FURTHER APPEAL FORM

SECTION 26		SECTION 37	

Appeal No: PL _____ Reg. Ref: 14/06760

Lodged: 30/11/15 Case Type: 03

O.H. Request Date: _____ P.A. Decision Date: 03/11/15

Correct Fee: ~~Y~~/N Name/Address: ✓ 3rd party ack: ✓ Applic.Lodged: 19/12/14

Appellant: Barna Wind Action Group - address for Denis Buckley

~~Address~~/Agent: Noonan Linehan Carroll Coffey

MR Sutton

1. Acknowledge with: BPOM

Merge:

(1) psplit	☐	(4) omitdoc	☐
(2) msplit	☐	(5) info	☐
(3) revplan	☐	(6) xmas	☐
	☐		☐

2. Issue appeal to:

(a) P.A: BP 06

(b) Applicant: BP 06

(c) Other: BP 06 - other appellant

3. Return appeal with: _____

4. Return to prepare exp.ltr: _____

Comments:

Please insert date of cross circulation on control sheet ✓

EO: Rob Forde AA: [signature]

Date: 9/12/15 Date: 02/12/15

J:abp\forms

Noonan Linehan Carroll Coffey

SOLICITORS
54 North Main Street
Cork
Ireland
www.nlcc.ie

Telephone 021 4270518
Fax 021 4274347
Email info@nlcc.ie
DX 2044 Cork

Addressee

The Secretary,
An Bord Pleanála,
64 Marlborough Street,
Dublin 1.

~ By Courier DX ~

27th November 2015
Our ref: 26310-14/JN/PW

RE: Cork County Council Planning Register Reference 14/6760
The construction of six wind turbines, with a maximum tip height of up to 131m and associated turbine foundations and hardstanding areas, 1 no. permanent meteorological mast up to 90m in height, upgrade of existing and provision of new site tracks and associated drainage, new access junction and improvements to public road to facilitate turbine delivery, 1 no. borrow pit, underground electrical and communications cables, permanent signage and other associated ancillary infrastructure. This application is said to be 'intended to replace' development already granted permission under PL04.219620 (05/5907) and subsequently extended under 11/6605. This application is seeking a 10-year planning permission.

Development Address – Lackareagh and Garranereagh, Lissarda, and Barnadivane (Kneeves) Terelton, County Cork
Applicant – Barna Wind Energy (BWE) Ltd
Our clients – Denis Buckley and others known as Barna Wind Action Group, c/o Denis Buckley, Moneygoff East, Castletown, Enniskeane, Co Cork

---

Dear Sir/Madam,

We act on behalf of Denis Buckley and others known as Barna Wind Action Group, c/o Denis Buckley, Moneygoff East. Castletown, Enniskeane, Co Cork. Our clients wish to appeal the above decision issued by Cork County Council on 3rd November 2015. We enclose cheque in the sum of €220 being your fee herein together with original receipt from Cork County Council dated 3rd February 2015.

Grounds for Appeal

O( )ients' grounds for appeal are as set out in the enclosed documents namely:

a. Our original Observations of 2 February 2015 submitted on behalf of our clients to Cork County Council
b. Our further Observations of 9 July 2015 submitted in response to the Council's RFI
c. Submission by Michael O'Donovan of Barna Wind Action Group, a copy of which is enclosed herewith and all of which material is intended to be read together with this letter.

Our letter of 2 February 2015 and enclosures details and substantiates our clients' principal legal and planning objections. Our letter of 9 July 2015 elaborates on these in the light of the response to the RFI. It appears to us from the Council's file that the Council did not advert to the content of our July letter.

Extensive local opposition

The widespread local opposition to the application is, we submit a factor to which the Board should have regard. It is evidenced by the signatures of those supporting this appeal as well as by the number and quality of the submissions made to the Council, which the Board and its Inspector will see in the course of considering this appeal. This is significant. It is relatively unusual in a rural setting to see a planning application meet with such extensive opposition from neighbours.

This local disquiet is mirrored at the County Council level by the recently stated view expressed by elected members of the Cork County Council on what they describe as the proliferation of windfarms in the County, especially close to homes. We ask the Board to have regard to that considered view of the elected representatives of the people of County Cork.

Conflicting policies

While Government policy favours the rapid development of renewable energy sources including wind, that policy is not intended, and should not be interpreted so as to nullify all other relevant policies.

Long standing national and regional policies in respect of the protection and strengthening of rural life are faithfully reflected in the Cork County Development Plan for example in Development Plan Objective CS 4-2 e) which records it as an objective of the County to strengthen and protect the rural communities of the area by encouraging sustainable growth in population, protecting agricultural infrastructure and productivity so that agriculture remains the principal rural land use and focusing other employment development in the main towns and key villages.

The Board will be aware of these national, regional and local policies which require rural and family life to be respected and protected from undue interference or disruption and we submit that the Board must address them specifically in the course of its decision on this appeal. How is the balance between conflicting policies to be struck? We ask the Board to make clear in its decision what weight it gives to competing factors in reaching its decision. This is we submit indispensable so that the public concerned can understand the Board's reasoning as well as its conclusion. We therefore

ask the Board, and its Inspector, to pay particular attention to this issue and to record its analysis for the benefit of our clients and of other members of the public concerned.

