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Pigeon Top Wind Farm

Cornavarrow Road, Dooish, Drumquin, Co. Tyrone

Supplementary Information

September 2011

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IntelligentSolutions

Table of Contents

Figures

Tables

1.0 Supplementary Information on the Proposed Development

1.1 Introduction

This supplementary information has been prepared to accompany a request for minor amendments to the previously consented wind farm (Planning Ref: K/2009/0081/F) for a 9 turbine wind farm at land approximately 1800m north east of 26 Cornavarrow Road, Dooish, Drumquin, Co. Tyrone, BT78 4RN.

This amendment application seeks permission for the following changes to the approved plans:

1. Increase in overall turbine height from 99.5m to up to 126m, rotor diameter from 71m up to 90m and turbine tower height from 64m to up to 85m.
2. Removal of access track spur and optimised reconfiguration of hardstand for consented Turbine 5 (WTG 5).
3. Provision for potential increase in foundation dimensions, from 18.2m diameter to up to 21m x 21m.

This document contains supplementary noise, shadow flicker and landscape and visual information which assess the potential impact of these requested amendments.

This supplementary information should be read in conjunction with the original EIA Submission for K/2009/0081/F and with issued Planning Appeal Decision 2009/A0265.

1.2 Planning History

On February 3rd 2009, Pigeon Top Wind Ltd c/o TCI Renewables submitted a full planning application and supporting Environmental Statement to Planning Service Headquarters Strategic Planning Department. The application consisted of the following:

> A wind farm comprising nine (9) wind turbines up to a maximum 99.5m tip height (comprising a configuration of up to 64m towers and up to 35.5m for blades). The development will also comprise associated transformers, site access tracks, gates, two (2) control room substation buildings, electrical cabling, two (2) temporary site compounds, site entrance, two (2) 80m permanent meteorological masts, road improvement works at the site entrance off Cornavarrow Road, improvement and upgrade works on Rolsons Lane, and other minor ancillary works.

Planning Service informed TCI Renewables that the proposed development would be refused planning permission. Planning refusal for the application was formally issued on 3rd December 2009.

An application for an appeal was lodged by Carson McDowell on behalf of Pigeon Top Wind Ltd with the Planning Appeals Commission on 16th December 2009. An informal hearing was set for 15th September 2010 at the Strule Arts Centre in Omagh where the appeal was heard in tandem with the appeal against the refusal of the adjacent 12 turbine Pollnalaght Wind Farm proposal (Planning Ref: K/2006/1368/F) by Commissioner George Scott.

The Planning Appeal Commission decision was issued on 13th December 2010 granting planning permission to both the Pigeon Top Wind Farm (Planning Ref: K/2009/0081/F) and Pollnalaght Wind Farm (Planning Ref: K/2006/1368/F) respectively.

TCI Renewables wrote to the planning service on 4th May 2011 seeking a determination Under Part II Regulation 6-(1) of The Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 1999 (Amended 2008) for an amendment to the existing Planning Permission and to request if the proposal would be an Environmental Impact Assessment Development as defined by the same Regulations. A copy of the letter is found in Appendix 1 in this document.

Planning Service responded formally by letter on 10th August 2011 where they determined that the proposed Photomontages, noise studies and shadow flicker assessment will be sufficient to allow assessment of an application to amend the approved turbine height and that an Environmental Statement was not required. A copy of this letter is found in Appendix 2 in this document.

1.3 Turbine Dimension Minor Amendment

The application seeks an increase in the overall height of the turbines from 99.5m up to a maximum of 126m overall turbine base to blade tip height. Thus the rotor diameter will increase from 71m to up to 90m and the tower heights will increase from 64m to up to 85m.

This requested amendment is necessary to bring the development in line with the recent planning approval for wind turbines of this height in the immediate locality (e.g. Pollnalaght Wind Farm Ref/K2006/1368, where wind turbines of 125m height have already been consented and so established as a visual feature in this locality and Landscape Character Area). The increase in overall height and rotor diameter will integrate the turbines of Pigeon Top and Pollnalaght at a uniform 125/126m overall height within their shared landscape.

In addition, this requested increase in maximum turbine height will allow consideration of a greater range of turbine models for the proposal.

Wind turbines of up to 125m base to blade tip height are routinely proposed and consented in Northern Ireland by DOE Planning and the Planning Appeals Commission, with turbines of 125m height approved for installation at the following wind farms: Crockagarron (Ref K/2005/0537), Gortfinbar (K/2006/1089), Pollnalaght (K/2006/1368/F), Dunbeg (B2007/0560), Castlecraig (K/2006/1934/F), Slieve Rushen (L/2004/2058/F), Garves (D/2003/0329), Crockdun (K/2006/0074), and Dunmore Wind Farm (B/2007/0563). The proposed turbine height of 126m will bring the Pigeon Top development in line with the current industry standard for commercial height wind turbines throughout Northern Ireland.

1.4 Project Layout Minor Amendments

Following a detailed analysis of each turbine location to determine the project's suitability for build, TCI Renewables request one minor adjustment to the proposed access spur and hardstand serving WTG 5. It is proposed to remove the access track spur and optimise reconfiguration of the approved hardstand, these aspects of the development will be located on marshy grassland habitat. This habitat type is identical to that of the adjacent field where these access provisions have already been approved. It is not proposed to alter the location of WTG5, which will remain at its approved location.

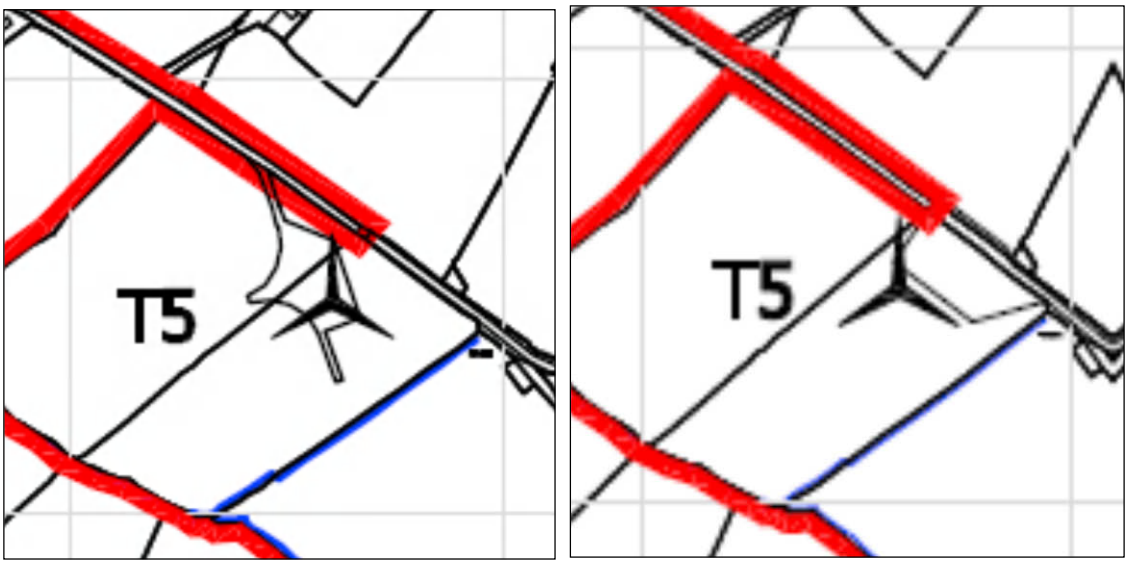


Figure 1.3 Approved Turbine T5 and Associated Access & Hardstand Location & Proposed amended T5 Access & Associated Hardstand Location
(Extracts from PAC Approved DWG No NI010-P002 Site Development Area Rev A & Amended DWG No NI010-P002 Site Development Area - Rev B)

The previously approved wind farm proposed using an Enercon E70 turbine which had a foundation of 18.2m diameter (Approved drawing No NI010-P015 - Rev A), in order to accommodate the larger alternative turbine models proposed in the amendment to planning, TCI Renewables would seek provision for a potential increase in foundation dimensions, from 18.2m diameter to up to 21m x 21m, as illustrated on drawing NI010-P015-Rev B.

1.5 Assessment and Illustration of Proposed Minor Amendments

These minor layout changes have been incorporated and accounted for in all independent consultants' reports, assessments and associated sections within this document:

- Noise Impact Assessment Report (contained here as Section 2 and Supplementary Information Booklet).
- Shadow Flicker Impact Assessment (contained here as Section 3).
- Landscape and Visual Impact Assessment (contained here as Section 4 and Supplementary Information Booklet).

The following planning proposal drawings have been amended to reflect the minor revisions:

- NI010-P002 Site Development Area - Rev B.
- NI010-P003 Site Layout Plan - Rev B.
- NI010-P023 Site Layout Plan-A0 - Rev B.
- NI010-P024 Orthophotographic Site Layout Plan-A0 – Rev B
- NI010-P012 Craneage Hardstand Detail 1 – Passing Bay – Rev B
- NI010-P013 Craneage Hardstand Detail 2 – Turning – Rev B
- NI010-P014 Turbine Elevations – Rev D.
- NI010-P015 Turbine Foundation Detail – Rev B.

No other amendments to the development are proposed at this time.

2.0 Re-assessment of Noise for Alternative Wind Turbine Models

2.1 Introduction

As requested in the recent determination letter to Planning Service, TCI Renewables are seeking to increase the overall height and rotor diameter as the existing consented turbines are sub-optimal. As such, TCI Renewables propose a turbine envelope similar to that of the adjacent and recently consented twelve turbine wind farm at Pollnalaght (Planning Ref: K/2006/1368/F). Thereby integrating all turbines at a uniform 125/126m overall height within their shared landscape.

The turbine models under consideration at the Pigeon Top wind farm are as follows:

- Nordex N90LS 2.5MW turbines on an 80m tower, 45m blade and overall height of 125m.
- Enercon E82 2.3MW turbines on an 85m tower, 41m blade and overall height of 126m.
- Enercon E70 2.3MW on an 85m tower, 35.5m blade and overall height of 120.5m.
- Vestas V80 2MW on an 80m tower, 40m blade and overall height of 120m.

The Pigeon Top project was consented at Planning Appeal (ref 2009/A0265) on the same day as the adjacent Pollnalaght Wind Farm (ref 2009/A0268). The Planning Appeals Commission applied the following noise conditions to both wind farm projects:

(9) The development shall be constructed and operated in such a manner that noise from installed wind turbines does not exceed the ESTU-R-97 standard of 40 dB(A) during day-time and 43 dB(A) during night-time.

WYG Environmental & Planning (Ireland) Ltd (WYG) was commissioned in August 2011 by TCI Renewables to carry out a noise impact re-assessment for the range of alternative wind turbine types identified above. WYG has previously prepared an initial Noise Impact Assessment in October 2009, followed by additional assessments of the Pigeon Top Wind Farm, in response to various planning process queries raised by Omagh District Council during the wind farm planning determination process.

2.2 Statement of Authority

The noise impact re-assessment for the proposed alternative wind turbine models was carried out by Mervyn Keegan of WYG Environmental & Planning (Ireland) Ltd who is an Associate Environmental Consultant for Company. Mervyn specialises in Acoustic & Noise Control and Air Quality & Odour consultancy and has over twelve years of consultancy experience. Mervyn presently manages the Air & Noise team in WYG Ireland. Mervyn obtained a Diploma in Pollution Assessment & Control (Sligo IT, 1995), a B.Sc. in Applied Biology (Coventry University, 1996), a M.Sc. in Environmental Science (Queens University Belfast, 1998) and a Diploma in Acoustics & Noise Control (Institute of Acoustics, University of Ulster, 2002). Mervyn is also a Member of the Institute of Acoustics and an Associate Member of the Institute of Environmental Management & Assessment.

Mervyn has extensive experience in the areas of Noise Monitoring, Prediction Modelling, Impact Assessment and Mitigation Design for a range of project types, including infrastructure, industry, energy projects, residential, commercial developments, etc. Mervyn has also provided consultancy advice in relation to building acoustics and has extensive experience in Wind Farm Noise Impact

Assessments having completed and reviewed in excess of 10 wind farm noise impact assessments through Northern Ireland and the Republic of Ireland.

2.3 Alternative Turbine Models

WYG were requested to investigate the potential noise impact of a number of different wind turbines at for the Pigeon Top Wind Farm site. This assessment was conducted in conjunction with the cumulative noise impact of the adjacent Pollnalaght Wind Farm development.

WYG has assessed the impact of the following four wind turbine types:

- Nordex N90LS 2.5MW turbines.
- Enercon E82 2.3MW turbines.
- Enercon E70 2.3MW turbines.
- Vestas V80 2MW turbines.

A turbine's sound power represents the sound energy at the centre of the blades, which propagates outward at the height of the hub. The Sound Power Levels (SWL) for wind turbines differs depending on the wind speed and the hub height of the turbine. The sound power levels were obtained for the Nordex N90LS 2.5MW turbines, Enercon E82 2.3MW turbines, Enercon E70 2.3MW and Vestas V80 2MW turbines from the manufactures data, and are summarised in Tables 2.3.1 to 2.3.4 below.

Wind Speed (m/s)	Sound Power Levels for Nordex N90LS 2.5MW (dB(A))
6	103
8	104.5
10	105

Table 2.3.1 Sound Power Levels for Nordex N90LS 2.5MW Turbines Rated Power Hub Height 80 m

Wind Speed (m/s)	Sound Power Levels for Enercon E82 2.3 MW (dB(A))
5	96.6
6	101.0
7	103.5
8	104.0
9	104.0
10	104.0
95% Rated Power	104.0

Table 2.3.2 Sound Power Levels for Enercon E82 2.3 MW Rated Power Hub Height 85 m

Wind Speed (m/s)	Sound Power Levels for Enercon E70 2.3 MW (dB(A))
4	91.1
5	94.1
6	99.7
7	101.6
8	103.5
95% PRated	104.5
10	104.5

Table 2.3.3 Sound Power Levels for Enercon E70 2.3 MW Rated Power Hub Height 85 m

Note: In order to account for the uncertainties of measurement and sound prediction calculations, to increase the acceptance at the authorities and to avoid eventual verification measurements ENERCON recommends a safety factor of 1 dB(A) on the guaranteed values when carrying out sound propagation calculations. In countries where safety factors are already mandatory due to local regulations the ENERCON recommendation is not applicable.

Wind Speed (m/s)	Sound Power Levels for Vestas V80 2.0 MW (dB(A))
3 m/s	91.9
4 m/s	94.1
5 m/s	99.6
6 m/s	102.9
7 m/s	104.2
8 m/s	105
9 m/s	104.8
10 m/s	103.8
11 m/s	104.2
12 m/s	104.5
13 m/s	104.5
14 m/s	104.5

Table 2.3.4 Sound Power Levels for Vestas V80 2.0 MW Rated Power Hub Height 80 m (V80/2000; Mode 0)

2.4 Methodology and Criteria for Rating Impacts

This noise impact re-assessment was completed using Cadna_A (Computer Aided Noise Abatement) Noise Modelling Software to predict the noise impact due to the operation of the alternative turbine types. A cumulative noise impact assessment of existing turbines at Pollnalaght and proposed alternative turbine types was completed. Reference was made in particular to The Planning Appeals Commission decision notice and conditions for Pigeon Top Wind Farm (reference 2009/A0265) which states the following in relation to noise requirements:

(9) The development shall be constructed and operated in such a manner that noise from installed wind turbines does not exceed the ESTU-R-97 standard of 40 dB(A) during day-time and 43 dB(A) during night-time.

