m. Variation 1 and 2 have lower rotor sweeps of 25 m.

Table 4: Difference in Collision Risk Modelling Parameters between Consented Development and Variation

Parameter	2016 HRA Addendum	Variation 1 (2-bladed turbine)	Variation 2 (3-bladed alternative)
Number of turbines	2	1	1
Risk window width	1,520 m	1,520 m	1,520 m
Risk window height	159 m	220 m	220 m
Risk window area	241,680 m^2	334,400 m^2	334,400 m^2
Hub height	99.5 m	135 m	135 m
Rotor diameter	155 m	220 m	220 m
Rotor swept area	37,738 m^2	38,013 m^2	38,013 m^2
Number of rotor blades	2	2	3
Rotation period*	5.05 seconds	6.60 seconds	6.60 seconds
Maximum chord width**	5.75 m	8.4 m	8.4 m
Pitch**	10°	10°	10°

** rotation period used is at the maximum rotation speed at rated wind speeds for the 2-bladed turbine model*

*** maximum chord (and rotation period) for the 3-bladed model are not known, therefore the same parameter values from the 2-bladed model have been applied*

**** pitch is variable; 10° is a realistic value consistent with other Firth of Forth offshore developments*

Replacing the parameters for the consented Development collision risk models with the parameters for the Variation yields revised collision risk estimates. Results for gannet are shown in Table 5.

Table 5: Collision Risk Modelling Outputs for Gannet for the Consented Development and Variation (both candidate turbine models)

Species	Collision Model	Collision Risk (Collisions/ Year)					
		Consented Development		Variation 1 (2-bladed turbine)		Variation 2 (3-bladed alternative)	
		98%	99%	98%	99%	98%	99%
Gannet (Predictable model – gliding)	1 (Site-based data)	1.833	0.917	1.219	0.610	1.828	0.914
	2 (Johnston *et al.* 2014 flight height data)	0.900	0.450	0.427	0.213	0.640	0.320

When compared using the same methods, the collision estimates for the single Variation turbines, both two-bladed and three-bladed, are lower than for the two consented Development turbines. An avoidance rate of 98.9% for gannet has been specified for use with the Band offshore collision risk model options 1 and 2. Applying a similar rate to this assessment a collision of less than one bird per annum is predicted. This would be indistinguishable from background mortality in the substantial breeding gannet population (current estimate c. 75,000 pairs (Murray *et al.*, 2014)) and not significant.

As gannet was predicted to have the highest collision risk in the 2016 HRA Addendum and revised modelling has shown that effects from the proposed Variation would be less regardless of the turbine used, all other seabird species at Forth Islands SPA are screened out of further assessment at this stage. This is consistent with the fact that collision risk was scoped out as no LSE for any species/SPA in the 2016 AA completed by MS-LOT/MSS. It is concluded that there would be no LSEs on any SPA qualifying species as a result of potential collision risk caused by either of the Variation turbine models. Collision risk is therefore scoped out of further assessment and hence it is concluded that there are no LSEs in relation to the Forth Islands SPA or the seabirds of the Outer Firth of Forth and St Andrews Bay Complex pSPA.

5 DISPLACEMENT

The 2016 HRA Addendum assessed displacement using SNH's recommended matrix method (JNCC, 2015a) and the estimated ZoI population derived from the mean of the monthly peak counts from the baseline surveys. The ZoI was defined as the area within a 1 km buffer of the two consented Development turbines and totalled 5.17 km^2. The buffer was limited to 1 km rather than the 2 km typically applied to large offshore wind farms due to the small scale of the consented Development and the proximity of the shore within 1.5 km in some areas to the west of the site.

The ZoI population was apportioned to the relevant SPA/dSPA according to the SPA population size. For the Firth of Forth SPA numbers were based on Cycle 2 site condition monitoring; for the Outer Firth of Forth and St Andrews Bay Complex, the dSPA population. The assessment assumed 100 % displacement and 100 % mortality.

The apportioning method resulted in the same effect size at the Firth of Forth SPA and the dSPA in terms of percentage of the population affected i.e. any effect on the SPA was an effect of the same magnitude on the d/pSPA. Effects were assessed as not significant in the 2016 HRA Addendum and in the 2016 AA.

The Variation comprises a larger single turbine (tip height of 245 m) compared with the two slightly smaller turbines of the consented Development (maximum tip height of 198.5 m). Using a 1 km buffer would result in a reduced ZoI of 3.14 km^2, a 39% decrease from the 5.17 km^2 assessed in 2016.

However, as discussed with SNH/MS, it is possible that the increase in upper tip height of the turbine could lead to displacement effects over a greater area. To investigate this, the radius of the ZoI has been extended in proportion with the increase in upper rotor tip height for the larger of the two Variation turbines. As this change from 198.5 m to 245 m represents an increase of 23.4 %, the radius of the buffer around the single turbine has been extended to 1.23 km giving a revised ZoI of 4.79 km^2 (Figure 2). This is a decrease of 7.4 % in area compared to the 5.17 km^2 which was assessed in 2016.

These two alternative buffers have been assessed by scaling the numbers of individuals affected by displacement in the original ZoI by the same proportions i.e. a decrease of 39% for the 3.14 km^2 buffer and a decrease of 7.4 % for the 4.79 km^2 buffer. The revised number of birds affected are shown compared to the original in Tables 6 and 7.