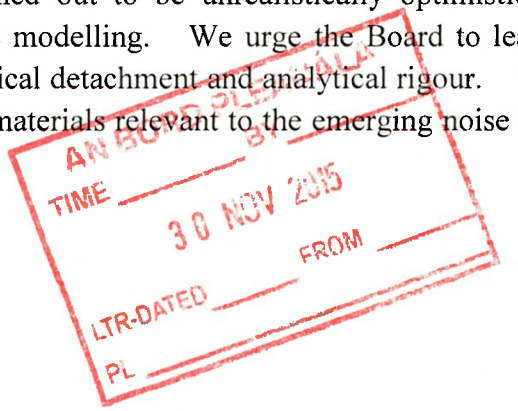
Large wind turbines pose particular challenges

This is now well known but it needs to be repeated. Several family homes have been rendered uninhabitable due to careless planning decisions which permitted large industrial wind turbines to be located close by. We are aware of homes in County Cork, in County Limerick and in County Roscommon which have been abandoned as a result. In each case planning was given for wind turbines in a manner which the relevant planning authority concluded would cause no undue interference with those living in nearby homes. That conclusion turned out to be mistaken. It is difficult to think of a more serious mistake than one which drives a family from its home. Yet that has happened, and we ask the Board to address the reasons why in the context of this appeal. What is it about the current approach that has led to such an outcome in so many places? Clearly something is wrong. The abandoned homes are the most extreme evidence of planning failure. Many more families have had their quality of life radically diminished. In most of these cases with which we are familiar, the residents affected were previously well disposed to windfarms. In many cases they were positively welcoming of their arrival locally. Yet the reality of the windfarm operations gave the lie to the impact predictions submitted during the planning process.

With the passage of time thus it has become clear that the approach taken in the past by planning authorities has not proven to be sufficiently robust to deliver decisions consistent with the proper planning and sustainable development of the area.

The Government has acknowledged that there is a problem by initiating its review of some of the elements of the 2006 Guidelines, including noise and shadow flicker. While the review process appears to have become bogged down, we submit that the Board must acknowledge that the fact of the review is confirmation that the noise and shadow flicker elements of the 2006 Guidelines are not now fit for purpose. We ask the Inspector and the Board to address our submission in this regard specifically in their Report and in their Decision, respectively as it is a key submission in this appeal. We further submit that it follows as a matter of logic and best practice that no planning permission should be granted on the basis of those elements of the 2006 Guidelines.

It is now clear that several windfarm planning permissions have been granted by the Board or by Local Authorities on the basis of what have turned out to be unrealistically optimistic impact statements relying particularly on inadequate noise modelling. We urge the Board to learn from experience and to consider this application with critical detachment and analytical rigour. To assist the Board in this respect we enclose a selection of materials relevant to the emerging noise nuisance issue.



Yours faithfully,

Joe Noonan,
NOONAN LINEHAN CARROLL COFFEY

Schedule of Enclosures

1. Receipt from Cork County Council
2. Cheque in the sum of €220
3. Submission by Michael O'Donovan.
4. Map referred to therein
5. Photographs referred to by Michael O'Donovan
6. Copy Observations to Cork County Council, 2nd February 2015.
7. Copy Observations to Cork County Council, 9th July 2015.
8. List of Supporting Signatures and Addresses
9. Article from Irish Examiner *"Consider solar energy and other green options to windfarms, say councillors in Cork"* 26th November 2015.

Articles

10. '*Wind Turbine Noise*' – British Medical Journal Editorial by Dr Christopher Hanning, Honorary Consultant in Sleep Medicine and Professor Alun Evans, Professor Emeritus

11. *'Diagnostic criteria for adverse health effects in the environs of wind turbines'* – Clinical Review in the Journal of the Royal Society of Medicine by Robert Y McMurtry and Carmen ME Krogh

12. *"Effects of Noise from Wind Turbines on Human Health"* by Colette Bonner, Deputy Chief Medical Officer in the Department of Health

13. *"Low Frequency Noise-Induced Pathology: Contributions Provided by the Portuguese Wind Turbine Case"* & *"Clinical Protocol for Evaluating Pathology Induced by Low Frequency Noise Exposure"* by Nuno Castelo Branco MD, Mariana Alves-Pereria Ph.D, Augusto Martinho Pimenta MD and José Reis Ferreira MD

14. Submission of Dr Christopher Hanning to the Australian Senate – Select Committee on Wind Turbines – February 2015

15. Proof of Evidence of Dr Christopher Hanning on behalf of Glenties Wind Information Group - Straboy Wind Farm Oral Hearing – October 2012

16. "Consider Solar Energy and Other Green Options to Windfarms" say Councillors in Cork 26 November 2015. Irish Examiner

Comhairle Contae Chorcaí
Cork County Council

An Rannóg Pleanála,
Halla an Chontae,
Bóthar Charraig Ruacháin, Corcaigh.
Fón: (021) 4276891 • Faics: (021) 4867007
R-phost: planninginfo@corkcoco.ie
Suíomh Gréasáin: www.corkcoco.ie
Planning Department,
County Hall,
Carrigrohane Road, Cork.
Tel (021) 4276891 • Fax (021) 4867007
Email: planninginfo@corkcoco.ie
Web: www.corkcoco.ie

Barna Wind Action Group
c/o Noonan Linehan Carroll Coffey Solicitors
54 North Main Street
Cork

05 FEB 2015

AN BORD PLEANÁLA
TIME _____ BY _____
30 NOV 2015
LTR-DATED _____ FROM _____

03/02/2015

APPLICANT: Barna Wind Energy (BWE) Ltd.