2.4.1 Noise Modelling Methodology (Cadna_A Noise Modelling Software)

Potential noise impacts in-relation to the specific operation of the proposed alternative turbine types have been assessed using this noise modelling software and the results compared to the previously measured background noise levels. The Sound Power Levels provided by the manufacturer of the various wind turbines have been incorporated into the model to show the noise generated from the cumulative operation of the wind turbines at increasing wind speeds at the nearest residential properties.

Cadna_A has been developed to allow detailed noise predictions to be undertaken in accordance with:

- ISO 9613 Acoustics. Attenuation of sound during propagation outdoors, 1996.
- CRTN. Calculation of Road Traffic Noise, Department of Transport/Welsh Office, 1988.
- CRN Department of Transport, 1985.

- BS 5228 Noise Control on Construction and Open Sites, 1992.

The model is integrated, allowing noise from all sources, with prediction methodologies to be undertaken simultaneously. The noise model also takes into consideration detailed effects:

- Topographical effects.
- Atmospheric absorption.
- Ground absorption.
- Screening effects.
- Reflections.
- Focussing effects.
- Metrological conditions.

The model propagates the sound level values for each octave band and source-receiver pair and produces a noise level contour map. Users are provided with 3-D graphics of noise at a site or facility. The noise level contours are colour coded, purple and red depict high noise levels while green, grey and black show low noise levels.

The key modelling applications include industrial noise assessment and mitigation design and Environmental Impact Assessment and planning assessments including constraints identification, impact assessment and mitigation design.

2.4.2 Cadna_A Noise Model Inputs

Digital Terrain Data was obtained for the area in the vicinity of the approved Pigeon Top Wind Farm development. This incorporated the X, Y & Z co-ordinates for the area of the site and extending beyond the nearest residential properties. This information allows the modelling to take account of the effect of the topographical / terrain on the noise level predictions. A ground absorption rate of 0.5m has been used in the noise model. TCI Renewables provided WYG with information in relation to the proposed wind turbine types, their locations, height, sound power level, etc. Tables 2.3.1 – 2.3.4 show the Sound Power Levels at varying wind speeds of the proposed alternative wind turbine types which were used in the model. This information was used to predict the Sound Pressure Levels at the nearest residential properties. Table 2.4.2 below outlines the co-ordinates of the wind turbines which were input into the Cadna_A model.

Turbine Number	Turbine Coordinates	
	X	Y
Pigeon Top 1	235463	369461
Pigeon Top 2	235708	369668
Pigeon Top 3	235907	369874
Pigeon Top 4	236149	370026
Pigeon Top 5	234401	371620
Pigeon Top 6	234682	371543
Pigeon Top 7	234983	371549
Pigeon Top 8	235270	371482
Pigeon Top 9	235545	371396
Pollnalaght 3	236354	369346
Pollnalaght 4	236274	369688
Pollnalaght 5	236508	369864
Pollnalaght 6	236437	370680

Pollnalaght 7	236041	370600
Pollnalaght 8	234695	370330
Pollnalaght 9	234292	370345
Pollnalaght 10	234741	370741
Pollnalaght 11	234487	371104
Pollnalaght 12	236061	371139
Pollnalaght 13	236012	371720
Pollnalaght 14	236594	371341

Table 2.4.2 Grid Coordinates of the Approved Pigeon Top and Pollnalaght Wind Turbines

Receiver	X	Y	Z
1 - NML 1 – 95 Omagh Road	234637	372327	141.02
2 - NML 2 – 71 Cornavarrow Road	235039	368892	179
3	233692	372301	94.32
4	235676	372254	179.64
5	233480	371456	117.5
6	233656	372012	111.37
7	233538	370759	136.86
8	234690	369489	152.13

Table 2.4.2.1 Receiver Location Coordinates

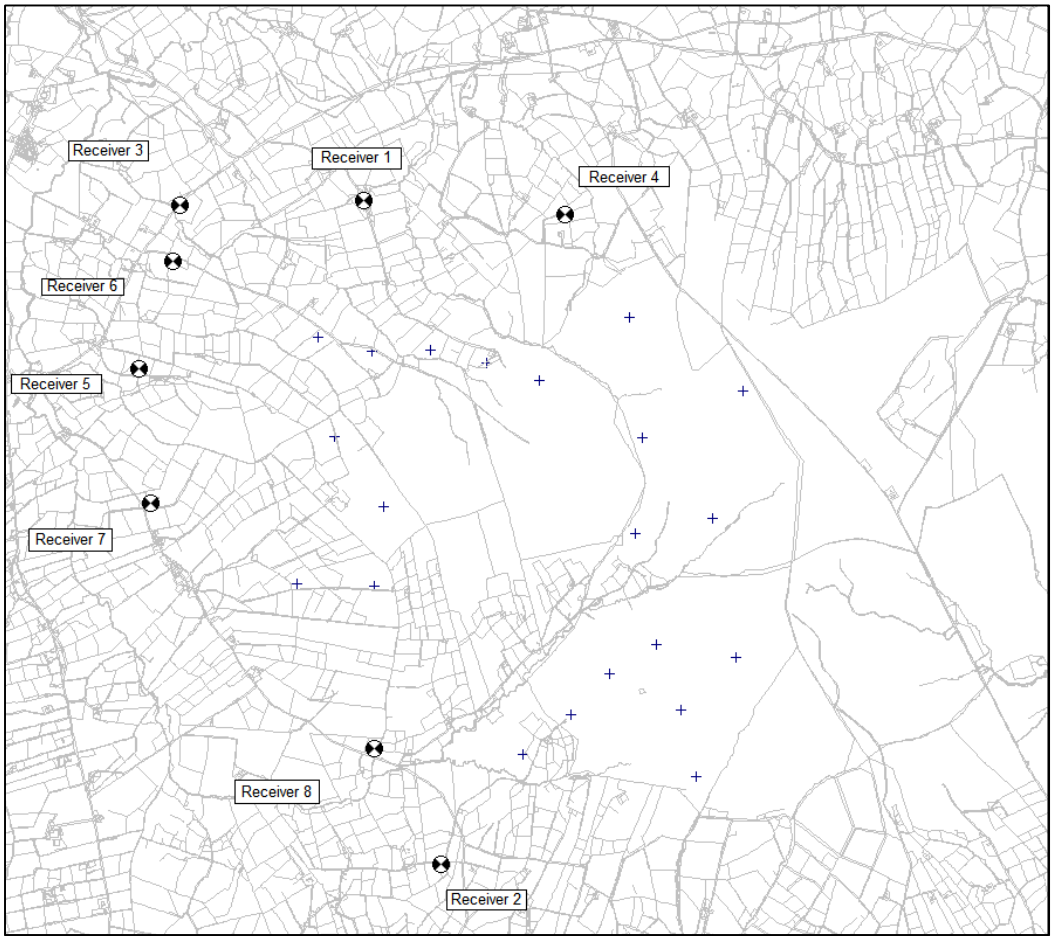


Figure 2.4.2 Map of Receiver Locations 1-8

The residential properties (Receiver 1 – 8 on Figure 2.4.2 above) were all assigned a receiver height of 4m. This approach allows for a prediction of noise levels at the bedroom level of properties reflecting night-time noise levels and therefore also a worst case outdoor daytime noise prediction scenario.

2.5 Impact Assessment

2.5.1 Operational Noise

As stated, the noise levels at each of the nearest residential properties receptors to the proposed wind turbine locations was predicted using Cadna_A modelling software. Using Cadna_A noise modelling, a comparison of the predicted turbine noise level to the consented planning permission condition on noise limits has allowed for the impact due to noise from the alternative turbine types to be assessed and quantified. The predicted noise level due to the proposed alternative wind turbine types together with the cumulative impact of the Pollnalaght Wind Farm at each residential receiver location is detailed below.

2.5.2 Predicted Noise Levels at Receiver Locations

The following noise levels are predicted to occur at the nearest residential properties, Receivers NML 1 - NML 8 at the various wind speeds, 6, 8 and 10 m/s due to the four alternative wind turbine types. The noise levels due to the operations of the proposed turbines will be lower at all other noise sensitive receiver locations in the area.

The Cadna_A Model predicts results as LAeq dB values. The ETSU-R-97 guidance advises that the LAeq values are likely to be in the region of 1.5 - 2.5 dB above the LA 90 values. Therefore, as outlined in ETSU-R-97, 2 dB has been subtracted from all predicted LAeq noise levels to indicate the predicted noise level at each receiver location.

2.5.2.1 Nordex N90LS 2.5MW Turbine on 80m Tower

Table 2.5.2.1 and Figure 2.5.2.1 below compares the predicted LA90 noise level, using the Nordex N90LS turbine, with the relevant planning conditions - daytime noise limit of 40 dB(A) and night-time noise limit of 43 dB - at the nearest noise sensitive receiver properties, at wind speeds of 6 m/s, 8 m/s and 10 m/s.

As outlined in Table 2.5.2.1, the predicted LA90 noise levels are well below the fixed night-time limit of 43 dB(A) and in accordance with the daytime limit of 40 dB(A). The maximum predicted LA90 noise level found at NML 1, 4 and 8 at a wind speed of 10 m/s is 40 dB(A).

The values indicated in Table 2.5.2.1 and Figure 2.5.2.1 indicate that the proposed Nordex N90 wind turbines comply and can operate within the relevant planning condition for noise.

Receiver No.	Predicted LA90 noise level at increasing sound power levels and varying wind speeds (dB)		
	103 dB(A) @ 6 m/s	104.5 dB(A) @ 8 m/s	105 dB(A) @ 10 m/s
1	38.6	39.8	40.3
2	37.3	38.5	39
3	33.2	34.4	34.9
4	38.4	39.6	40.1
5	35.9	37.1	37.6
6	35.2	36.5	37
7	36.6	37.8	38.3
8	38.5	39.7	40.2

Table 2.5.2.1 Predicted Sound Pressure Level (Predicted LA90 noise levels) at Nearby Receivers from the Operation of Nordex N90 Turbines

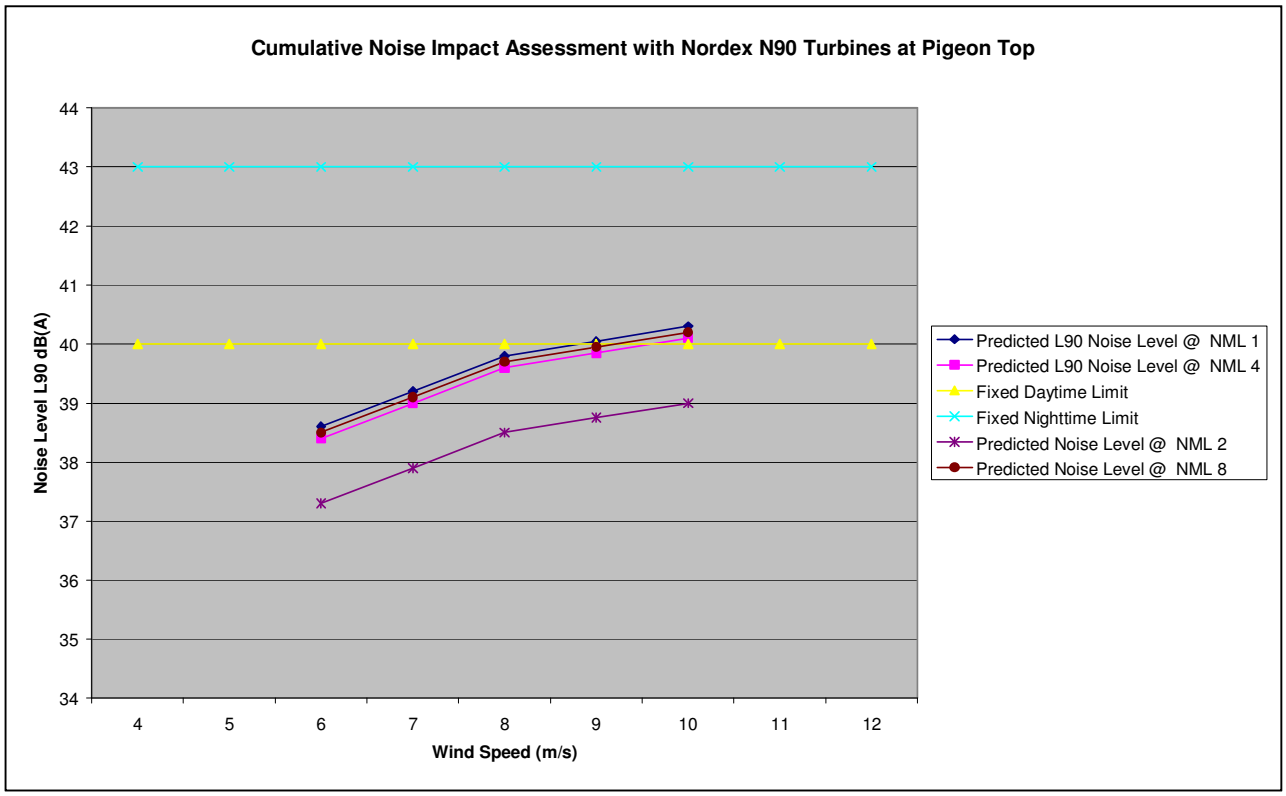


Figure 2.5.2.1 Predicted Noise Levels Using the Nordex N90 Wind Turbines

On the following pages the Cadna_A graphical models are presented for representative wind speeds of 6, 8 and 10 metres per second for the Nordex N90LS Turbine model.