The reference populations used to assess potential effects on the Forth of Forth SPA are based on the Cycle 2 Site Condition Monitoring dataset, which was the most recent population dataset available at the time of writing. The reference populations cited in the document "*Outer Firth of Forth and St Andrews Bay Complex Proposed Special Protection Area (pSPA) NO. UK9020316 SPA Site Selection Document: Summary of the scientific case for site selection*" were used to assess the potential effects on the pSPA.

Table 6: Apportioned ZoI Population Sizes and Displacement Magnitude for the Consented Development and Variation in the Context of the Firth of Forth SPA (Cycle 2 SCM) Populations

Species	Reference population(Cycle 2 SCM)	Consented Development: ZoI population apportioned to SPA	Consented Development: % SPA population affected	Variation ZoI 3.14 km^2 population apportioned to SPA	Variation ZoI 3.14 km^2 % SPA population affected	Variation ZoI 4.79 km^2 population apportioned to SPA	Variation ZoI 4.79km^2 % SPA population affected
Common scoter	988	3.8	0.4%	2.31	0.23%	3.52	0.36%
Common eider	5,184	5.6	0.1%	3.40	0.07%	5.19	0.10%
Long-tailed duck	205	1.4	0.7%	0.85	0.41%	1.30	0.63%
Red-breasted merganser	368	0.5	0.2%	0.30	0.08%	0.46	0.13%
Red-throated diver	81	0.3	0.4%	0.18	0.22%	0.27	0.33%
Velvet scoter	731	7.6	1.0%	4.62	0.63%	7.05	0.96%

For the six wintering seaduck/diver species assessed in Tables 6 and 7, the results indicate that changes in potential mortality arising from the proposed Variation would be (in terms of 'whole birds') no greater than or reduced for all species depending on the buffer size applied. Given that this assumption is based on effect levels of 100 % displacement and 100 % mortality and that, in reality, rates are anticipated to be much lower, the assessment is highly precautionary.

It can therefore be concluded that the Variation would not adversely affect the site integrity of the Firth of Forth SPA or the Outer Firth of Forth and St Andrews Bay Complex pSPA with respect to displacement for each of the six qualifying interest species assessed.

In support of this, monitoring of the large single turbine at the near-shore location at Methil operated by ORE Catapult (the Fife Energy Park Offshore Demonstration Wind Turbine (FEPODWT) now renamed the Levenmouth Demonstration Turbine) and approximately 1.5 km from the location of the proposed Variation turbine, has shown that the turbine, with a tip height of approximately 195 m, has had no obvious displacement effect on the majority of waterbird species (including common scoter,

eider, long-tailed duck, red-breasted merganser and velvet scoter) using the marine habitat around the turbine. Only red-throated diver showed a possible, small displacement effect.

As the effects of the proposed Variation are the same as or less than those of the consented Development, there are no changes to the previous in-combination assessment.

Table 7 Apportioned ZoI Population Sizes and Displacement Magnitude for the Consented Development and Variation in the Context of Outer Firth of Forth and St Andrews Bay Complex pSPA Populations

Species	Reference population in dSPA (from 2016 HRA Addendum)	Consented Development: ZoI population apportioned to dSPA	Consented Development: % dSPA population affected	Reference population in pSPA citation	Variation ZoI 3.14 km^2 population apportioned to pSPA	Variation ZoI 3.14 km^2 % pSPA population affected	Variation ZoI 4.79 km^2 population apportioned to pSPA	Variation ZoI 4.79 km^2 % pSPA population affected
Common scoter	4,435	17.3	0.39	4,677	10.51	0.22%	16.03	0.34%
Common eider	21,034	22.6	0.11	21,546	13.73	0.06%	20.95	0.10%
Long-tailed duck	1,881	13.2	0.70	1,948	8.02	0.41%	12.24	0.63%
Red-breasted merganser	369	0.5	0.14	431	0.30	0.07%	0.46	0.11%
Red-throated diver	767	3.2	0.42	851	1.94	0.23%	2.97	0.35%
Velvet scoter	774	8.0	1.03	579	4.86	0.83%	7.41	1.28%

6 CONCLUSION

This HRA has considered the effects of the proposed Variation to the Forthwind Test Site on the qualifying interests of four SPAs:

- Firth of Forth SPA and Ramsar site;
- Forth Islands SPA;
- Loch Leven SPA and Ramsar site; and
- Cameron Reservoir SPA and Ramsar site.

In addition, it has considered the potential effects on features of the Outer Firth of Forth and St Andrews Bay Complex pSPA.

Potential barrier effects and indirect effects were screened out as no LSE was identified.

Similarly, and as concluded in the previous 2016 AA, no LSEs were identified with respect to Loch Leven SPA/Ramsar or Cameron Reservoir SPA/Ramsar and they were also screened out of further assessment.

Reassessment of effects with potential to increase or change as a result of the proposed Variation has been undertaken for collision and displacement. For collision, re-assessment of an indicative species, gannet, showed no material change from the 2016 assessment. As a result, all seabird species at Forth Islands SPA and in the Outer Firth of Forth and St Andrews Bay Complex pSPA were screened out of further assessment on the basis of no LSE.