DEVELOPMENT: The construction of six wind turbines, with a maximum tip height of up to 131m and associated turbine foundations and hardstanding areas, 1 no. permanent meteorological mast up to 90m in height, upgrade of existing and provision of new site tracks and associated drainage, new access junction and improvements to public road to facilitate turbine delivery, 1 no. borrow pit, underground electrical and communications cables, permanent signage and other associated ancillary infrastructure. This application is intended to replace the development already granted permission under PL04.219620 (05/5907) and subsequently extended under 11/6605. This application is seeking a 10-year planning permission. An Environmental Impact Statement and AA Screening Report have been prepared in respect of the planning application.

AT: Lackareagh and Garranereagh Lissarda and Barnadivane (Kneeves) Teerelton Co Cork

FOR: Permission

PLANNING REGISTRATION NO: 14/06760

A Chara,

I wish to acknowledge receipt of your submission/observation on 02/02/2015 concerning this application. I enclose herewith receipt no. PLG9241 in respect of correct fee paid. I wish to confirm that your submission/observation has been received within the period of five weeks beginning on the date of registration of the application and is therefore considered a valid submission/observation.

Copies of site map/plans and particulars submitted in connection with the application will be available for inspection at this department during office hours (9.00 a.m. to 4.00 p.m., Monday to Friday) until the application, or any appeal thereon, is finally determined. The applicant shall be given your name and content of the submission/observation should it be requested.

Your letter will form part of the documentation available for inspection by the public. You will be notified when a decision is made on the application.

Comhairle Contae Chorcaí
Cork County Council

An Rannóg Pleanála,
Halla an Chontae,
Bóthar Charraig Ruacháin, Corcaigh.
Fón: (021) 4276891 • Faics: (021) 4867007
R-phost: planninginfo@corkcoco.ie
Suíomh Gréasáin: www.corkcoco.ie
Planning Department,
County Hall,
Carrigrohane Road, Cork.
Tel (021) 4276891 • Fax (021) 4867007
Email: planninginfo@corkcoco.ie
Web: www.corkcoco.ie

AN BORD PLEANÁLA
TIME _____ BY _____
30 NOV 2015
LTR-DATED _____ FROM _____
PL _____

This letter should be retained. If you wish to appeal such decision a copy of this acknowledgement together with the attached official document must accompany your appeal to An Bord Pleanála.

Yours faithfully,

Declan Whelton
Clerical Officer

Form no. 3

Articles 28 and 35

Comhairle Contae Chorcaí
Cork County Council

An Rannóg Pleanála,
Halla an Chontae,
Bóthar Charraig Ruacháin, Corcaigh.
Fón: (021) 4276891 • Faics: (021) 4867007
Ríomhphost: planninginfo@corkcoco.ie
Suíomh Gréasáin: www.corkcoco.ie

Planning Department,
County Hall,
Carrigrohane Road, Cork.
Tel (021) 4276891 • Fax (021) 4867007
Email: planninginfo@corkcoco.ie
Web: www.corkcoco.ie

ACKNOWLEDGEMENT OF RECEIPT OF SUBMISSION OR OBSERVATION ON A PLANNING APPLICATION

THIS IS AN IMPORTANT DOCUMENT

KEEP THIS DOCUMENT SAFELY. YOU WILL BE REQUIRED TO PRODUCE THIS ACKNOWLEDGEMENT TO AN BORD PLEANÁLA IF YOU WISH TO APPEAL THE DECISION OF THE PLANNING AUTHORITY. IT IS THE ONLY FORM OF EVIDENCE WHICH WILL BE ACCEPTED BY AN BORD PLEANÁLA THAT A SUBMISSION OR OBSERVATION HAS BEEN MADE TO THE PLANNING AUTHORITY ON THE PLANNING APPLICATION.

PLANNING AUTHORITY NAME **Cork County Council**

PLANNING APPLICATION REFERENCE NO. 14/06760

A submission/observation, in writing, has been received from:

AN BORD PLEANÁLA
TIME _____ BY _____
30 NOV 2015
LTR-DATED _____ FROM _____
PL _____

Barna Wind Action Group
c/o Noonan Linehan Carroll Coffey Solicitors
54 North Main Street
Cork

ON 02/02/2015 in relation to the above planning application.

The appropriate fee of €20 has been paid.

The submission/observation is in accordance with the appropriate provisions of the Planning and Development Regulations, 2001 and will be taken into account by the Planning Authority in its determination of the planning application.

Planning Department
03 FEB 2015
Cork County Council
County Hall
Cork.

Local Authority Stamp

Declan Whelton
Clerical Officer

Date: 03/02/2015

Download Cork County Council's Planning Viewer App

Google Play Store **App Store**

Recycled

Barna Wind Action Group
c/o Noonan Linehan Carroll Cof
54 'h Main Street
Co.

03-FEB-2015
12:19:19

Cork County Council
County Hall
Cork
Tel - 021 427 6891
VAT Registration No - 0007458M

Receipt : PLG0009241

Header Details

Receipt Reference:	PLG0009241
Received From:	Barna Wind Action Group
Billing Address:	c/o Noonan Linehan Carroll Cof 54 North Main Street Cork
Account No.:	POS 7000004
Amount Paid (EUR):	20.00
Type:	CHEQUE
Comments:	Submission 14/6760
Receipt Issued By:	AFALVEY
Receipt Date:	03-Feb-2015
Site:	0300 : Planning Applications/Submiss
D/N/U:	D
Invoice Reference:	9000063192 : CHEQUE

AN BORD PLEANÁLA
TIME _____ BY _____
30 NOV 2015
LTR-DATED _____ FROM _____
PL _____

Line Details

From Reference	To Reference	Transaction Date	Remarks	Amount
PLG0009241	9000063192	03-Feb-2015	Submission 14/6760	20.00

RECEIPT IS ISSUED SUBJECT TO CLEARANCE OF CHEQUE/CREDIT CARD
ISSUED ON BEHALF OF
Planning Applications/Submiss,
Planning Front Office, Floor 1,
,

An Bord Pleanala,

64 Marlborough Street,

Dublin 1

THIS APPEAL IS IN RELATION TO PLANNING APPLICATION NO.14/06760

The construction of six no. turbines and associated works

The developer is Barna Wind Energy Ltd.