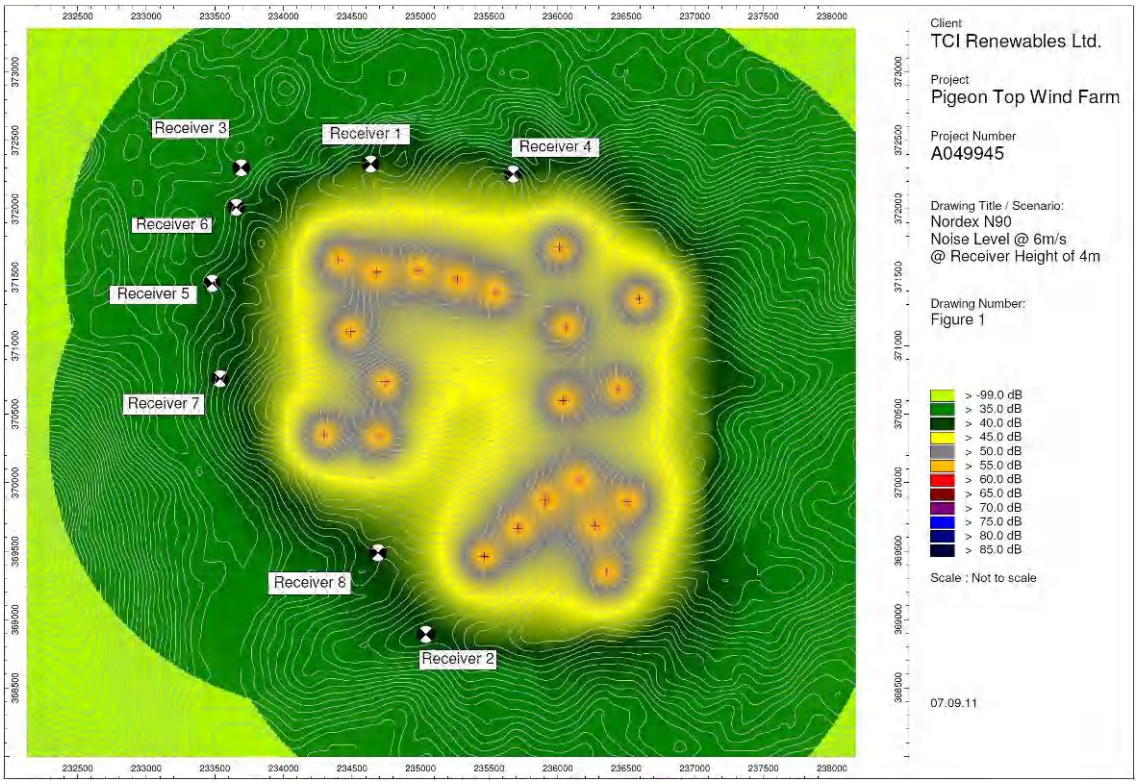


Figure 2.5.2.1.1 Nordex N90 Noise Level at 6m/s

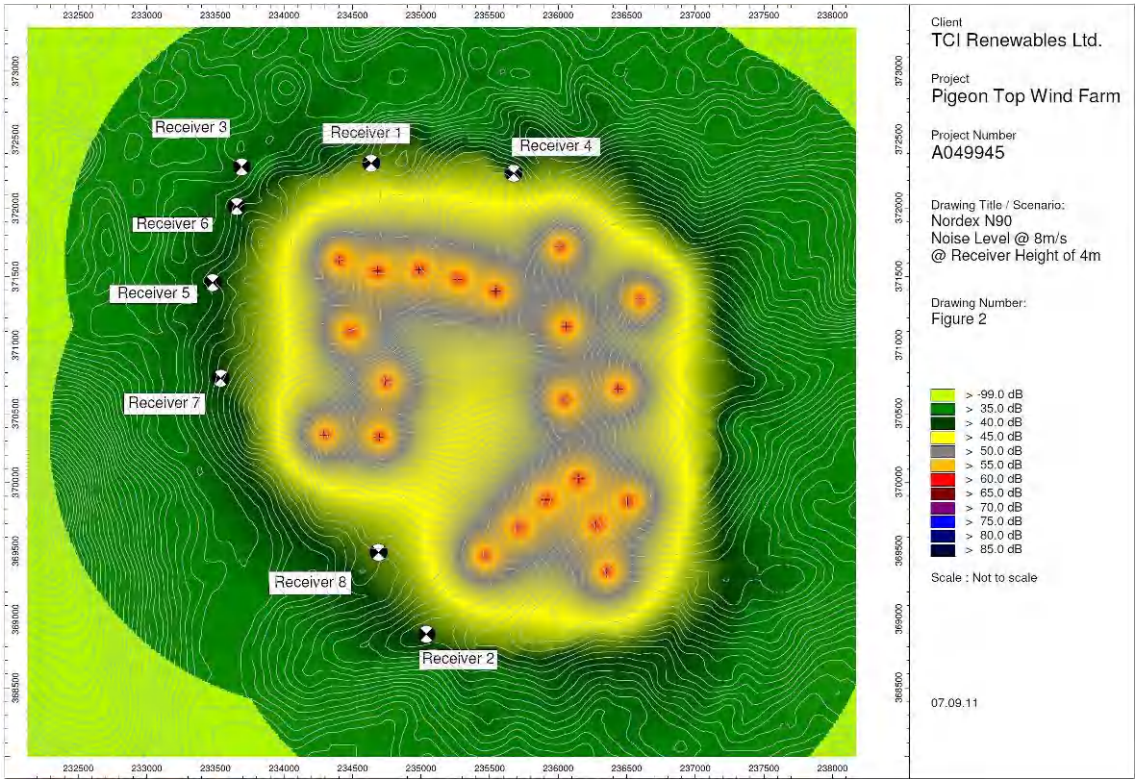


Figure 2.5.2.1.2 Nordex N90 Noise Level at 8m/s

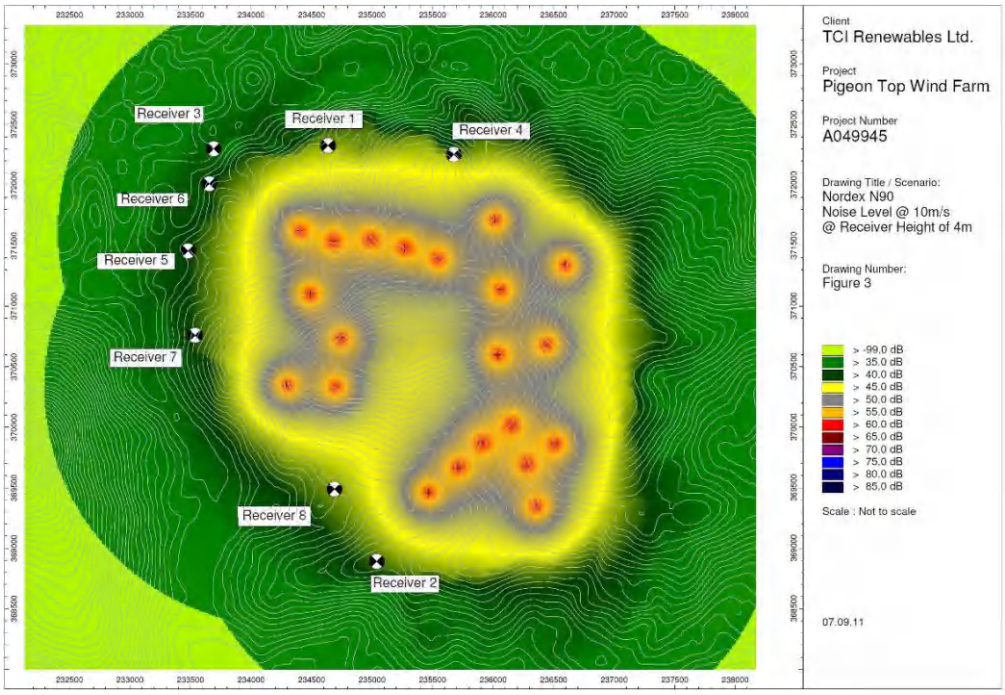


Figure 2.5.2.1.3 Nordex N90 Noise Level at 10m/s

2.5.2.2 Enercon E82 2.3MW Turbines on an 85m Tower

Table 2.5.2.2 and Figure 2.5.2.2 below compare the predicted LA90 noise level, using the Enercon E82 turbine, with the relevant planning conditions - daytime noise limit of 40 dB(A) and night-time noise limit of 43 dB - at the nearest noise sensitive receiver properties, at wind speeds of 6 m/s, 8 m/s and 10 m/s.

As outlined in Table 2.5.2.2, the predicted LA90 noise levels are well below the fixed night-time limit of 43 dB(A) and in accordance with the daytime limit of 40 dB(A). The maximum predicted LA90 noise level at a wind speed of 10 m/s is at NML 1 and NML 8 is 40 dB(A).

The values shown in Table 2.5.2.2 and Figure 2.5.2.2 indicate that the proposed Enercon E82 wind turbines comply with the relevant planning condition for noise.

Receiver No.	Predicted noise level at increasing sound power levels and varying wind speeds (dB)		
	103 dB(A) @ 6 m/s	104.5 dB(A) @ 8 m/s	105 dB(A) @ 10 m/s
1	36.8	39.4	39.6
2	36	38	38.4
3	31.6	34	34.2
4	37.6	38.8	39.3
5	34.8	36.5	36.9
6	33.7	35.9	36.2
7	36	36.9	37.6
8	37.6	39	39.5

Table 2.5.2.2 Predicted Sound Pressure Level (Predicted LA90 noise levels) at Nearby Receivers from the Operation of Enercon E82 Wind Turbines

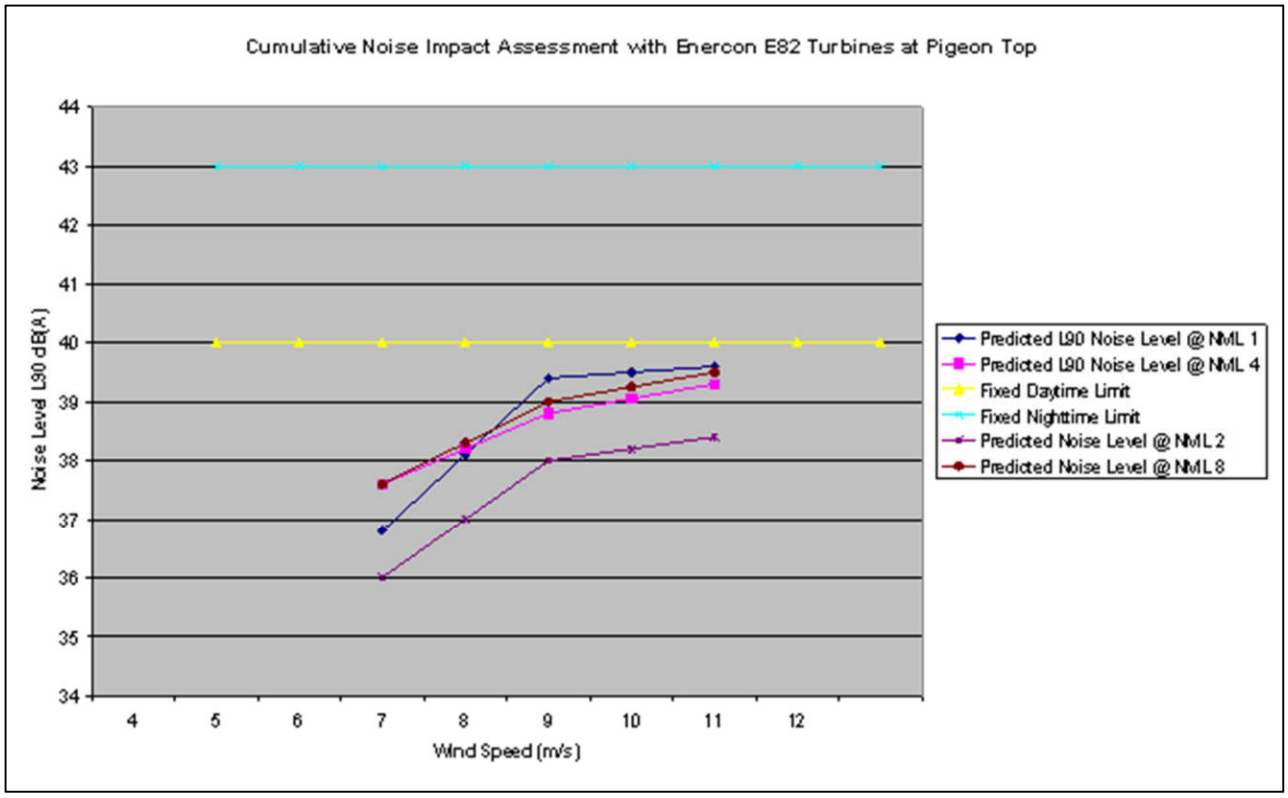


Figure 2.5.2.2 Predicted Noise Levels using the Enercon E82 Wind Turbines

On the following pages the Cadna_A graphical models are presented for representative wind speeds of 6, 8 and 10 metres per second for the Enercon E82 turbine model.