With respect to the relevant qualifying interest species of the Firth of Forth SPA and Outer Firth of Forth and St Andrews Bay Complex pSPA. The 2016 AA identified LSE in respect of potential displacement acting on six wintering diver/seaduck species.:

- Common scoter;
- Long-tailed duck;
- Red-breasted merganser;
- Red-throated diver;
- Velvet scoter; and
- Common eider.

These were reassessed for displacement based considering the Variation turbine plus 1 km buffer and also with an increased buffer radius of 1.23 km to reflect the maximum potential increase in turbine height. Effects were found to be approximately the same as or less than those of the consented Development.

Based on the above assessment, it is concluded that the effects of the proposed Variation both alone and in-combination with other projects within the region, would not adversely affect the site integrity of the Firth of Forth SPA or the Outer Firth of Forth and St Andrews Bay Complex pSPA with respect to each of the six qualifying interest species assessed.

7 REFERENCES

Band, W., Madders, M. & Whitfield, D.P. (2007) Developing field and analytical methods to assess avian collision risk at wind farms. In de Lucas, M., Janss, G. and Ferrer, M. (eds.) *Birds and Wind Power*. Quercus, Madrid.

Band, B. (2012). *Using a collision risk model to assess bird collision risk for offshore windfarms*. Strategic Ornithological Support Services (SOSS), Project SOSS-02. British Trust for Ornithology, Thetford, UK.

Furness, R.W., Wade, H.M., Masden, E.A. (2013) Assessing vulnerability of marine bird populations to offshore wind farms. *Journal of Environmental Management*, Volume 119: 56-66.

Johnston, A., Cook, A. S.C.P., Wright, J.W., Humphreys, E.M. & Burton, N.H.K. (2014) Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. *Journal of Applied Ecology*. 51 (1): 31-41.

Masden, E.A., Haydon, D.T., Fox, A.D., Furness, R.W., Bullman, R. & Desholm, M. (2009). Barriers to movement: impacts of wind farms on migrating birds. *ICES Journal of Marine Science*, 66: 746-753.

Masden, E.A., Haydon, D.T., Fox, A.D. & Furness, R.W. (2010) Barriers to movement: modelling energetic costs of avoiding marine wind farms amongst breeding seabirds. *Mar Poll Bull* 60. 1085-1091.

Murray, S., Wanles, S. & Harris, M. (2014) The Bass Rock – now the world's largest Northern Gannet colony. *British Birds* 107. 765-769

Natural England (2015) *Pink footed goose anthropogenic mortality review: collision risk modelling*. 94 pp. NECR197.

Plonczkier, P. & Simms I.C. (2012) Radar monitoring of migrating pink-footed geese: behavioural responses to offshore wind farm development. *Journal of Applied Ecology* 49: 1187–1194.

SNH (2013) *Avoidance rates for wintering species of geese in Scotland at onshore wind farms.* SNH, Inverness.

WWT & Macarthur Green (2014) *Strategic Assessment of Collision Risk of Scottish Offshore Wind Farms to Migrating Birds*. Report to Marine Scotland.

Wade, H.M., Wade, H.M., Masden, E.A., Jackson, A.C. & Furness, R.W. (2016) Incorporating data uncertainty when estimating potential vulnerability of Scottish seabirds to marine renewable energy developments. *Marine Policy* 70: 108–113.

APPENDIX 4 – COMMUNICATIONS WITH THE JRC

[redacted]

From: JRC Windfarm Coordinations <windfarms@jrc.co.uk>
Sent: 14 August 2018 16:06
To: Marc Murray
Subject: Forthwind [WF434924]

Dear Forthwind,

A Windfarms Team member has replied to your coordination request, reference **WF434924** with the following response:

Dear Sir/Madam,

***Site Name**: Methil in Fife (offshore)*

***Turbine at NGR**: 337812 697333*

***Hub Height**: 150m **Rotor Radius**: 110m*

*This proposal ***cleared*** with respect to radio link infrastructure operated by:*

Scottish Power and Scotia Gas Networks

JRC analyses proposals for wind farms on behalf of the UK Fuel & Power Industry. This is to assess their potential to interfere with radio systems operated by utility companies in support of their regulatory operational requirements.

In the case of this proposed wind energy development, JRC does not foresee any potential problems based on known interference scenarios and the data you have provided. However, if any details of the wind farm change, particularly the disposition or scale of any turbine(s), it will be necessary to re-evaluate the proposal. Please note that due to the large number of adjacent radio links in this vicinity, which have been taken into account, clearance is given specifically for a location within the declared grid reference (quoted above).

In making this judgement, JRC has used its best endeavours with the available data, although we recognise that there may be effects which are as yet unknown or inadequately predicted. JRC cannot therefore be held liable if subsequently problems arise that we have not predicted.

It should be noted that this clearance pertains only to the date of its issue. As the use of the spectrum is dynamic, the use of the band is changing on an ongoing basis and consequently, you are advised to seek re-coordination prior to submitting a planning application, as this will negate the possibility of an objection being raised at that time as a consequence of any links assigned between your enquiry and the finalisation of your project.

JRC offers a range of radio planning and analysis services. If you require any assistance, please contact us by phone or email.