The location is Lackareagh and Garranereagh, Lissarda and Barnadivane (kneeves) Teerelton Co. Cork.

ENVIRONMENT/ECOLOGY

ECOLOGIST PRIMARY REPORT/ENGINEERING REPORT FURTHR INFORMATION 13/02/2015 and 27/07/2015 SHARON CASEY

1.THE GEARAGH cSAC (108)/SCREENING CONCLUSION

Here it is stated that because of the *lack of physical or hydrological connection between the development site and this site.....no further information is required.*

The ecologist has agreed with the EIS and concluded for the above mentioned reasons, that the Gearagh cSAC can be screened out at this poit of the process. It is my contention that this is a factual error.

The Cummer River, which drains the northern part of the proposed site, connects with the Bulingea River, which subsequently enters the Carrigadrohid reservoir to the north west of Lissarda. Carrigadrohid reservoir stretches from Carrigadrohid village, almost as far as Toon bridge.

Carrigadrohid reservoir most certainly includes the Gearagh cSAC and also the

Gearagh SPA. This is an indisputable fact and the Bord can verify this for themselves. No information is provided by the applicants in relation to the hydrology of the lake reservoir with regard to, lake water balance, geochemical processes, siltation and sedimentation processes, flow rates and directions, input forces and interconnectivity of the above.

No information is given either in terms of flora and fauna. The Gearaghs eastern boundary is merely a line drawn across the reservoir and clearly the local flora and fauna do not respect this division.

THERE IS A HYDROLOGICAL CONNECTION BETWEEN THE PROPOSED WIND FARM AND THE GEARAGH cSAC AND SPA AS THAY ARE CONTAINED WITHIN THE WATER CATCHMENT OF THE CARRIGADROHID RESERVOIR.

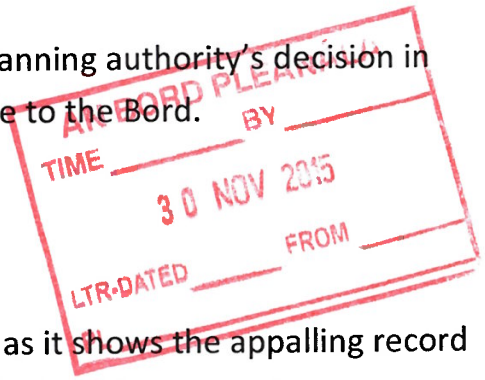
I have no doubt that the planning authority and the applicant have made a mistake in screening out the Gearagh based on the lack of a hydrological connection. Below I have included a recent high court decision that is pertinent to this case.

APPROPRATE ASSESSMENT

The Irish High Court in Kelly & Ors. v An Bord Pleanála4 (25 July 2014) considers the application of the Habitats Directive, and provides clarity on how a consenting authority should undertake an Appropriate Assessment ("AA"). It requires a very stringent and comprehensive analysis to be carried out when considering AA and in conducting and recording decisions in respect of both Phase 1 Screening for AA and Phase 2 AA. In Kelly, Ms Justice Finlay Geoghegan concluded that the Board had not lawfully conducted an AA in accordance with Article 6(3) of the Habitats Directive. She held that, in order to be lawfully conducted an AA: » Must identify, in the light of the best scientific knowledge in the field, all 4 [2014] IEHC 400 aspects of the development project which can, by itself or in combination with other plans or projects, affect the European site in the light of its conservation objectives. This clearly requires the decision maker to carry out both examination and analysis and to carefully record same. » Must contain complete, precise and definitive findings and conclusions and may not have lacunae or gaps. The

requirement for precise and definitive findings and conclusions requires examination, analysis, evaluation and the making of a complete decision. Further, the reference to findings and conclusions in a scientific context requires the decision maker to make findings following analysis and to draw conclusions following an evaluation of those findings, each in the light of the best scientific knowledge in the field. » May only include a determination that the proposed development will not adversely affect the integrity of any relevant European site where, upon the basis of complete, precise and definitive findings and conclusions made , the consenting authority (in this case the Board) decides that no reasonable scientific doubt remains as to the absence of the identified potential effects.

I conclude that the Bord should re-evaluate the planning authority's decision in light of the new findings that I have made available to the Bord.



APPROPRIATE ASSESSMENT SAC/SPA

I feel that it is also worth including this document as it shows the appalling record Ireland has in applying and transposing the Birds And Habitats Directives especially with regard to SACs and SPA s. It is principally for this reason that there have been so many judgements against the Bord in this matter and many more are coming down the line if the Directives cannot be enforced robustly in this country. I particularly draw your attention to the section about Cork County Council and its ignominious role in this affair. It is clear now that the so called wind designated areas are illegal in many cases as there is a paucity of designated sites in the county. Many potential SACs and SPAs have been subject to development, especially windfarms which would explain why there is a proliferation of wind farms in county cork, with many more in the pipeline and a scant disregard for the flora and fauna of the county. A sound legal basis has been missing from many grants of planning permission in this county.