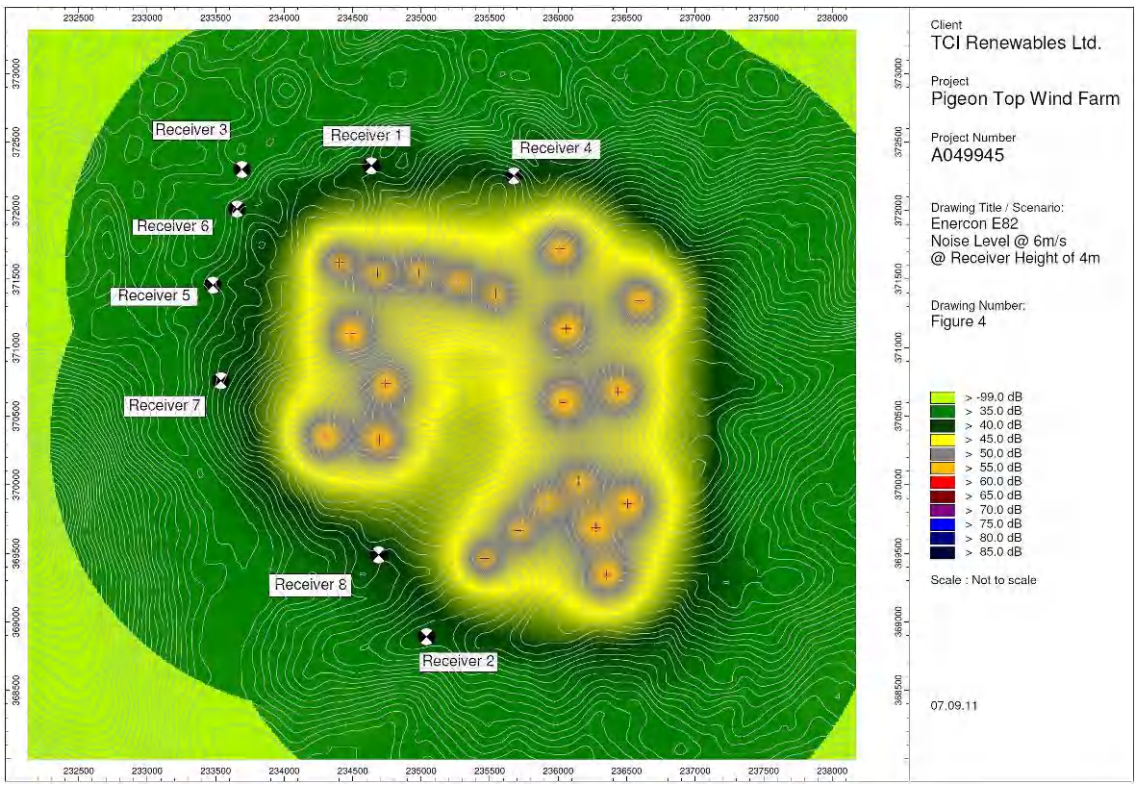


Figure 2.5.2.2.1 Enercon E82 Noise Level at 6m/s

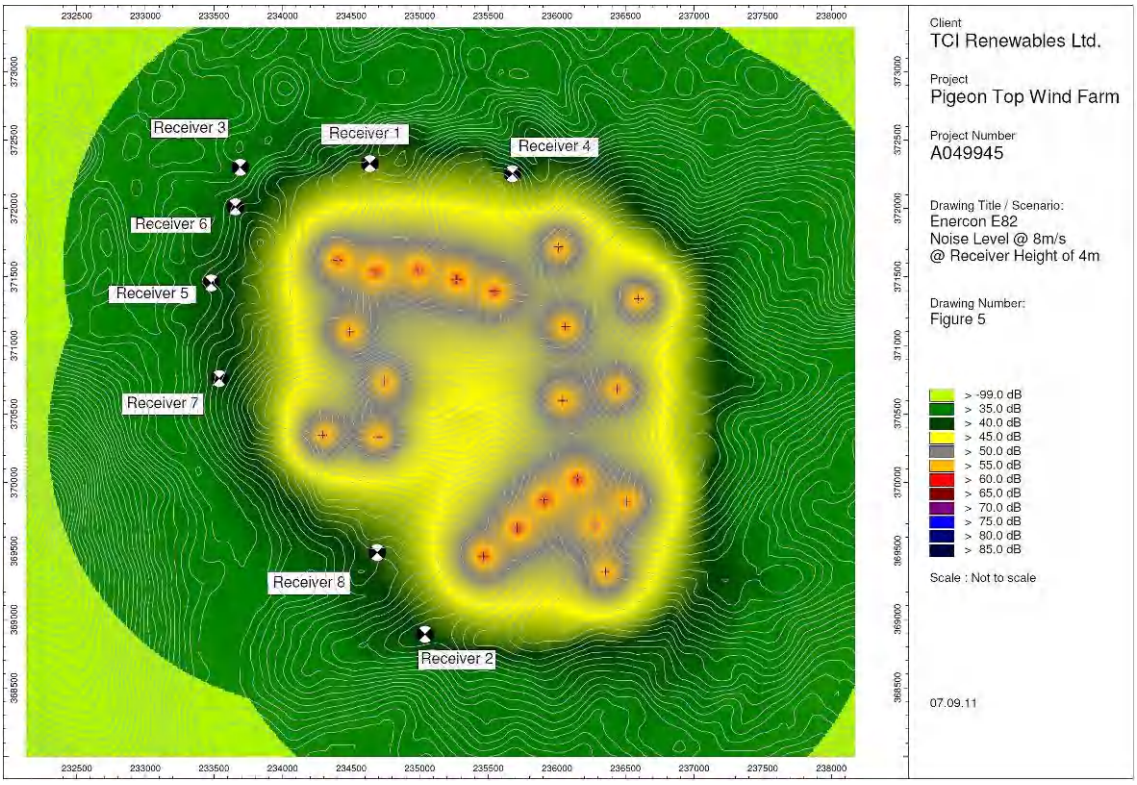


Figure 2.5.2.2.2 Enercon E82 Noise Level at 8m/s

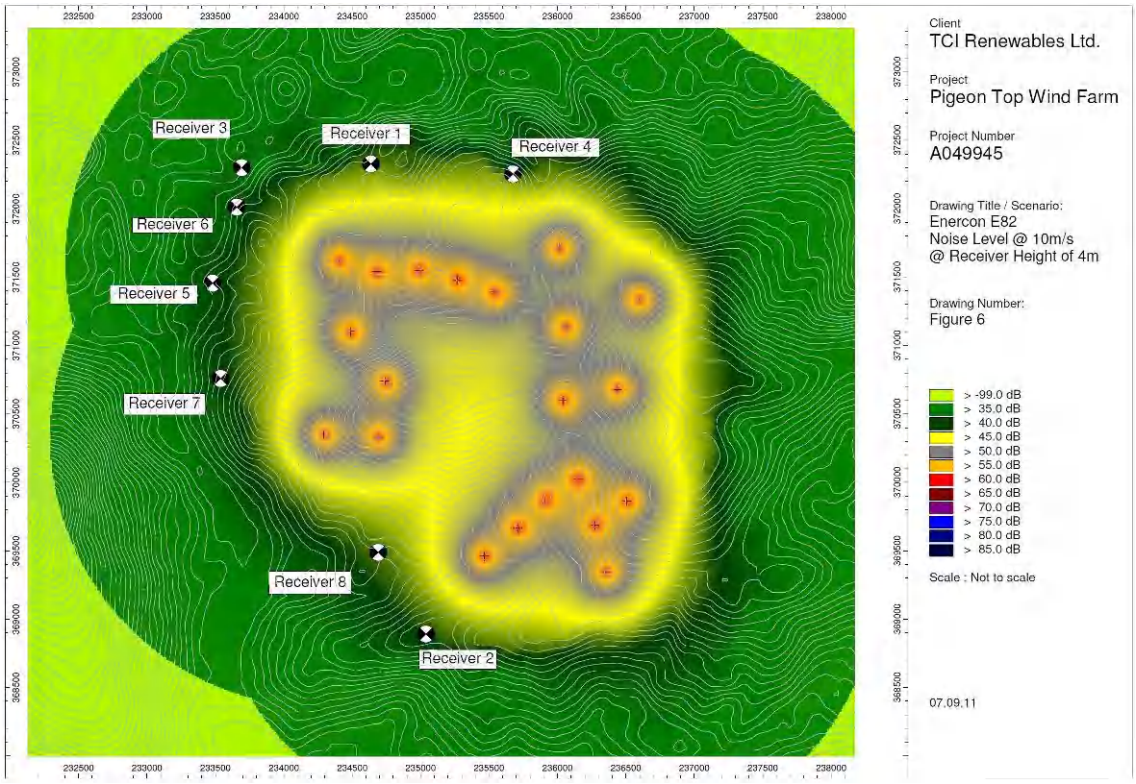


Figure 2.5.2.2.3 Enercon E82 Noise Level at 10m/s

2.5.2.3 Enercon E70 2.3MW on an 85m Tower

Table 2.5.2.3 and Figure 2.5.2.3 below compare the predicted LA90 noise level, using the Enercon E70 turbine, with the relevant planning conditions - daytime noise limit of 40 dB(A) and night-time noise limit of 43 dB - at the nearest noise sensitive receiver properties, at wind speeds of 6 m/s, 8 m/s and 10 m/s.

As outlined in Table 2.5.2.3, the predicted LA90 noise levels are well below the fixed night-time limit of 43 dB(A) and in accordance with the daytime limit of 40 dB(A). The maximum predicted LA90 noise level at a wind speed of 10 m/s is at NML 1 is 40 dB(A).

The values shown in Table 2.5.2.3 and Figure 2.5.2.3 indicate that the proposed Enercon E70 wind turbines comply with the relevant planning condition for noise.

Receiver No.	Predicted noise level at increasing sound power levels and varying wind speeds (dB)		
	103 dB(A) @ 6 m/s	104.5 dB(A) @ 8 m/s	105 dB(A) @ 10 m/s
1	36.1	39.3	39.9
2	35.5	38.2	38.4
3	31	34	34.4
4	37.4	39.5	39
5	34.4	36.9	36.8
6	33.1	36	36.3
7	35.9	37.8	37.1
8	37.3	39.5	39.2

Table 2.5.2.3 Predicted Sound Pressure Level (Predicted LA90 Noise Levels) at Nearby Receivers from the Operation of Enercon E70 Wind Turbines

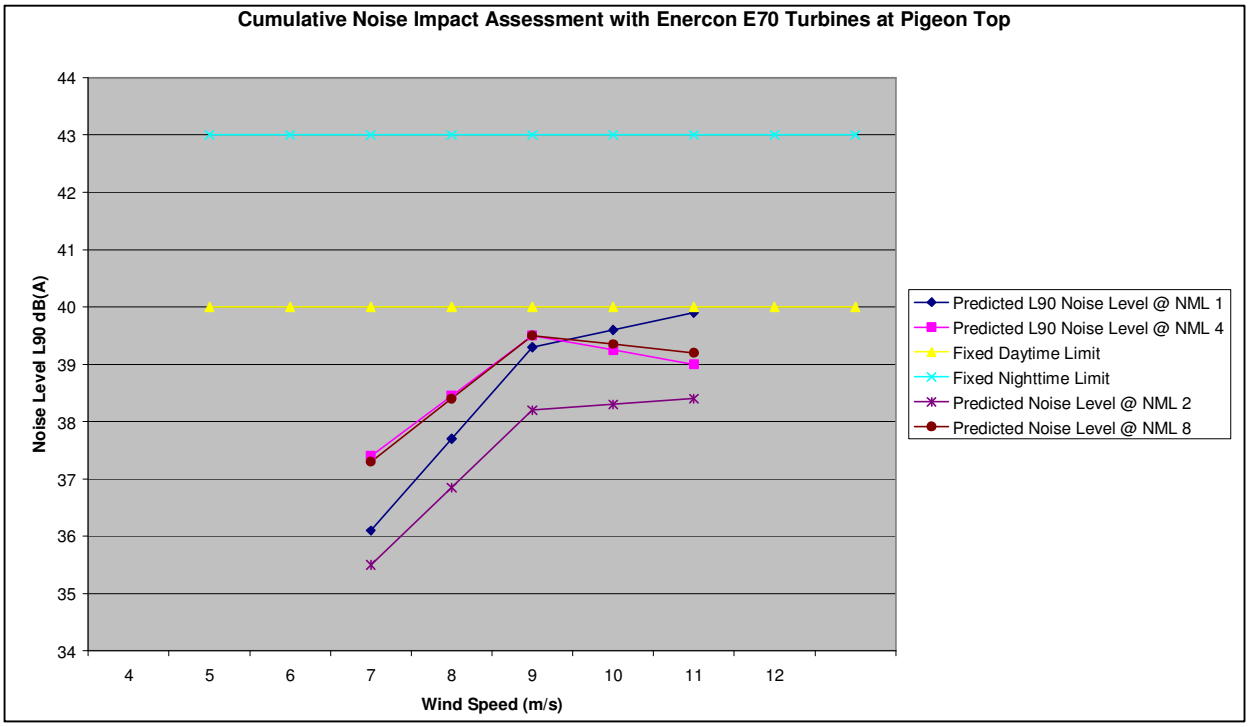


Figure 2.5.2.3 Predicted Noise Levels using the Enercon E70 Wind Turbines

On the following pages the Cadna_A graphical models are presented for representative wind speeds of 6, 8 and 10 metres per second for the Enercon E70 Turbine model.