Regards

Wind Farm Team

The Joint Radio Company Limited
Delta House
175-177 Borough High Street
LONDON
SE1 1HR
United Kingdom

Office: 020 7706 5199

JRC Ltd. is a Joint Venture between the Energy Networks Association (on behalf of the UK Energy Industries) and National Grid.
Registered in England & Wales: 2990041
http://www.jrc.co.uk/about-us

JRC is working towards GDPR compliance. We maintain your personal contact details in accordance with GDPR requirements for the purpose of "Legitimate Interest" for communication with you. However you have the right to be removed from our contact database. If you would like to be removed, please contac [redacted]

We hope this response has sufficiently answered your query.
If not, please **do not send another email** as you will go back to the end of the mail queue, which is not what you or we need. Instead, **reply to this email keeping the subject line intact or login to your account** for access to your coordination requests and responses.

https://breeze.jrc.co.uk/tickets/view.php?auth=o1xmidqaaaxgeaaaAy2rf0bHdmpu%2FQ%3D%3D

APPENDIX 5 – SEASCAPE LANDSCAPE AND VISUAL IMPACT ASSESSMENT UNDERTAKEN BY OPEN

Forthwind Consent Amendment Application

Landscape and Visual Supporting Information

23/08/2018

optimised environments

contents

› figures

Appendix 1: Visual Representations

1. Introduction

1.1 Background

Cierco propose to introduce an option to deploy one larger turbine in Stage 1 of the Forthwind project ('the proposed project changes'). The change in strategy means that Cierco are considering deploying other innovative offshore wind turbine technologies at the Forthwind site, resulting in the need to amend the existing consent for two 198.5m 2 bladed lattice tower turbines to one larger 2 bladed or 3 bladed turbine up to 260 m in height to blade tip.

Initial consultations with MSLOT and SNH have highlighted the need for Cierco to follow the Scottish Government Energy Consents and Deployment Unit guidance on applying for a S36 consent variation and to comply with SSI 304 "The Electricity Generating Stations (applications for Variation of Consent)(Scotland) Regulations 2013". Specifically, Cierco need to submit a formal request to MSLOT to determine whether the proposed project changes are a variation to the existing s36 consent, or whether there is a need to apply for a new consent.

Cierco have commissioned Optimised Environments Ltd (OPEN) to provide supporting landscape and visual information with this formal request to MSLOT, addressing the changes to the landscape and visual impact of the proposed project changes.

This landscape and visual supporting information aims to assist MSLOT with their consideration of whether the change to the consent can be a variation, or if the proposed project changes require a new application. This is dependent on whether the change fundamentally alters (a) the character of the authorised development, (b) the scale of the authorised development and/or (c) the impact from what was previously authorised by the existing consent. If it is determined that the proposed changes are a fundamentally different, then a new application is required.

1.2 Contents of this supporting information

The proposed reduction from two turbines to one turbine is likely to simplify the appearance of the development, however a higher blade tip height (up to 61.5m higher) and larger rotor diameter (up to 48m larger) has the potential to increase both the geographic extent and the scale of effects experienced from the immediate coastline. Although a single larger 2 bladed or 3 bladed turbine should not necessarily result in any additional adverse landscape and visual impact to that consented in original application, the supporting information provided in this document provides further illustration and appraisal of the likely changes in effects.

Section 2 of this report provides a written narrative appraisal of the additional extent of the Zone of Theoretical Visibility (ZTV) of the single larger 2 and 3 bladed turbine options; a visual appraisal from key viewpoints and a summary of the potential changes/additional impacts likely to arise from the increased turbine height and rotor diameter, from what was previously authorised by the existing consent. Conclusions are set out in Section 4 of this report.

A separate figure volume is presented in Appendix 1. Comparative Zone of Theoretical Visibility (ZTV) maps showing the additional geographic extent of visibility of the single larger turbine of up to 260m in height to blade tip are illustrated against the consented ZTV (198.5m blade tip) in Figures 1-4.

Visual representations from 4 key viewpoints (Buckhaven, West Wemyss, Leven and Gullane) are presented in Figures 5-8 showing the existing baseline view, together with wireline visualisations of the consented project and the proposed project changes, with wireline views of both 2 bladed and 3 bladed turbines up to 260 m in height to blade tip.

2. Landscape & Visual Impacts

2.1 Changes in character and scale

A summary of the project changes relevant to landscape and visual impacts is set out in Table 1.

Table 1: Revised project parameters

Design Element	Parameter	Consented Turbines	2 bladed lattice tower turbine	3 bladed tubular tower turbine
Turbine	No of turbines	2	1	1
	No of blades per turbine	2	2	3
	Max blade tip height (m) (LAT)	198.5m	245m	260m
	Max rotor diameter	172m (155m*)	220m	220m
	National Grid reference (NGR)	Turbine FWA1 337812, 697333 Turbine FWB1 336964, 696677	Turbine FWB1 336964, 696677	Turbine FWB1 336964, 696677
Duration	Consent validity from Dec 2016	5 years Dec 2021	Up to 8 years (Dec 2024)	
*155m rotor diameter defined in CRM of Habitats Regulations Appraisal (HRA) Addendum, submitted further to consultation comments regarding ornithology. 172m rotor diameter was shown and assessed in the LVIA of The ForthWind Offshore Wind Demonstration Project ES (July 2015).				