An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht

Judgment of the Court of Justice of the European Union in Case C 418/04 Commission v Ireland

"The Birds Case"

A Programme of measures by Ireland to ensure full compliance with the Judgment of the Court of Justice of the European Union

Update – July 2015

CONTENTS SUMMARY

- The case against Ireland – what is it about
- Ireland's response to the Judgement

Sections

Response to the specific findings against Ireland

1. **Inadequate Number and size of areas classified as SPAs, contrary to Article 4 (1) and (2) of the Birds Directive**

2. **Failure to apply the first sentence of Article 4(4) of the Birds Directive to the areas that should have been classified as SPAs**

3. **Failure to transpose and apply the second sentence of Article 4(4) of the Birds Directive**

4. **Inadequate transposition and application of Article 6(2)-(4) of the Habitats Directive**

5. **Failure to transpose Article 10 of the Birds Directive. Obligation on Minister to encourage research**

The Department contacted planning authorities by way of circular letter (PL 16/2013 of 28 August 2013) reminding all planning authorities to ensure that any non-compliant plans are brought into compliance in a timely manner. The Department specifically requested those planning authorities who have 'existing plans' in place which encompass Hen Harrier SPAs to fully satisfy themselves as to the compliance of their land use plans (both development plans and local area plans) that pre-dated the commencement of the relevant 2010 Act provisions, paying particular attention to the zoning of environmentally sensitive lands for major developments, e.g. wind farms, where there are sensitivities in regards to the Hen Harrier SPAs.

The Department reported the outcome of this analysis to the Commission (Letter from Planning Section on 19 November 2013 – see position as set out below) and confirmation from the relevant planning authorities regarding compliance of their land use plan objectives with the Planning and Development

(Amendment) Act 2010. In this context, it is not deemed necessary and accordingly not proposed to make further amendments to primary legislation on this issue, especially as the existing provisions in the Planning and Development (Amendment) Act 2010 are being implemented sufficiently. However, the Department continues to keep the matter under consideration and monitors compliance of both existing and new plan objectives.

Hen Harrier SPAs (Laois, Offaly, Cork, Kerry, Limerick, Tipperary, Monaghan, Clare and Galway)

The position in regard to the nine planning authorities with Hen Harrier SPAs (Laois, Offaly, Cork, Kerry, Limerick, Tipperary, Monaghan, Clare and Galway) is as follows:

Eight of the planning authorities (Laois, Offaly, Kerry, Limerick, Tipperary, Monaghan, Clare and Galway) concerned have confirmed that their relevant plans are fully compliant with the Habitats and Birds Directives.

In the case of Cork County Council, the Council has outlined that, in relation to the existing County Development Plan 2009-15, the plan does not contain wind energy land-use zoning maps. However, it does contain a Wind Energy Strategy which includes an indicative map (unscaled) identifying certain parts of the county as "strategic search" areas, where developers are encouraged to focus efforts in the identification of suitable sites for wind energy initiatives. Some of these search areas partially overlap with mountainous and upland areas running from the Stacks to Mullaghareirks and West Limerick Hills Special Protection Area which is designated for the protection of Hen Harriers. Importantly, the objective relating to the strategic search area (INF 7-4) states that, in considering the merits of particular planning applications in such areas, the Planning Authority will have regard to 'the impact of nature conservation, in particular avoiding designated and proposed European sites'.

Furthermore, the Council's wind energy strategy is currently being reviewed in the context of the review of the County Development Plan (the draft plan was published for first round of public consultation in January 2014).

The County Cork Hen Harrier SPAs (Sites 4161 and 4162) are all within the

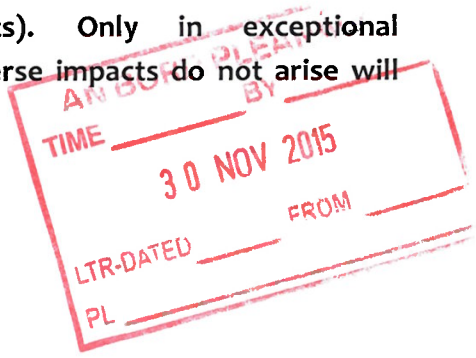
Normally Discouraged Zones as identified on the Wind Energy Strategy Map in the draft County Development Plan as published in December 2013. In addition, it has been proposed through the material amendments to include a 500m buffer around these sites to be included in the Normally Discouraged Zone.

It is further proposed through the material amendments

- to include all Natura 2000 sites within the Normally Discouraged Zone (some parts of some Natura 2000 sites had not been included within this zone on publication of the draft CDP); and
- to include an 800m buffer around SPAs designated for the protection of Wetlands and Waterbirds within the Normally Discouraged Zone.

The proposed policy for the Normally Discouraged Zone is as follows:

> **ED 3-6 Commercial wind energy developments will be discouraged in these area which are considered to be sensitive to adverse impacts associated with this form of development (either individually or in combination with other developments). Only in exceptional circumstances where it is clear that adverse impacts do not arise will proposals be considered.**



2. WHITE TAILED SEA EAGLE

The applicants were asked to contact the Irish Raptor Study Group, it has failed to do so saying that it has received no response. This is unacceptable. A professional opinion must be got from this organisation and until it is the Bord should not consider this matter to be closed. This species is listed Red because of its tiny breeding population which needs to expand if the reintroduction programme is to succeed. Cork has already seen breeding in Glengarriff in 2015 and a breeding attempt in Loch Alua in 2014 in the upper Lee valley not far from this site. Breeding is expected to take place in the Gearagh in the future which will be a huge and much needed tourist draw for the area and indeed it is hoped that the Lee valley will host a strong and internationally important population.There is a

severe lack of understanding of the ecological requirements of the WTS Eagle in the EIS and subsequent reports.