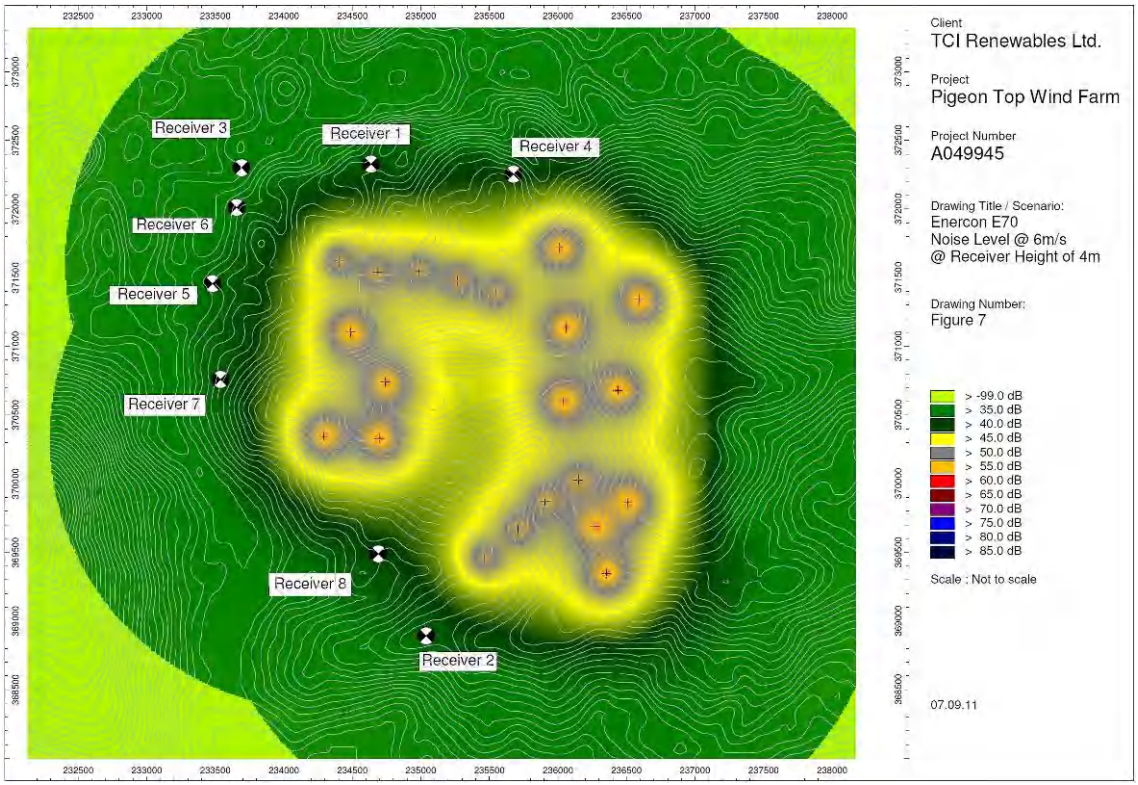


Figure 2.5.2.3.1 Enercon E70 Noise Level at 6m/s

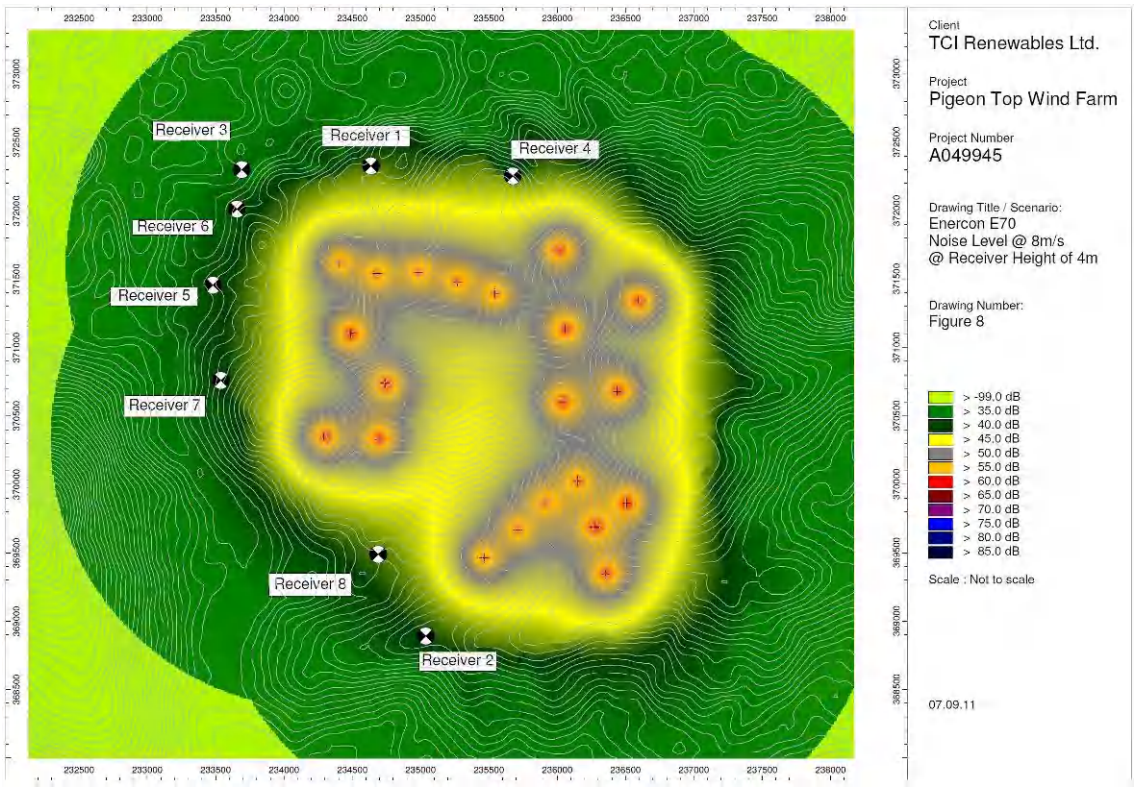


Figure 2.5.2.3.2 Enercon E70 Noise Level at 8m/s

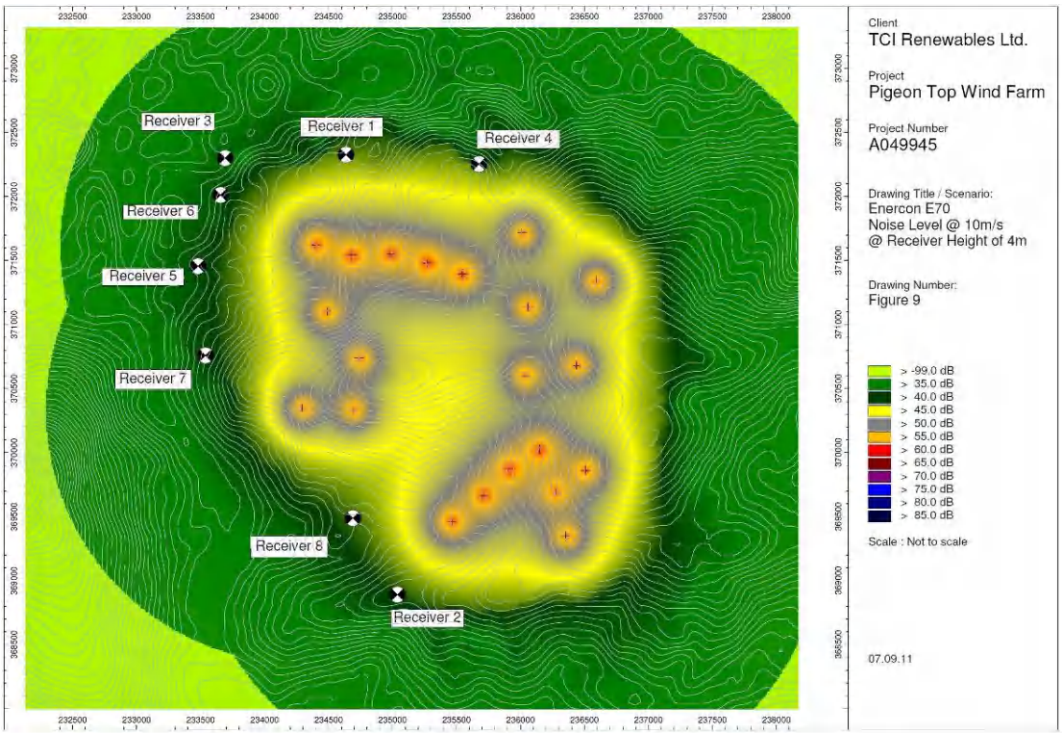


Figure 2.5.2.3.3 Enercon E70 Noise Level at 10m/s

2.5.2.4 Vestas V80 2.0MW on an 80m Tower

Table 2.5.2.4 and Figure 2.5.2.4 below compare the predicted LA90 noise level, using the Vestas V80 turbine, with the relevant planning conditions - daytime noise limit of 40 dB(A) and night-time noise limit of 43 dB - at the nearest noise sensitive receiver properties, at wind speeds of 6 m/s, 8 m/s and 10 m/s.

As outlined in Table 2.5.2.4, the predicted LA90 noise levels are well below the fixed night-time limit of 43 dB(A) and in accordance with the daytime limit of 40 dB(A). The maximum predicted LA90 noise level at a wind speed of 10 m/s is at NML 1, 4 and 8 is 40 dB(A).

The values shown in Table 2.5.2.4 and Figure 2.5.2.4 indicate that the proposed Vestas V80 wind turbines comply with the relevant planning condition for noise.

Receiver No.	Predicted noise level at increasing sound power levels and varying wind speeds (dB)		
	103 dB(A) @ 6 m/s	104.5 dB(A) @ 8 m/s	105 dB(A) @ 10 m/s
1	38.5	40.5	39.6
2	37.3	39.2	38.6
3	33.1	35.1	34.3
4	38.3	40	39.9
5	35.8	37.7	37.3
6	35.1	37	36.4
7	36.6	38.3	38.3
8	38.4	40.2	40

Table 2.5.2.4 Predicted Sound Pressure Level (Predicted LA90 noise levels) at Nearby Receivers from the Operation of Vestas V80 Wind Turbines

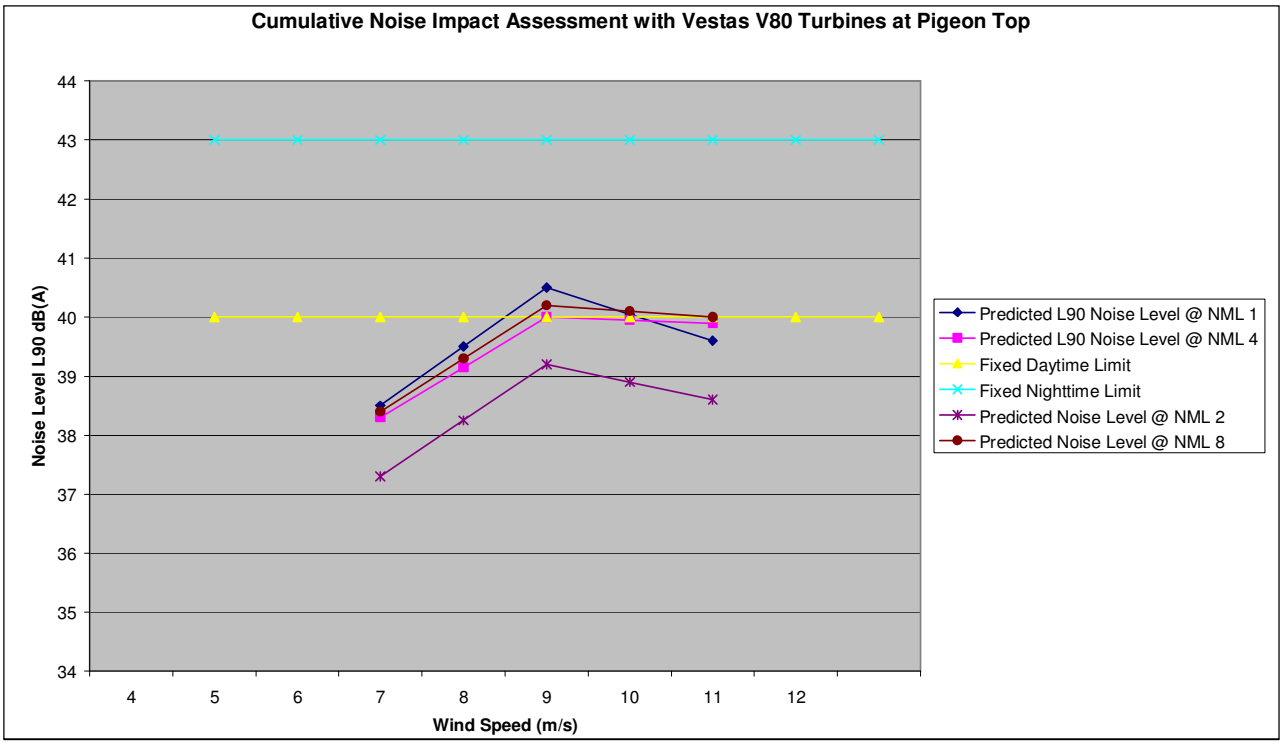


Figure 2.5.2.4 Predicted Noise Levels using the Vestas V80 Wind Turbines

On the following pages the Cadna_A graphical models are presented for representative wind speeds of 6, 8 and 10 metres per second for the Vestas V80 turbine model.