The primary changes in terms of character and scale of the Forthwind project, are therefore:

- Turbine position FWA1 omitted, with turbine position FWB1 retained, as shown in Plate 1.
- The appearance of one larger turbine up to a blade tip height of 260m, instead of two smaller turbines up to a blade tip height of 198.5m.
- Potential change in appearance from 2 bladed lattice tower to a 3 bladed tubular tower (as illustrated in Plate 2).

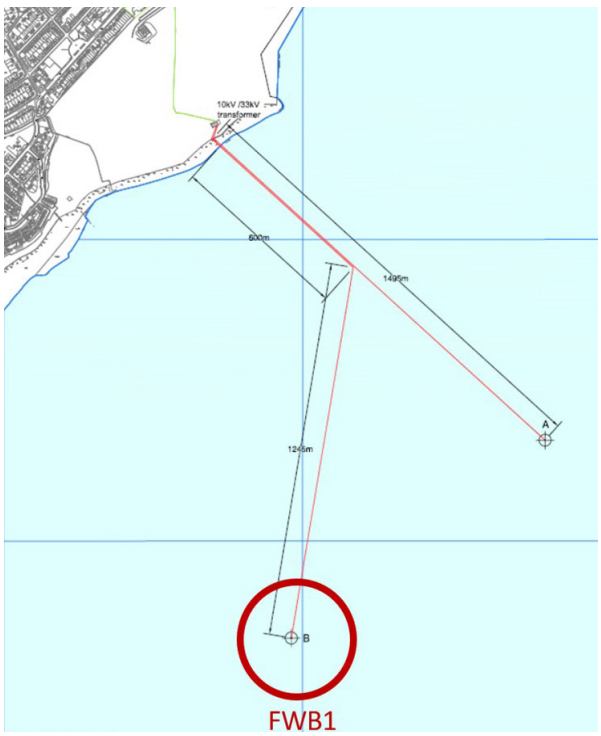

Plate 1: Consented turbine and cable layout

Plate 2: Illustrative 3D model of 2 bladed lattice turbine (left) and 3 bladed tubular tower turbine (right)

2.2 Changes in landscape and visual impact

2.2.1 Potential Changes in Zone of Theoretical Visibility (ZTV)

2.2.1.1 Consented baseline (2 x 198.5m 2 bladed lattice tower turbines) (Figure 1)

Visual effects will occur when the introduction of the consented development changes or influences the visual amenity and views experienced by people in the study area. The consented visual baseline is defined by the Zone of Theoretical Visibility (ZTV) of the consented 2 x 198.5m turbines, which is shown in Figure 1. The ZTV broadly shows that the consented 2 x 198.5m turbines will primarily be visible from the inner Firth of Forth, approximately between Kinghorn, Edinburgh, North Berwick and Fife Ness; the Fife coast between Kinghorn and Anstruther, extending inland to to the coastal hills of Fife and the Lomond Hills; and extending to be visible in views across the Firth of Forth, from Edinburgh and its waterfront; the East Lothian coastline and immediate coastal plain between Musselburgh and North Berwick. Within this area, there are a number of settlements, transport and recreational routes, and visitor facilities which may afford people views of the consented development, thereby affecting visual amenity.

The ZTV in Figure 1 shows the geographical extent of theoretical turbine visibility (in green) that has been consented. In order to consider the changes in landscape and visual impact that may arise from the proposed project changes, comparative ZTVs have been produced to show the additional geographical extent of visibility of single larger turbines at 245m and 260m to blade tip, over and above the consented ZTV. These are shown in Figures 2 and 3 and are considered further as follows.

2.2.1.2 Changes arising from single 2 bladed lattice tower turbine (1 x 245m tip) (Figure 2)

The comparative ZTV for a 245m blade tip height 2 bladed turbine is shown in Figure 2. In this ZTV, areas with visibility of the consented scheme alone are shown in green; areas with visibility of a 245m single turbine alone are shown in yellow; and areas with visibility of both the consented scheme and 245m single turbine are shown in blue. Using the ZTV, it is possible to identify areas where a 245m single turbine extends the geographic extent of visibility to effect views from new areas (shown in yellow), which would not have visibility of the consented scheme. There are very slight increases in the geographic extent of visibility of a 245m single turbine, at the edges of the consented ZTV, as represented by the yellow areas on the ZTV. These include very limited areas to the north-east around the East Neuk of Fife between Earslferry and Crail, however the main locations include areas beyond 10km to the north-west between Falkland and Pitmedden Forest; the edges of the Ochil Hills; the Riccarton Hills in West Lothian and to the far north of the study area on the southern slopes of the Sidlaw Hills (over 40km away). Due to their location at the edges of the ZTV, it is likely that from these areas it would be the rotor/blade tips of the turbine visible, rather than the whole turbine. There are also some small geographic areas where visibility of the consented two turbine scheme is eliminated as a result of retaining just one turbine (as opposed to two).

Overall, the ZTV shows that a 245m single turbine would be visible primarily from those areas whose baseline would already be influenced by views of he consented scheme (areas coloured blue in the ZTV). The introduction of a larger single 245m turbine would result in a negligible to slight increase in the overall extent of visibility (areas shaded yellow in the ZTV). These areas are limited in extent and generally confined to locations at long distance.