Cork county planning department cannot cherry pick which directives, guidelines, legislation, etc. that it wants to follow. This has been clearly demonstrated in a recent high court decision which stated that no one policy etc. can override another; rather all decisions must be compliant with all relevant policies etc. The wind industry wants have clearly trumped cork county councils own development environmental objectives and many of its obligations under EU environmental law.

3.KESTREL AND SNIPE

Not wishing to reiterate points I made in my original objection I would like to add that the conclusions drawn by the planning authority in relation to both these species are based on very little data. There is no quantification of the actual losses incurred by the development. This is not a sound basis for the wilful destruction of these Amber Listed species.

I am also concerned that the Meadow Pipit (breeding and winter visitor to this site), Red listed, was dismissed in terms of the significance of the levels of negative impacts on this species. The statement by the applicant that the reasons for the decline of this species may be due to recent cold winters, was both misplaced and misguiding.

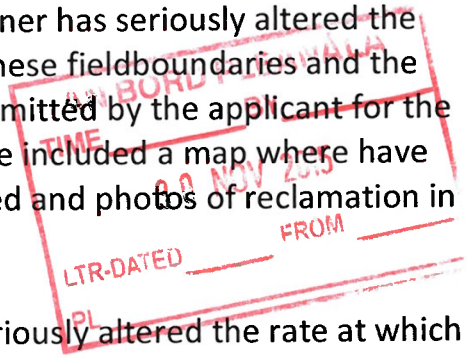
Meadow pipits, like all ground nesting farmland birds in Ireland , have undergone catastrophic declines, especially in the last 25 years. There are no exceptions. According to the most recent Bird Atlas 2007-2011, meadow pipits have been in decline for at least 11 years. This is why it has gone onto the critically endangered list and all relevant statutory bodies are obliged to consider this serious matter.

5. BATS

LAND ALTERATIONS

Part of this site, where it abuts the River Bride was altered last September/October. The lands in question are owned by Barry O'Sullivan. Significant works were carried out when several hundred metres of hedgerow/fieldboundaries were removed to create larger fields. Most importantly, hedgerows were removed that were running parallel to the river Bride. This is discouraged in the IFA guidelines and by the Inland Fisheries because such banks have a very important blocking effect on the movement of rainwater into the river. More significantly one bank was at the base of a very steep hill while another was a good bit further up the hill enclosing several small fields. The hill is more open now and very deep drainage channels have been dug running perpendicular to the river. The reclaimed area adjoins one of the turbine locations.
The fieldboundaries that were removed were the subject of part of a recent RFI issued by the planners with regard to the flight lines of bats on site and mitigation measures needed to divert the bats away from the turbines.

a) By removing the fieldboundaries the landowner has seriously altered the flight patterns of the bats that occur here. These fieldboundaries and the flight lines were clearly marked on maps submitted by the applicant for the RFI and can be examined by the board. I have included a map where have marked the approximate hedgerows removed and photos of reclamation in progress.



b) The creation of new drainage ditches has seriously altered the rate at which water now leaves this area which has other implications.

I believe that a reassessment needs to take place in light of these alterations and that the planning authorities decision (especially mitigation measures) was based on information that is no longer valid.

Only two bat roosts were recorded as being near the proposed development. This is erroneous, as I have stated on several occasions. I have requested, that a maternity bat roost in the attic of my house, be assessed by the applicant as part of the EIS. I know of several more in other houses and outbuildings. There has been no approach so far by the applicant to me, which goes against best practice of seeking out local knowledge when surveying, which is only common sense.

Until these matters are sorted out, I suggest that the Bord defer their decision.

6.TERRESTRIAL HABITATS

The applicants were asked to supply a revised and detailed map illustrating all habitat types within the site. As I have already shown, the map they have provided is factually incorrect. Several habitat types were omitted, such as Rocky Outcrops (site of borrow pit) and an area of intact Montane Heath located on the landed owned by Seamus O'Leary. I can only conclude that the map presented was the result of a desktop survey (google earth map) and the site was never walked over. It is the only reasonable conclusion when one lists all the errors and I ask the Bord to investigate this matter further. EIS findings based on this map are invalid.

7.FRESHWATER HABITATS/RIVER BRIDE AND ADJACENT MARSH

It says in the Senior Executive Planner Report *that the Bride River is c. 1,5km to the southwest of the boundaries of the windfarm.....there are no significant watercourse within any of the proposed development sites.*

This is factually incorrect as the River Bride abuts the southern margins of the site. Therefore it is within the site. The entire site represents a large area of the headwater catchment of the River Bride. As of now, the applicants have screened the Bride and adjacent ecologically important marsh out of the EIS reports. I continue to maintain my position that this is an unacceptable omission.

INVASIVE SPECIES

There is very little consideration given to invasive species at and around this site, including what may be present along the haulage route. I believe this to be a deficiency in the EIS.
Invasive species are recognized as one of the greatest threats to Ireland's flora and fauna. As I have demonstrated already that as there is a hydrological

connection to the Gearagh cSAC/SPA, then a much more robust plan must be developed through proper investigative surveys.

PLANNING APPLICATION

Planning Authority Guidelines state *that the submission of incorrect information or omission of required information will lead to the invalidation of your application.*

Below are some points which may be worthy of consideration by the board.