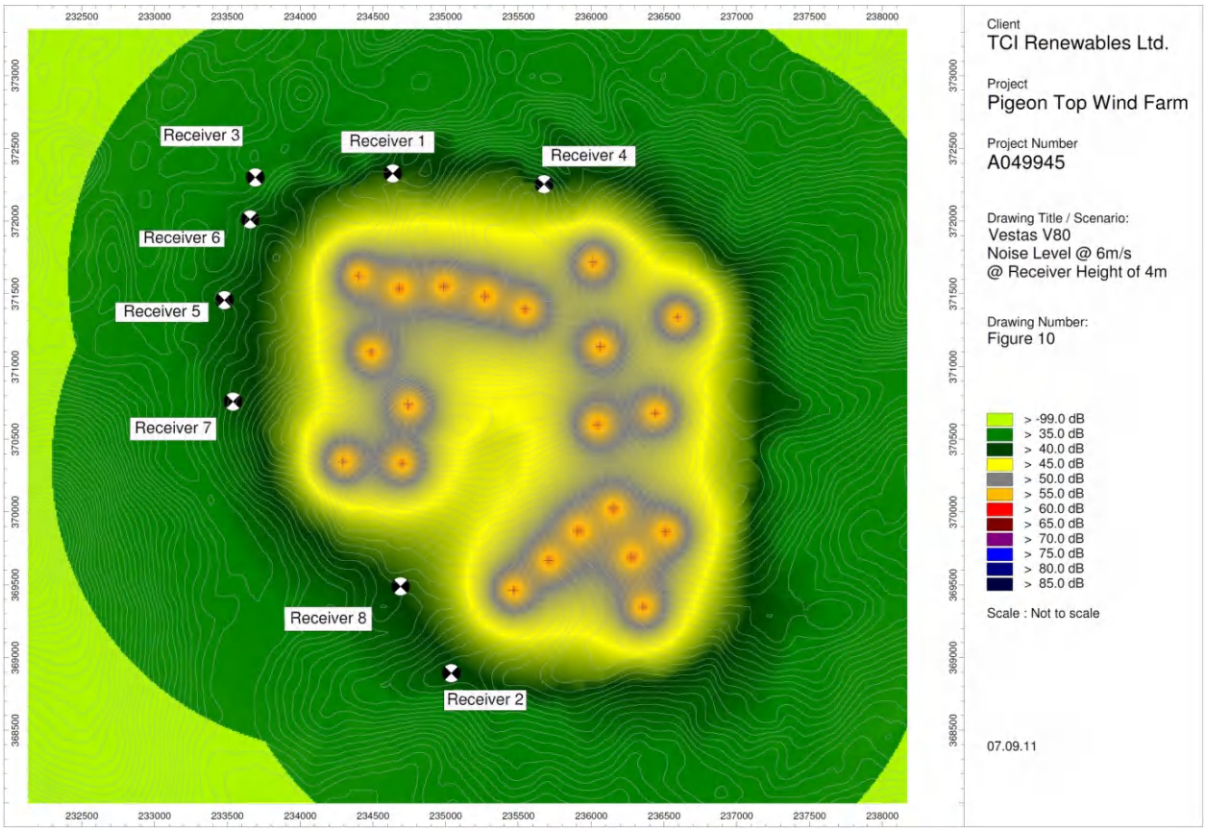


Figure 2.5.2.4.1 Vestas V80 Noise Level at 6m/s

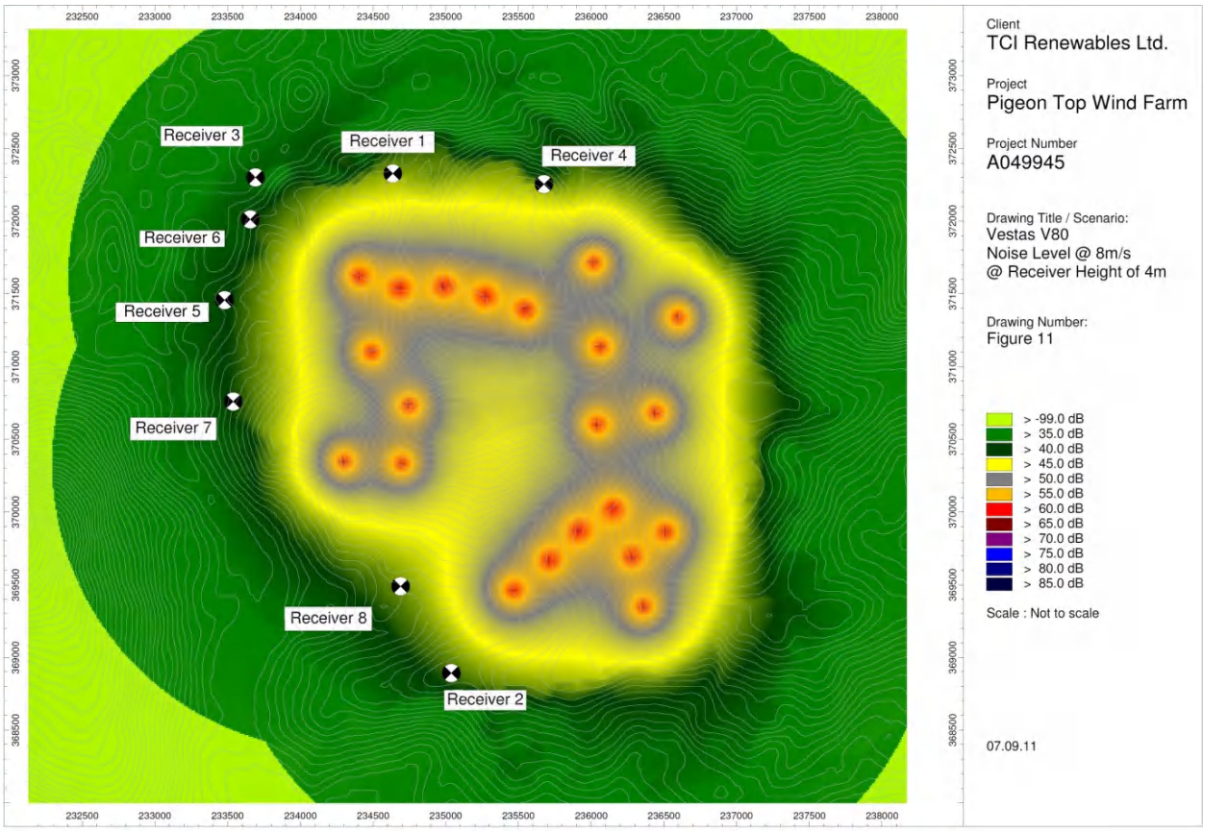


Figure 2.5.2.4.2 Vestas V80 Noise Level at 8m/s

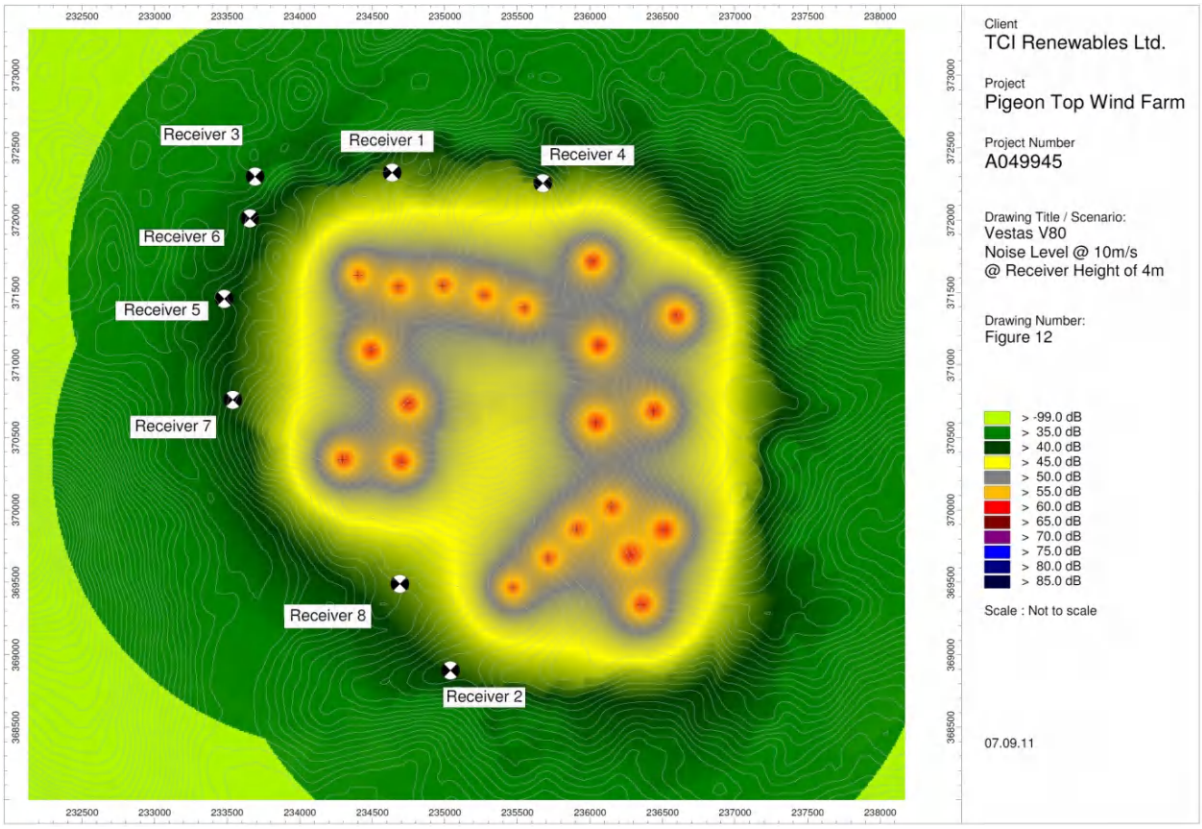


Figure 2.5.2.4.3 Vestas V80 Noise Level at 10m/s

2.6 Conclusions

WYG carried out a noise re-assessment of four alternative turbine types in accordance with The Planning Appeals Commission decision notice and conditions for Pigeon Top Wind Farm (reference 2009/A0265) and the cumulative operation of Pollnalaght Wind Farm (reference 2009/A0268) which states the following in relation to noise requirements:

(9) The development shall be constructed and operated in such a manner that noise from installed wind turbines does not exceed the ESTU-R-97 standard of 40 dB(A) during day-time and 43 dB(A) during night-time.

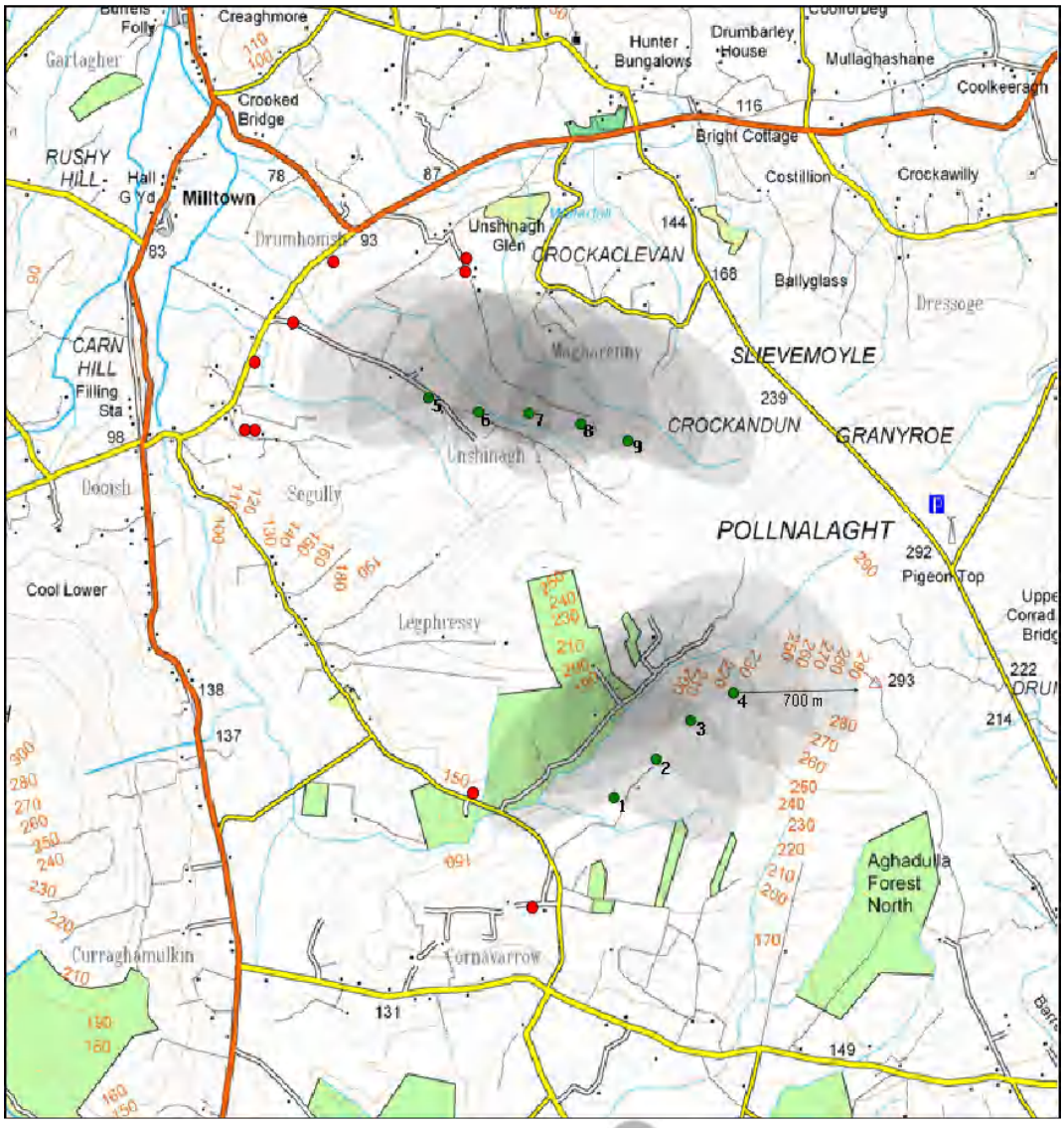
Using the Sound Power Level data provided for the Nordex N90LS, Enercon E82, Enercon E70 and Vestas V80 turbine types as provided by TCI Renewables from the wind turbine manufacturers technical specifications, WYG has determined that each of the alternative wind turbine types are suitable for use within the wind farm at the Pigeon Top site. The predicted noise levels from the operation of the alternative wind turbines, are all in accordance with the planning condition noise limits set at 40 dB(A) during day-time and 43 dB(A) during night-time. The planning condition noise limits will ensure the protection of the external amenity during the daytime and the prevention of sleep disturbance during the night-time.

The full noise impact assessment completed by WYG has been included in the accompanying booklet entitled – Noise Impact Assessment Supplementary Information – Pigeon Top Wind Farm.

3.0 Re-assessment of Shadow Flicker for Alternative Wind Turbine Models

3.1 Introduction

A full analysis of shadow flicker was undertaken in Section 13 of the original Environmental Impact Statement in 2009 and it was concluded that no properties would be within the general shadow zone of the proposed wind farm at Pigeon Top based upon Enercon E70 2.3MW turbines, as shown in Figure 3.1 below.



Nearest Occupied Houses Turbine Locations Extent of Shadow Flicker effect

Figure 3.1 Shadow Flicker Model for Enercon E70 2.3MW on 64m Towers

As part of the proposed amendment to the existing planning permission and associated supplementary information submission, TCI Renewables have re-run the shadow flicker models for each of the four considered alternative wind turbines to incorporate their larger blades and taller tower heights. By using more current and sophisticated computer modelling software, mapping GIS

software and more accurate use of met office data TCI Renewables have been able to demonstrate and ensure that each turbine model proposed meets with the recommended sub 30 hour limit requirements specified in PPS18 – Best Practice Guidance.

Indeed when the model is re-run for each alternative turbine type and the Met Office data "Sunshine Index" applied (which is the percentage of unimpeded low sun in a clear cloudless sky during daylight hours) shadow flicker falls below 10 hours in the year at the most proximate residential properties. An analysis of the results for each turbine type is shown in Section 3.4 below.

3.2 Statement of Authority

TCIR is a specialist dedicated wind farm development company based in Belfast, Northern Ireland. TCIR's project management team has over 60 years combined experience in developing renewable energy projects in Northern Ireland, Great Britain, Canada, USA, and Australia.

This section was produced by TCIR Technical department, using specialist software packages and published data from a variety of authoritative sources. Members of the technical department have experience in Geographical Information Systems, MapInfo, wind farm design, wind data analysis and Graphical data capture.

Members of the TCIR technical department carry out a detailed analysis and design on all of TCIR portfolio of wind projects in Northern Ireland, England, Canada and North America.

3.3 Methodology

Shadow Flicker modelling is produced using industry recognised software Wind farm™, GIS mapping packages and Met Office Sunshine Index data. The models were run by the Technical Team of TCIR.

The residential amenity assessment was carried out through detailed desk top analysis and on-site visits carried out in conjunction with the property owner.

3.4 Shadow Flicker Assessment

A desk-top analysis was completed and follow-up site visits were conducted (14/04/08 and 23/09/08) to originally evaluate the properties most likely to be affected by shadow flicker. A further site visit to re-examine the area for any new properties or landscape alterations was carried out on 15/08/11. The area is rural and properties are relatively sporadic throughout the landscape and as a result it was extremely unlikely that any properties would be affected by shadow flicker.

A worst case scenario is always reported when using the computer model to predict shadow flicker and it should be noted that there are several common factors which normally significantly reduce these effects including; the presence of landscaping, topography, trees, the size of windows and the orientation of the dwelling.

3.5 Nordex N90LS Shadow Flicker Assessment

The shadow flicker model was run for the Nordex N90LS wind turbine which has a blade diameter of 90m and a tower height of 80m. This is the largest of the proposed alternative models in terms of blade radius and as a result would reflect the worst case potential shadow flicker results from the Pigeon Top Wind Farm. The results are shown in the graphic in Figure 3.5 below.

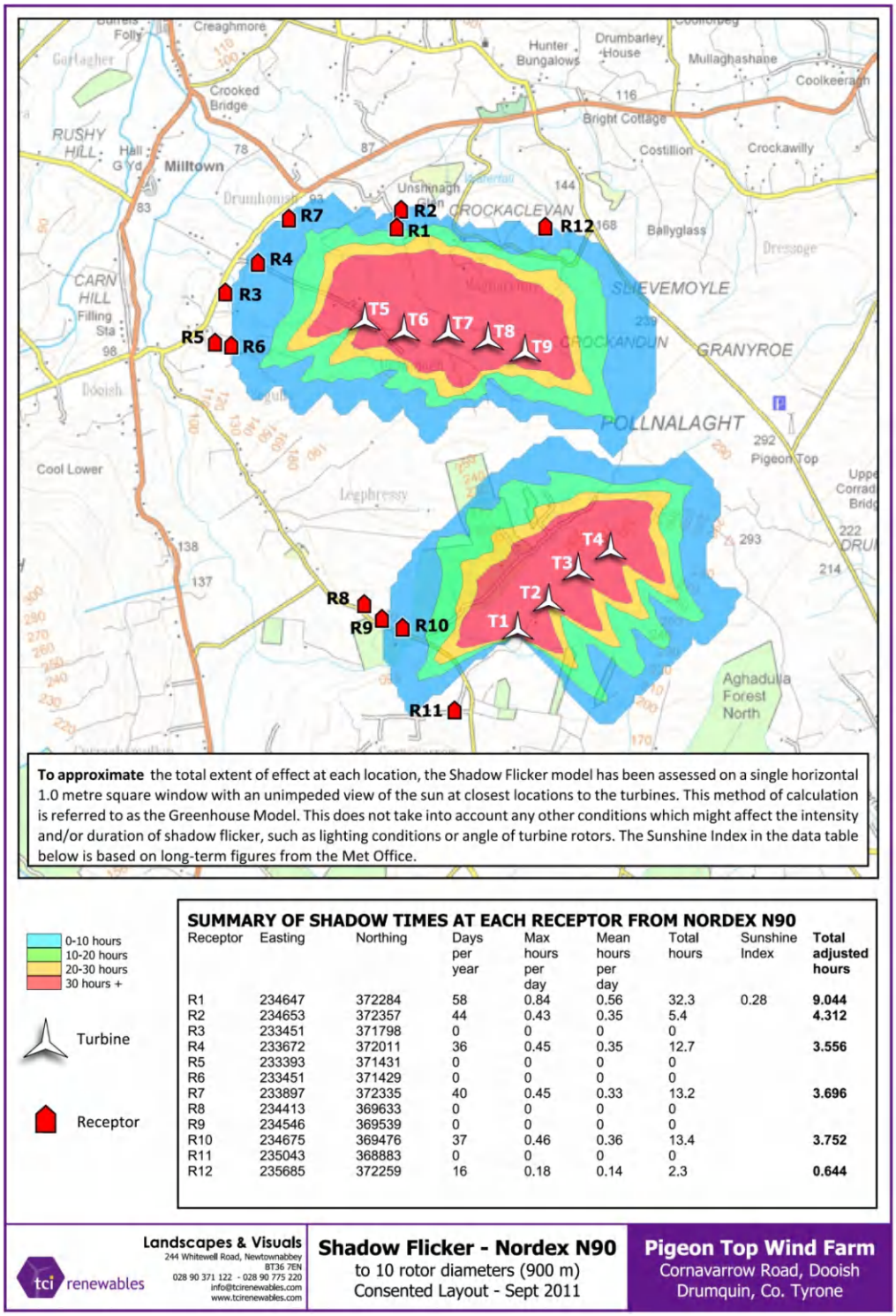


Figure 3.5 Shadow Flicker Model for Nordex N90 wind turbine to 10 rotor diameters (900m)

As can be seen from the mapping and summary table in Figure 3.5 above, only six properties are located within the identified shadow zone for this turbine type. The results illustrate that each of the properties will fall below ten hours in the year and as such are all well below the recommended sub 30 hour limit requirements specified in PPS18 – Best Practice Guidance. In addition the shadow flicker model illustrates a worst case scenario and does not identify any natural screening features or property orientations which would significantly further reduce or eradicate the possibility of shadow flicker occurring at all. An analysis of each of the six properties is presented below.