In addition, all those areas shaded blue on the ZTV that would have views of two consented turbines

would experience visibility of only one single (taller) turbine, rather than the two smaller (198.5m) turbines, resulting in a reduced lateral spread of development in views and a more concentrated visual focus as a single point feature. The changes in appearance and scale are considered further in Section 2.2.2 using visualisations from representative viewpoints.

2.2.1.3 Changes arising from single three bladed turbine (1 x 260m tip) (Figure 3)

The comparative ZTV for a 260m blade tip height 3 bladed turbine is shown in Figure 3. In this ZTV, areas with visibility of the consented scheme alone are shown in green; areas with visibility of a 260m single turbine alone are shown in yellow; and areas with visibility of both the consented scheme and a 260m single turbine are shown in blue. Using the ZTV, it is possible to identify areas where a 260m single turbine extends the geographic extent of visibility to effect views from new areas (shown in yellow), which would not have visibility of the consented scheme.

Similar to the slight increase identified for a 245m single turbine, there are some slight increases in the geographic extent of visibility of a 260m single turbine, at the edges of the ZTV, as represented by the yellow areas on the ZTV. These include very limited areas to the north-east around the East Neuk of Fife between Earslferry and Crail, however the main locations include areas beyond 10km to the north-west between Falkland and Pitmedden Forest; the edges of the Ochil Hills; the Riccarton Hills in West Lothian and to the far north of the study area on the southern slopes of the Sidlaw Hills (over 40km away). Due to their location at the edges of the ZTV, it is likely that from these areas it would be the rotor/blade tips of the turbine visible, rather than the whole turbine. There are also some small geographic areas where visibility of the consented two turbine scheme is eliminated as a result of retaining just one turbine (as opposed to two).

Overall, the ZTV shows that a 260m single turbine would be visible primarily from those areas whose baseline would already be influenced by views of the consented scheme (areas coloured blue in the ZTV). The introduction of a larger single 260m turbine would result in a slight increase in the overall extent of visibility (areas shaded yellow in the ZTV). These areas are limited in extent and generally confined to locations at long distance.

In addition, all those areas shaded blue on the ZTV that would have views of two consented turbines would experience visibility of only one single (taller) turbine, rather than the two smaller (198.5m) turbines, resulting in a reduced lateral spread of development in views and a more concentrated visual focus as a single point feature. These changes in appearance and scale are considered further in Section 2.2.2 using visualisations from representative viewpoints.

2.2.2 Potential Changes in Visual Effects

Table 2: Viewpoint Appraisal

Viewpoint	Consented 2 x 198.5m Blade Tip	2 bladed lattice tower turbine (245m Blade Tip)	3 bladed tubular tower turbine (260m blade tip)
Viewpoint 1 Buckhaven, Shore Road	The ForthWind Offshore WindDemonstration Project ES (July 2015) (the ES) identified that the 2 x 198.5m lattice tower turbines would be a noticeable new feature in the view and that the 2 turbines would occupy a large proportion of the field of view. The existing industrial influences in the view were also noted.	The appearance of single 2 bladed lattice tower turbine is similar to what has been consented, with the same type of 2 bladed lattice turbine visible as was consented. The visual effect of the single, larger, 2 bladed lattice tower turbine appears to have less visual impact than the two consented 198.5m lattice tower turbines. Although larger in scale, the removal of one turbine and subsequent reduction in the field of view effected, results in a reduced effect despite the increase in height of the retained turbine. The single turbine also creates a simpler visual image, as it forms a single focal point and avoids existing foci in the view, particularly Bass Rock and Berwick Law. The use of a lattice tower in industrial seascape context associates a certain form of turbine with the industrial land use and has visual consistency with lattice structures of existing large scale oil rigs visible in the view.	A 3 bladed tubular tower turbine represents the biggest variation in appearance from the consented project, due to the change in appearance of the 3 bladed turbine and its larger (260m) blade tip height. It does, however, have the most consistent appearance with the design of existing wind turbines in the baseline, notably the Levenmouth wind turbine which is visible in the wider view. The visual effect of the single larger 3 bladed wind turbine appears to have less impact than the two consented 198.5m lattice tower turbines. Although larger in scale, the removal of one turbine and the subsequent reduction in the field of view effected, results in a reduced effect despite the increase in height of the turbine. The single turbine creates a simpler visual image as it forms a single focal point in the view. The single turbine avoids existing foci in the view, particularly Bass Rock and Berwick Law.
Viewpoint 2 West Wemyss, Fife Coastal Path	The ES identified that the 2 x 198.5m lattice tower turbines would be a noticeable new feature in the view, while occupying a relatively small portion of the field of view at this viewing angle, it was noted as altering the composition of the view by extending the influence of wind energy development into the Firth of Forth and intensifying the influence of wind energy development in the view.	The appearance of single 2 bladed lattice tower turbine is similar to what has been consented, with the same type of 2 bladed lattice turbine visible as was consented. The scale difference of the larger 2 bladed turbine is notable against the existing Levenmouth turbine, but due to its position offshore its large scale is legible/ understandable as a single larger 'offshore' element. Although larger in scale, the removal of one turbine results in a slight reduction in the field of view effected by development. The single turbine also creates a simpler visual image, as it forms a single focal point between the East Neuk and Inchcolm Island. Use of proposed lattice tower in industrial seascape context, associates a certain form of turbine with the industrial land use and has visual consistency with lattice structures of existing large scale oil rigs visible in the view.	A 3 bladed tubular tower turbine represents the biggest variation in appearance from the consented project, due to the change in appearance of the turbine (3 bladed) and its larger (260m) blade tip height. The scale difference of the larger 3 bladed turbine is notable against the existing Levenmouth turbine, but due to its position offshore its large scale is legible/understandable as a single larger 'offshore' element. Although larger in scale, the removal of one turbine results in a slight reduction in the field of view effected by development. The single turbine also creates a simpler visual image, as it forms a single focal point between the East Neuk and Inchcolm Island. The 3 bladed turbine has the most consistent appearance with the design of existing wind turbines in the baseline, notably the Levenmouth wind turbine which is visible in the same view direction along the coast.