10. Are you satisfied that the proposed development does not constitute a 'Strategic Infrastructure Development' as defined in the planning and development acts2000-2010(please tick)

The applicant responded-Yes

Under the O'Griana judgement, every aspect of a wind farm project must be assessed as 'one'. When this application was made, the applicant had already lodged an application for a proposed new substation which if granted will be part of this development. The applicant has subsequently revealed that the substation will be taken over by Eirgrid who will be free to make any connections and extensions that they wish. This changes the substation status, from only to serve Barnidivane substation (Bord Pleanala SID meeting minutes which are on the proposed substation file) to SID status following a statement acknowledging further connections (Shehymore wind farm) and Eirgrid takeover. This change of circumstances means that the substation qualifies as a transmission generator strategic infrastructure development.

22. Development Details

Does the application relate to work within or close to a European site (under S.I.No.94 of 1997) or a National Heritage Area?

The applicant responded – No

Considering that I have already demonstrated that there is at the very least a hydrological connection between the Gearagh SAC/SPA and, that the proposed site is merely 6kms from the Gearagh and having regard to S.I.No.94 of 1997, I believe that the answer here should have been yes.

30. Please give details of all emissions produced on site and details of the proposals for the control of such emissions i.e. smoke, odour, noise, dust, etc.

The applicant responded-No significant emissions produced on site.

When one considers that for instance, about 3000 cubic mts of concrete will be needed just for the turbine bases, the processes involved in making roads and tracks which include quarrying and rock breaking and possibly the use of explosives, construction traffic etc, the list is extensive in such a large industrial project, I do not think the applicants response is at all adequate.
There was also, among other things, an RFI asking that... *A construction phase noise impact assessment should be undertaken and submitted...* Andrew Mc Donnell, Environmental report Primary. This must surely demonstrate an omission or false information submitted and has gone on to cost the planning authority and the general public, time and money through RFIs etc.

Q31.Please give details of all liquid effluents and solid wastes, including method of disposal and/or treatment of sewage.

The applicant responded-No liquid effluents will be produced during operational phase. All solid wastes from maintenance works during operation will be disposed of at a licensed facility.

The applicant has limited his comments to the operational phase only, which constitutes an omission. Liquid effluents will be produced during the operational phase actually, nacelle maintenance etc.

Q33 (a) Please state the estimated No. of employees:

The applicant's response-N/A

(b)Please state the estimated amount of traffic likely to be generated:

The applicant's response-N/A

The applicant has stated in the EIS that there will be employment during the construction and operational phases. So why this answer?
And since there will clearly be both construction and operational phase traffic, again, why this answer?

CONCLUSION

It is my belief that the above document does not satisfy the Cork County Planning Authority planning application rules and should be deemed invalid. It is at the very least misleading and many of the issues that were raised through RFIs should have been flagged through this document for consideration by the planning authority at the pre-planning meetings stage. This document has played a large role in terms of the O'Griana case in regard to assessing the overall cumulative impacts of the entire project.

VISUAL IMPACT

PLANNERS REPORT PRIMARY CAROL STACK 19/02/2015

The senior planner states *that there is a distinct relationship between a wide range of mitigation measures.....and that these interactions would have a potentially significant effect, depending on the effectiveness or otherwise to mitigate risk.*
She goes on to state that regarding residual effects, that the main areas of concern *are increase in turbine height, ecology, residential amenity and potential for noise impacts.*

The integrated effects of this proposed development are wide ranging. The proposed development is situated in an area with relatively high density of domestic and agricultural dwellings for a wind farm site of this scale. There is a high mitigation risk factor built in to this development. Were all of the mitigation measures to fail it would have a very significant effect, the cumulative impact huge.

The residual effect would be very considerable and would include permanent alterations to, rolling hilltop and valley depression, domestic, agricultural and commercial features, tourism and recreational area, environment and future planning applications, noise impacts from various sources and health issues.

I believe that the residual effect of this development cannot be militated against effectively in any way and that the development goes against objectives in the county development plan designed to protect people and the environment, and is neither proper nor sustainable development.
I do not believe that the (very considerable) impacts as listed in the planners reports have been dealt with at all adequately and that the applicant's negligible or positive effects are, frankly, ludicrous. There is not one of 258 submissions that think this is likely either. The constant referral by the applicant that the "do nothing scenario" is that the permitted No.14 turbines will be built is fallacious. Planning has been going on at this site for decades and nothing has been built yet. In fact the applicant has stated (on file, proposed substation) that he cannot build the permitted No.14 turbines unless he gets approval for the new substation, as the permitted substation does not meet new Eirgrid standards (2011). Again in the cumulative impacts assessment of the proposed windfarm, proposed substation and private roadway, which is deemed negligible compared to the "do nothing scenario", is a total misrepresentation of the facts in my opinion and do not assuage the fears of this community.
So, let me be clear, the do nothing scenario is, that things continue as they are, and the majority of this community continue to enjoy the natural and recreational benefit that this area yields, after all, it is their home.

I do not agree with the Senior Executive Planner in her summing up that despite the short comings in the EIS and the need for a further information request, she believes that the EIS is not deficient in legal terms. She then says that a full EIA cannot be carried out until a cumulative evaluation is completed. I believe that this is a noncompliance with the EIS directives and does in fact make the EIS document legally deficient and as such the entire planning application invalid.

In her conclusions the Senior Executive Planner only references policies and plans that are biased in favour of wind development and does not examine any contrary policies and plans etc.