3.5.1 R1 95 Omagh Road

Figure 3.5.1 Orthophotography Showing R1 95 Omagh Road

This two storey property belongs to one of the Pigeon Top Wind Farm landowners with a financial involvement in the wind farm. The aerial photograph of the property in Figure 3.5.1 above shows that due to the aspect of this residence to the proposed wind turbines, shadow flicker will not occur. There are no windows or door openings which directly face the turbines or have an uninterrupted view as shown in Figure 3.5.1.1 overleaf. In addition there are several outbuildings, and the property is surrounded by mature tree clusters between the property and the proposed wind turbine locations to further minimise any potential effects. As a result of these existing features the projected 9 hour total per year will be reduced to zero hours at this property.

Figure 3.5.1.1 R1 95 Omagh Road Orientated Away From the Wind Farm and Surrounded by Outbuildings and Mature Trees

3.5.2 R2 93 Omagh Road

Figure 3.5.2 Orthophotography Showing R2 93 Omagh Road

This two storey property belongs to one of the Pigeon Top wind farm landowners with a financial involvement in the wind farm. The aerial photograph in Figure 3.5.2 shows the property located to the north off a newly created driveway and due to the aspect of this residence to the proposed wind turbines, shadow flicker will not occur. There are no windows or door openings which directly face the turbines or have an uninterrupted view as shown in Figure 3.5.2.1 below. In addition there are several outbuildings located in the yard of 95 Omagh Road which further restrict any view of the wind turbines. As a result of these screening features the predicted figure of 4.3 hours in the year will be reduced to zero.

Figure 3.5.2.1 93 Omagh Road Orientated In a Different Direction to the Proposed Wind Farm

3.5.3 14 Rolsons Lane (Located off Segully Road)

Figure 3.5.3 Orthophotography showing R4 14 Segully Road

This single storey property belongs to a private individual with no connection to the wind farm. The aerial photograph of the property in Figure 3.5.3 shows that due to the orientation of this residence to the proposed wind turbines, shadow flicker will not occur. The property is shielded from views due east along Rolsons Lane towards the wind farm by a large outbuilding and mature planting around the boundary of the property. The predicted worst case shadow flicker model indicates just 3.5 hours per year but in reality for the aforementioned reasons this property will not be subjected to any shadow flicker incidences.

Figure 3.5.3.1 Rear of R4 14 Rolsons Lane with View towards General Wind Farm Direction

3.5.4 R7 New Build Property on Segully Road

Figure 3.5.4 Orthophotography Showing R7 New Build on Segully Road

This two storey property belongs to a private individual with no connection to the wind farm. The aerial photograph of the property in Figure 3.5.4 shows that the rear of the property is orientated towards the northern turbines; however the lands behind the property rise steeply from 110m ASL up to 190m ASL at the location of the first turbine. In addition the hillside has numerous clusters of mature trees which screen any potential views to the hilltop. The level of predicted shadow flicker at this property is just 3.6 hours in the year and it is anticipated that this will be eliminated completely by the topography to the rear of the property.

Figure 3.5.4.1 R7 New Build on Segully Road

Figure 3.5.4.2 R7 New Build on Segully Road Showing Steep Hillside Topography and Tree Cover To the Rear

3.5.5 R10 61 Cornavarrow Road

Figure 3.5.5 Orthophotography showing R10 61 Cornavarrow Road

This single storey property belongs to a private individual with no connection to the wind farm. The aerial photograph of the property in Figure 3.5.5 shows that due to the orientation of this residence to the proposed wind turbines, shadow flicker will not occur. The property is shielded from views due east towards the wind farm by an outbuilding and large scale mature forestry plantations around the boundary and surrounding landscape of the property. The predicted worst case shadow flicker model indicates just 3.7 hours per year but in reality for the aforementioned reasons this property will not be subjected to any shadow flicker incidences.

Figure 3.5.5.1 View from the rear of single storey property R10 61 Cornavarrow Road

3.5.6 R12 28 Magherenny Road

Figure 3.5.6 Orthophotography showing R12 28 Magherenny Road

This single storey property belongs to a private individual but would appear on distant viewing to be uninhabited at this stage and has no connection to the wind farm. The aerial photograph of the property in Figure 3.5.6 shows that due to the screening of thick mature tree cover around the boundary of the site, shadow flicker will be very unlikely to occur. The predicted worst case shadow flicker model indicates just 0.6 hours per year.

Figure 3.5.6.1 View towards R12 28 Magherenny Road Illustrating Thick Tree Cover around the Property

3.5.7 Conclusions

The initial shadow flicker model for the Nordex N90LS indicated that six properties would be located within the shadow flicker zone. However, the total adjusted sunshine index figures reveal that all properties will fall below ten hours in the year and as such are all well below the recommended sub 30 hour limit requirements specified in PPS18 – Best Practice Guidance. A detailed analysis of each property has also revealed that orientation, natural screening and topography will eliminate any potential incidences of shadow flicker with this proposed turbine model.

3.6 Enercon E82 Shadow Flicker Assessment

The shadow flicker model was re-run for the Enercon E82 wind turbine which has a blade diameter of 82m and a tower height of 85m. The results are show in Figure 3.6 below.

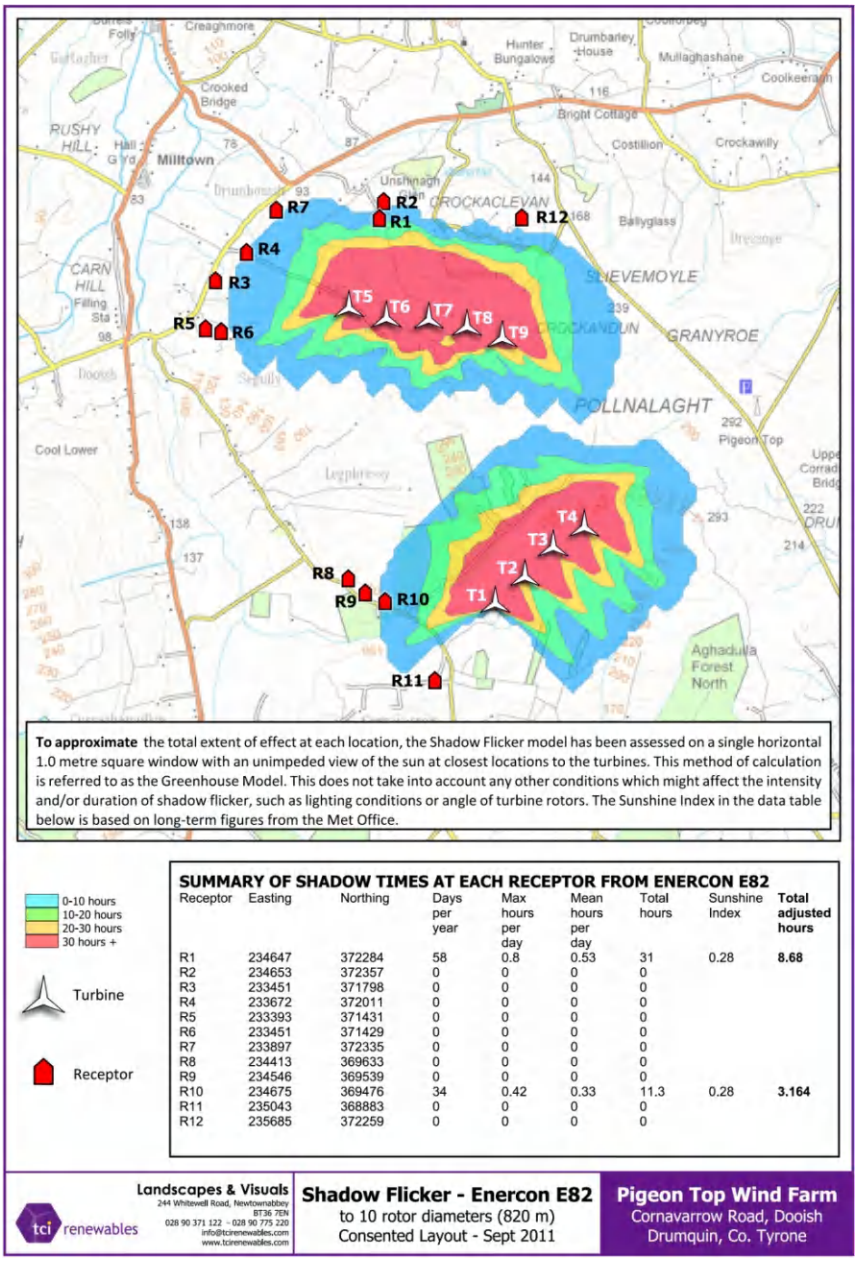


Figure 3.6 Shadow Flicker Model for Enercon E82 Wind Turbine to 10 Rotor Diameters (820m)

As can be seen from the mapping and summary table in Figure 3.6 above, only two properties are located within the identified shadow zone for this turbine type. The results illustrate that each of the properties will fall below nine hours in the year and as such are all well below the recommended sub 30 hour limit requirements specified in PPS18 – Best Practice Guidance. In addition the shadow flicker model illustrates a worst case scenario and does not identify any natural screening features or property orientations which would significantly further reduce or eradicate the possibility of shadow flicker occurring at all. As illustrated in section 3.5.1 R1 95 Omagh Road is orientated away from the wind farm and surrounded by outbuildings and mature trees and R10 61 Cornavarrow Road in section 3.5.5 is shielded from views due east towards the wind farm by an outbuilding and large scale mature forestry plantations around the boundary and surrounding landscape of the property. As a result the Enercon E82 turbine is not expected to cause any incidences of shadow flicker to neighbours of the Pigeon Top Wind Farm.

3.7 Enercon E70 Shadow Flicker Assessment

The shadow flicker model was re-run for the Enercon E70 wind turbine which has a blade diameter of 71m and a tower height of 85m. The results are shown in Figure 3.7 below.

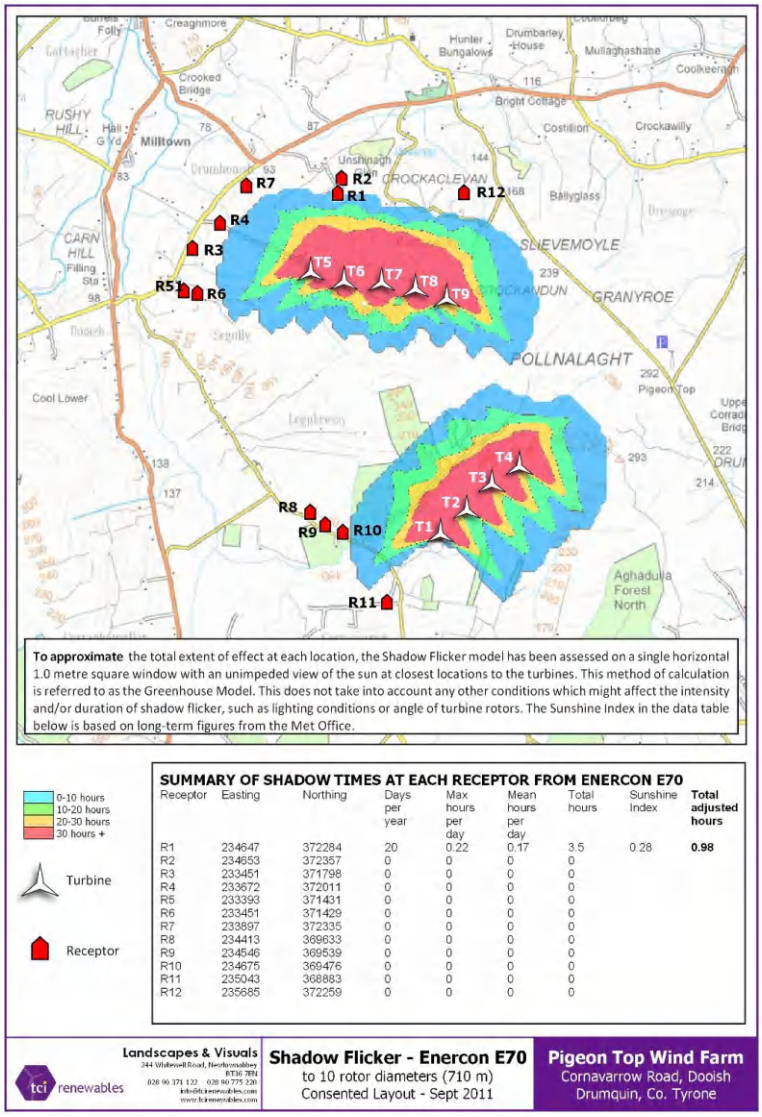
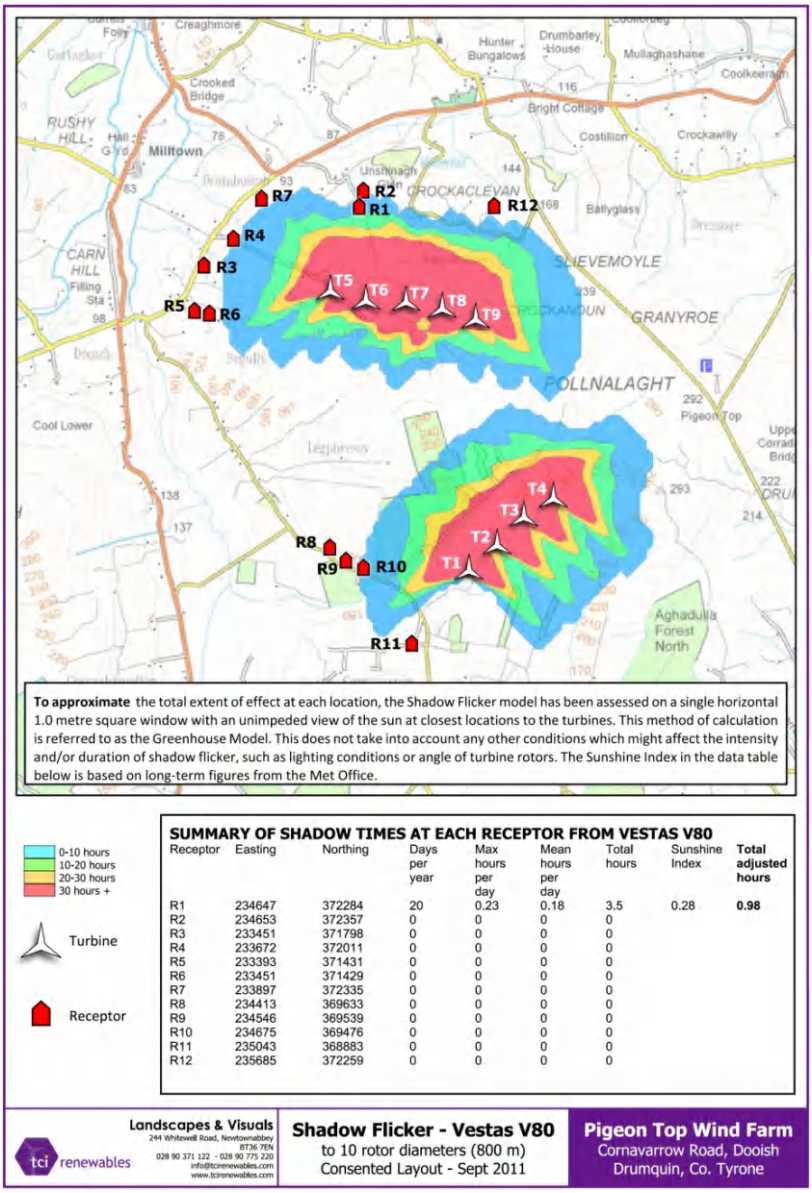


Figure 3.7 Shadow Flicker Model for Enercon E70 Wind Turbine to 10 Rotor Diameters (710m)

As can be seen from the mapping and summary table in Figure 3.7 above, only one property was located within the identified shadow zone for this turbine type. The results illustrate that the property (R1 95 Omagh Road), will fall below 1 hour in the year and as such is inconsequential in terms of the recommended sub 30 hour limit requirements specified in PPS18 – Best Practice Guidance. In addition the shadow flicker model illustrates a worst case scenario and does not identify any natural screening features or property orientations which would significantly eradicate the possibility of shadow flicker occurring at all. As illustrated in section 3.5.1 R1 95 Omagh Road is orientated away from the wind farm and surrounded by outbuildings and mature trees. As a result the Enercon E70 turbine is not expected to cause any incidences of shadow flicker to neighbours of the Pigeon Top Wind Farm.