Viewpoint	Consented 2 x 198.5m Blade Tip	2 bladed lattice tower turbine (245m Blade Tip)	3 bladed tubular tower turbine (260m blade tip)
Viewpoint 3 Leven, Fife Coastal Path	The ES identified that the 2 x 198.5m lattice tower turbines would be visible in the context of a heavily modified landscape including Methil Docks and Levenmouth Wind Turbine and would occupying a relatively small portion of thefield of view. The extension of influence of wind energy development into the Firth of Forth was identified as well as the different design of the towers and rotors compared to existing turbines.	The appearance of a single 2 bladed lattice tower turbine is similar to what has been consented, with the same type of 2 bladed lattice tower turbine visible as was consented. The scale difference of the larger 2 bladed lattice tower turbine is not really notable against the existing Levenmouth turbine, due to the perspective effect of it being located further from the viewpoint it appears smaller than the two closer onshore turbines at Methil docks. The visual effect of the single larger 2 bladed lattice tower turbine appears to have less visual impact than the two 198.5m 2 bladed lattice tower turbines. Although larger in scale, the removal of one turbine represents only a small lateral extension into the Firth of Forth and results in a reduced effect, despite the increase in height of the retained turbine.	A 3 bladed tubular tower turbine represents the biggest variation in appearance from the consented project, due to the change in appearance of the turbine (3 bladed) and its larger (260m) blade tip height. It does, however, have the most consistent appearance with the design of existing onshore wind turbines and forms a defined cluster of three x 3 bladed turbines at Methil docks. The scale difference of the larger 3 bladed turbine is not really notable against the existing onshore turbines due to the perspective effect of it being located further from the viewpoint it appears smaller than the two closer onshore turbines at Methil docks. The visual effect of the single larger 3 bladed wind turbine appears to have less visual impact than the two 198.5m 2 bladed lattice tower turbines. Although larger in scale, the removal of one turbine represents only a small lateral extension into the Firth of Forth and results in a reduced effect, despite the increase in height of the turbine.
Viewpoint 4 Gullane, Marine Terrace	The ES identified that the 2 x 198.5m lattice tower turbines would be visible as very minor elements in the view, occupying a small portion of the field of view and seen against a backdrop of the developed coast. It was also noted, however, that the wind turbines would be visible as quite separate elements, spaced widely apart.	The appearance of single 2 bladed lattice tower turbine is similar to what has been consented, with the same type of 2 bladed lattice turbine visible as was consented. The scale difference is notable as an increase in rotor size/blade tip height relative to the skyline backdrop of the landform behind the turbine. Although larger in scale, the removal of one turbine and the subsequent reduction in the field of view effected, results in a reduced effect despite the increase in height of the retained turbine. The single turbine also creates a simpler visual image, as it forms a single focal point and avoids existing foci in the view, particularly the Lomond Hills and Largo Law.	A 3 bladed tubular tower turbine represents the biggest variation in appearance from the consented project, due to the change in appearance of the turbine (3 bladed) and its larger (260m) blade tip height. It does, however, have the most consistent appearance with the design of existing onshore wind turbines in the view, forming a slightly closer and larger turbine that extends the existing characteristic influence of scattered 3 blade wind turbines around the developed Fife coast. The scale difference is notable as an increase in rotor size/blade tip height relative to the skyline backdrop of the landform behind the turbine. Although larger in scale, the removal of one turbine and the subsequent reduction in the field of view effected, results in a reduced effect despite the increase in height of the retained turbine. The single turbine also creates a simpler visual image, as it forms a single focal point.

3. Conclusions

3.1 Landcape and Visual

This report provides information in support of Cierco's formal request to MSLOT to determine whether the proposed project changes are a variation to the existing s36 consent. The visual representations in Appendix 1 illustrate some of the likely changes in landscape and visual effects resulting from the proposed project changes and these are described in the appraisal in Section 2 of this report.

The single 2 bladed lattice tower turbine (245m) and single 3 bladed tubular tower turbine (260m) would be visible primarily from the same areas that would be influenced by views of the consented scheme. The introduction of the larger single turbine up to 260m in blade tip height, would result in only a very slight increase in the overall geographic extent of visibility. These areas are limited in extent and generally confined to locations at long distance. There are also some small geographic areas where visibility of the consented two turbine scheme is eliminated as a result of retaining just one turbine (as opposed to two).