3.8 Vestas V80 Shadow Flicker Assessment

The shadow flicker model was run for the Vestas V80 wind turbine which has a blade diameter of 80m and a tower height of 80m. The results are shown in Figure 3.8 below.



SUMMARY OF SHADOW TIMES AT EACH RECEPTOR FROM VESTAS V80

Receptor	Easting	Northing	Days per year	Max hours per day	Mean hours per day	Total hours	Sunshine Index	**Total adjusted hours**
R1	234647	372284	20	0.23	0.18	3.5	0.28	**0.98**
R2	234653	372357	0	0	0	0		
R3	233451	371798	0	0	0	0		
R4	233672	372011	0	0	0	0		
R5	233393	371431	0	0	0	0		
R6	233451	371429	0	0	0	0		
R7	233897	372335	0	0	0	0		
R8	234413	369633	0	0	0	0		
R9	234546	369539	0	0	0	0		
R10	234675	369476	0	0	0	0		
R11	235043	368883	0	0	0	0		
R12	235685	372259	0	0	0	0		

Figure 3.8 Shadow Flicker Model for Vestas V80 Wind Turbine to 10 Rotor Diameters (800m)

As can be seen from the mapping and summary table in Figure 3.8 above, only one property was located within the identified shadow zone for this turbine type. The results illustrate that the property (R1 95 Omagh Road), will fall below 1 hour in the year and as such is inconsequential in terms of the recommended sub 30 hour limit requirements specified in PPS18 – Best Practice Guidance. In addition the shadow flicker model illustrates a worst case scenario and does not identify any natural screening features or property orientations which would significantly eradicate the possibility of shadow flicker occurring at all. As illustrated in section 3.5.1 R1 95 Omagh Road is orientated away from the wind farm and surrounded by outbuildings and mature trees. As a result the Enercon E70 turbine is not expected to cause any incidences of shadow flicker to neighbours of the Pigeon Top Wind Farm.

3.9 Mitigation

In the unlikely event that residents experience shadow flicker impacts or nuisance once the Pigeon Top wind farm becomes operational, and assessments indicate that these impacts are generated from the Pigeon Top wind turbines, the Wind farm owner and operator will have responsibility to implement appropriate mitigation measure(s) to be agreed with the local Council and householders. Possible Shadow Flicker reduction and mitigation measures could include, but are not limited to:

- Landscaping and other vegetative screening could be put in place. This would act to block any shadow flicker effects and direct views of the turbines.
- Blinds may be fitted for windows where shadow flicker impacts are noted.
- A multi-directional lighting system could be installed in shadow flicker effected houses/rooms, thereby reducing the impact of the shadows cast over a directional light source such as a window.
- As the shadow flicker is predicted to occur only during specific times of year and specific times of the day, the turbine(s) responsible for shadow flicker could be turned off during this short period of time thereby removing the shadow flicker impacts.

In any case, the Pigeon Top wind turbines will be equipped with a shutdown module that will turn the turbines off when the conditions exist for shadow flicker to occur. With the application of this module, the potential for shadow flicker impacts on residential amenity from Pigeon Top wind farm are not of significant concern.

3.10 Conclusions

All four proposed turbine models have been assessed and each can fully comply with the recommended sub 30 hour per year limit requirements set by PPS18 – Best Practice Guidance. As a result it is concluded that due to the physical direction of the nearest properties to the turbines/sun, low rotational speeds, frequent cloud cover, turbine to residence separation, intervening vegetation and durations of unfavourable turbine to sun alignment, shadow flicker will not cause a nuisance to neighbours of the Pigeon Top Wind Farm and each of the four proposed wind turbine models is appropriate for use at this site.

4.0 Landscape & Visuals - Alternative Wind Turbine Model Assessment

4.1 Introduction

As part of the original Environmental Impact Statement for the Pigeon Top Wind Farm a full detailed cumulative landscape and visual impact assessment was completed by Raymond Holbeach, BSc, MLA, MLI, a Regional Director with RPS Planning & Environment and as Chartered Landscape Architect with over 17 years' experience including multiple LVIA for wind farm projects. This assessment contained 30 photomontage viewpoint images and multiple ZTV maps. The landscape and visual impact assessment concluded that overall there will be no significant cumulative landscape and visual impacts for the vast majority of the 20km study area when combined with all existing and approved wind farms. It is recommended that the full landscape assessment report in the original Environmental Impact Statement is read in conjunction with this supplementary information.

As discussed previously in Section 1.2 Planning History within this supplementary information, document the Pigeon Top and Pollnalaght Top Wind Farms were initially refused planning consent and taken to planning appeal where they were heard together at an informal hearing on 15th September 2010 at the Strule Arts Centre in Omagh by Commissioner George Scott. The two applications were subsequently approved on 13th December 2010 granting planning permission to both the Pigeon Top Wind Farm (Planning Ref: K/2009/0081/F) and Pollnalaght Wind Farm (Planning Ref: K/2006/1368/F) respectively. The issued appeal decision reports from Commissioner Scott fully discussed and addressed both the individual and cumulative visual impacts of the two wind farms. In the case of the Pigeon Top Wind Farm the Commissioner stated the following:

"Given the proposal's compliance with the general requirements of the SPG the existence of intervening landform and vegetation, and the generally permissive nature of PPS 18, I find that this wind farm would not, of itself, have an unacceptably adverse impact on the visual amenity landscape character of the area."

In addition the following conclusions were drawn up on cumulative impacts for the Pigeon Top Wind Farm:

"*I do not consider that the cumulative impact of Pigeon Top with any of the existing and approved wind farms would have an unacceptable adverse visual impact on the landscape character of the area. I also consider that there is sufficient distance and intervening undeveloped landform between clusters to prevent the main ridge lines becoming dominated by turbines".*

The Pollnalaght Wind Farm turbines were consented at appeal at 125m overall height and are located in higher, more prominent locations above the landscape ridgelines and skyline than the proposed Pigeon Top wind turbines. By increasing the height of the Pigeon Top Wind Turbines, all turbines will now appear at a uniform 125/126m overall height and be of the same colour and three-bladed design within their shared landscape. This ensures that the two wind farms (Pollnalaght & Pigeon Top) appear as one large cluster and do not demonstrate any visual height discrepancies to the discerning viewer.

4.2 Statement of Authority

All photography and visualisations presented in the full colour A3 booklet entitled Pigeon Top Wind Farm Landscape and Visual Impact Assessment supplementary Information have been undertaken by TCI Renewables Paul Megahey. Paul is a professional Architectural Photographer of over 12 years standing in the architectural and construction fields. His work has been commissioned by architects and companies throughout the UK and Ireland, several of which have used his images in winning submissions for architectural, design and landscape awards. His work has been published in Perspective, The Ulster Architect and Specify magazines as well as in UK-based publications. Paul has five years of specialist experience in photography and visualisation for wind farm projects in the UK, Ireland and Canada.

4.3 Selected Viewpoints & Photomontages

As per the planning service determination letter of 10th August 2011 TCI Renewables have re-run ten selected cumulative photomontages from the original ES submission of thirty viewpoints The photomontages have been run using the tallest of the proposed alternative turbine models, the Enercon E82, utilising an overall height of 126m. The viewpoints were chosen as the most appropriate within the set to appropriately demonstrate that the proposed increase in height for the Pigeon Top Wind Farm will not cause any additional or more significant visual impacts beyond those already considered and consented through the planning appeal process.

The following viewpoints in Table 4.3 were chosen from the original thirty to be re-run as part of the planning amendment supplementary information.

Viewpoint	Title	Easting	Northing	Bearing	Field of View
V06	Dooish Road Bridge	233166	373292	148^0	72^0
V08	Sloghan Glen Waterfall	227692	374233	112.5^0	50^0
V16	Killyliss Road	241558	361015	328^0	46^0
V21	Cornavarrow	235161	368944	18^0	70^0
V22	Tattysallagh Road	233325	368580	37.7^0	73^0
V23	Dooish Road	233004	370162	66.5^0	88^0
V24	Glen Road	232555	371326	84^0	70^0
V25	Baronscourt	234303	376765	172.9^0	46^0
V27	Drumrawn Road	235589	373107	176.5^0	62^0
V30	Drumlegagh Road North	232898	380669	172.5^0	46^0

Table 4.3 Viewpoint Information

The location of each of the original thirty viewpoints is highlighted in Figure 4.3 below with the selected ten viewpoints for re-run shown with a red circle around each.

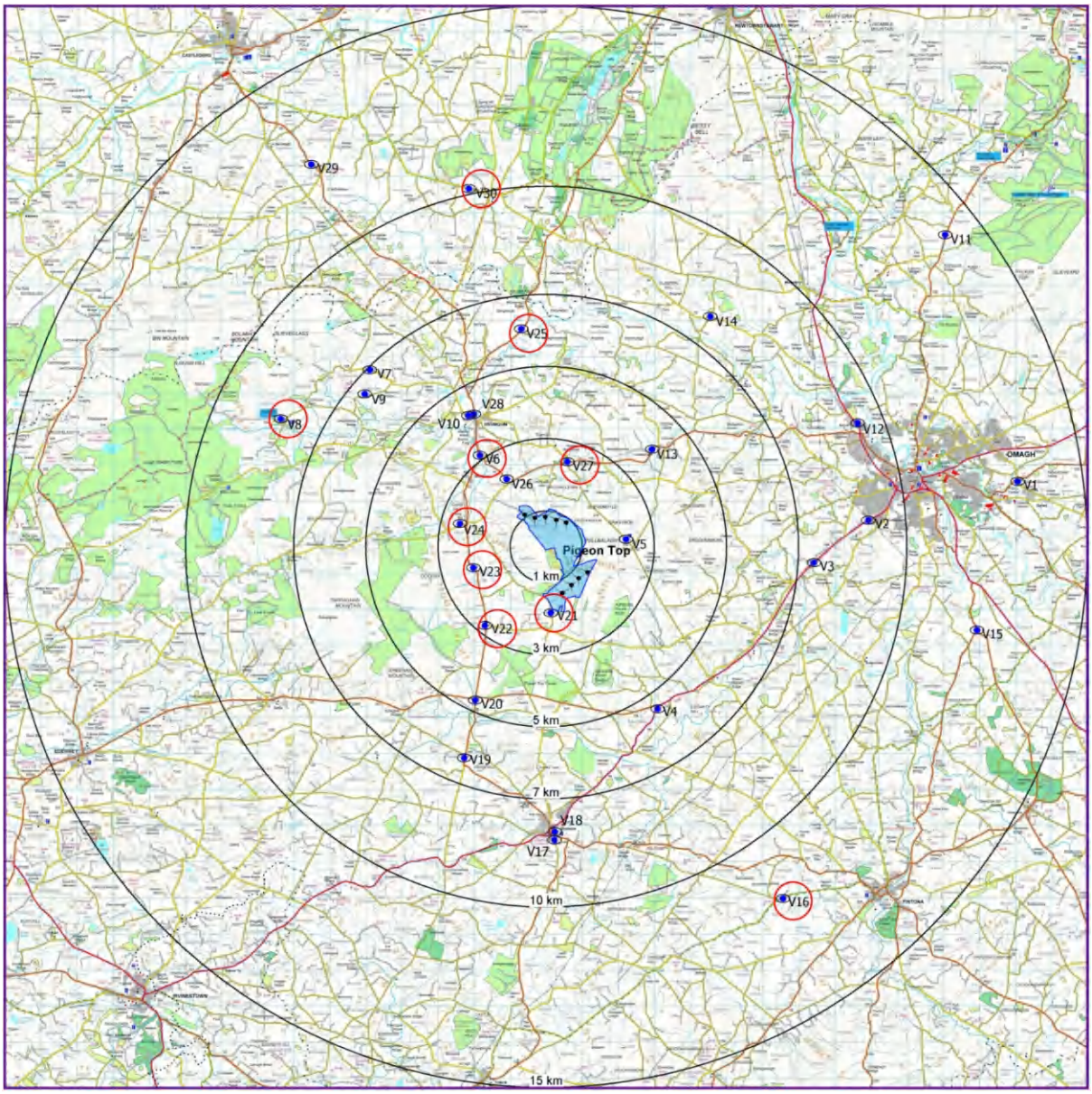


Figure 4.3 Original Viewpoint Map with Selected Ten Viewpoint Locations For Re-Run Highlighted

Each photomontage has been presented in the accompanying full colour A3 booklet entitled Pigeon Top Wind Farm Landscape and Visual Impact Assessment supplementary Information.

4.3.1 Conclusions

The photomontages demonstrate that, in cumulative context, the proposed change in height would be within acceptable limits of visual and landscape change. The increase of 26.5m in overall turbine height is nominal in the case of a structure of this size and will not be visually obvious. The proposed increase in height will not be evident in views of the turbines nor will it result in an increase in the visual or landscape impacts of the proposed development.

The approved Pollnalaght and Pigeon Top wind farm developments render the immediate receiving landscape as one already characterised by wind energy use, thus in terms of this locale, sensitivity to change by the introduction of taller proposed turbines at Pigeon top would now be considered low.

4.4 Cumulative ZTV Map with Pollnalaght Wind Farm

In order to demonstrate that the proposed increase in overall height of the Pigeon Top turbines from 99.5m to 126m will not create any additional significant adverse landscape and visual impacts, TCI Renewables have re-run the original cumulative ZTV map with the consented adjacent Pollnalaght Wind Farm. The original and re-run ZTV maps are presented in the full colour A3 booklet entitled Pigeon Top Wind Farm Landscape and Visual Impact Assessment supplementary Information.

When the two ZTV maps are compared side by side it is evident that the increase in height of the Pigeon Top wind turbines does not increase the overall ZTV area of the two wind farms. The shaded areas indicating the combined visibility of both wind farms remain the same in both maps.

4.4.1 Conclusions

As demonstrated in the cumulative ZTV mapping the proposed height increase does not spatially extend the area occupied by the two consented wind farms. It will however, contribute to the more successful meshing of the two developments, in most views.

This document has demonstrated that the proposed height increase will not result in a significant change in the appearance of the approved wind farm.

Appendix 1

Appendix 2