Some alterations in the character and scale of the consented Forthwind project will occur due to the deployment of one larger turbine up to a blade tip height of 260m, instead of two smaller turbines up to a blade tip height of 198.5m; and the potential change from a 2 bladed lattice tower turbine to a 3 bladed tubular tower turbine.

The potential changes in visual impact from what was previously authorised by the s36 consent have been considered, for both a single 2 bladed lattice tower turbine (245m blade tip) and a 3 bladed tubular tower turbine (260m blade tip). Some of these potental changes in effect are common to both single larger turbines (up to 260m blade tip).

3.1.1 Single 2 bladed lattice tower turbine (245m Blade Tip)

The appearance of a single 2 bladed lattice tower turbine, with a blade tip height of up to 245m (and rotor diameter of 220m) is the scenario which is most similar to what has been consented, with the same type of 2 bladed lattice tower turbine visible as was consented. The blade tip height of the single retained turbine has been increased by 46.5m, largely as a result of the increased rotor diameter.

In the closest views from the immediate Fife coastline, such as from Buckhaven and West Weymss, the scale difference of the larger turbine is notable in comparison, however the turbine will be located in large scale seascape context, where the use of a 2 bladed lattice tower turbine in industrial seascape context associates a certain form of turbine with the industrial land use and has visual consistency with lattice structures of existing large scale oil rigs visible in the view. In views from the north-east around Leven, the scale difference of the larger 2 bladed lattice tower turbine is not really notable against the existing Levenmouth turbine. Due to the perspective effect of it being located further from the viewpoint, it appears of similar scale to the two closer onshore turbines at Methil docks. In long distance views across the Firth of Forth, the scale difference is only slightly apparent as an increase in blade tip height relative to the skyline backdrop of the landform behind the turbine.

3.1.2 Single 3 bladed tubular tower turbine (260m blade tip)

Based on the appraisal and visual representations provided in this report, it is considered that the option of deploying a 3 bladed tubular tower turbine, rather than a 2 bladed lattice tower

turbine, represents the biggest variation in appearance from the consented project. This is due to the change in appearance of the 3 bladed tubular tower turbine, compared to the consented 2 bladed lattice tower turbines, together with its larger 260m blade tip height (an increase of 61.5m). increased rotor diameter (220m) and tower height.

The 3 bladed turbines on a tubular tower will however, have the most consistent appearance with the design of existing wind turbines in the baseline, notably the Levenmouth wind turbine which is visible nearby in existing views, avoiding the potentially complex visual mix of turbine types in the same locality and in some views, such as that from Leven, forms part of a defined cluster of 3 bladed turbines at Methil docks.

The use of a 3 bladed turbine with a tubular tower would be of similar form, design and colour as those already associated with the coastal landscape at Methil. Although of larger scale (approximately 64m higher than Levenmouth turbine), the large scale of both turbines is evident and as the largest onshore turbine operating in Scotland, siting the proposal near this turbine represents the least difference in scale possible.

3.1.3 Effects common to both single larger turbines (up to 260m blade tip)

There are some common changes in visual effect that result from one larger turbine (up to a blade tip height of 260m) instead of two smaller turbines up to a blade tip height of 198.5m. The visual effect of the single larger 2 bladed lattice tower turbine appears to have less visual impact than the two consented 198.5m lattice tower turbines. Although larger in scale, the removal of one turbine and subsequent reduction in the field of view effected and/or reduced lateral extension into the Firth of Forth, results in a reduced effect despite the increase in height of the turbine. A single wind turbine creates a simpler visual image in the landscape, which is viewed consistently from different viewing locations, as it forms a single focal point in views and does not have a visual relationship with other wind turbines in an array (so there is no visual complexity created by rows, stacking etc within an array).

A single turbine tends to forms a single focal point within the landscape, forming a simple visual image, and although it will form a focal point in views, tends to avoid disruption of the heirarchy of existing focal features in views across the Firth of Forth, minimising potential visual conflicts and avoiding compromising the value of existing foci such as Bass Rock, Berwick Law and the Forth Bridges.

3.1.4 Summary

While the proposed project changes represent an alteration to the consented development, these changes are not considered to be fundamental in character and scale. Although the appearance of a larger single 2 or 3 bladed turbine represents a change from the two consented 2 bladed lattice tower turbines, the impacts are not considered to be fundamentally different from what was previously authorised by the existing consent. In views experienced by the many of the main receptors, it is evident that the scale of effect is likely to decrease from that consented, as a result of the removal of one turbine and subsequent reduction in the field of view effected by development, which is likely to result in a reduced effect despite the increase in height of the retained turbine.

› Appendix 1: Visual Representations

optimised environments ltd.

Edinburgh
Quartermile Two | Level 2 | 2 Lister Square
Edinburgh | EH3 9GL
t 0131 221 5920
w optimisedenvironments.com

London
Warnford Court | 29 Throgmorton Street
London | EC2N 2AT
t 020 79474062

Manchester
13 Swan Street
Manchester | M4 5JJ
t 0161 696 7550

Optimised Environments Ltd. Registered in Scotland SC359690.
Registered address: Quartermile Two | Level 2 | 2 Lister Square | EH3 9GL