She then uses the planning history of the site and the existing nearby windfarm as a reason to consider this proposal at this location. However with regard to the planning history at this site I include below some comments from the Bords own Planning Inspector (ABP ref 04.219620 Planning Inspector's Report).

The An Bord Pleanala Inspector's Report relating to appeal ref. no. 04.219620 and relating to the permission for the 14 permitted wind turbines actually recommended refusal but the Bord did not agree with this recommendation. The Inspector stated *the need to respect the intimate nature of the landscape area* and goes on to say *having regard to the landscape character of the area and the pattern of residential development in the vicinity and not withstanding the designation of the site with a Strategic Search Area it is considered that the proposed development.....would be excessively dominant and visually obtrusive in the landscape. The proposed development would , therefore, seriously injure the amenities of the area and property in the vicinity and would be contrary to the proper planning and sustainable development of the area.*

The notion that the existence of a wind farm creates a precedence which favours future wind farm applications, has many legal implications if it were true.

SCENIC ROUTES

The Draft County Development Plan for Cork places a high value on preserving its outstanding landscape and it's many established Scenic Routes-

'County Cork contains many vantage points from which views and prospects of great natural beauty may be obtained. This landscape is of enormous amenity value…. And constitutes a valuable economic resource… the plan identifies specific Scenic Routes consisting of important and valued views and prospects within the County' (13.7.1)

In general these Scenic Routes are to be protected to a high degree-

'Protect the character of these views and prospects obtainable from scenic routes and in particular stretches of scenic routes that have very special views and prospects' (GI7-2)

The proposed windfarm will impact upon one scenic route dramatically and several other less so. It will also dramatically affect the entire Coppeen Waymarked Walking Trails routes.

NOISE

PLANNERS REPORT FURTHER INFORMATION ASSESSMENT/ PAUL MURPHY/3/11/2015

In a further information request stating *further additional noise monitoring needs to be conducted in this regard in order to evaluate the existing environment and its sensitivity.*

This RFI refers to a proper and clear determination of the true background noise levels at this site. This data represents possibly the single most important piece of data in respect of noise evaluation and Cork County Planning Authority deemed it necessary to have this information in order to make a correct and safe decision on the application before them.
The applicants have however, reassessed their data which was subsequently peer reviewed and declared that there was no point in conducting any additional noise monitoring as the results would be that same as before.
I do not concur with this rational. The applicants cannot be absolutely sure that there have been no environmental changes at this site. They also have not taken this opportunity to place microphones in alternate locations in order to give as balanced a record of background noise as is possible. As it stands the windfarm is only barely within the allowable noise thresholds as per the DoEHG guidelines. The applicants have not satisfied the RFI request on this crucial matter and I believe that the Planning Authority have demonstrated specious reasoning in accepting the applicants response.

The issues around turbine make and model and the methodology of the applicants noise modelling has not been satisfactorily resolved in my opinion and needs to be resolved in the interests of fairness and clarity. To this point a large number of the issues in the submissions on this proposed development raised the issue of noise impacts.

Cork County Planning Dept. have imposed a number of conditions relating to noise emissions from the proposed development, conditions no. 22 & 23. This inherently implies that there is the potential for the proposed development to exceed the allowable thresholds as expressed in the DoEHG guidelines. I do not

have faith in conditions that are wholly to be implemented by the developer. In fact Cork County Councils Environment department does not even have the equipment necessary to measure the noise levels at windfarm developments. I find this situation to be unacceptable and at the very least, for the sake of public health and safety, windfarm noise emissions should come in well below the allowable thresholds.

CONSTRUCTION TRAFFIC
I still have concerns over construction traffic predicted noise, effects upon roads and water surface runoff, health and safety and choice of haulage routes.

ARCHAEOLOGIST'S REPORT

It is stated here (re cultural heritage) that if any 19th century field boundaries are removed, they will be recorded during archaeological testing and recording. As I have already stated in the section under BATS, some field boundaries have already been removed recently and have not been duly recorded.
Would the Bord please comment upon this development?

HYDROLOGY

I am not satisfied with the Bords decision, especially considering that there are no mitigation measures in place to protect the River Bride and Cummer, and associated wetlands from potential leaching of CaCo3 and other minerals from the concrete bases of the turbines. As the receiving water catchment is very acidic, the effects of calcium carbonate leaching into the system would be significant. The aquatic fauna adapted to live in acidic conditions are very vulnerable to CaCo3 contamination.

CONCLUSION

It is to be noted that there were 258 submissions made on this proposed development to Cork County Planning Dept. and this level of concern by the

community was sustained during the reopening of the planning due to significant further information being received. Further petitions were signed and public meetings convened within the local community by concerned residents were well attended. As can be seen by viewing the addresses of the submissions received, the vast majority of the community is against this proposed development and does not agree with either the applicant or the planning authority with regard to any apparent positive effects of the proposal but rather feel overwhelmed by the level of negative impacts that this proposal would impose on them against their will. This concern deserves to be given due consideration by the Bord.

I respectfully ask the Bord to consider the issues that I have raised in this Appeal.

Michael O'Donovan
Moneygoff East,
Castletown,
Enniskeane,
County Cork

CURRICULUM VITAE

EDUCATION

MICHAEL O DONOVAN holds a Diploma in Geology at UCC, a Diploma in Amenity Horticulture at Scoil Stiofan Naomha, a Diploma in Textiles at Fas specialising in plant fibres and the cultivation and use of plants for dyeing, Forestry Inventory training with Coillte, various specialist Horticulture courses in the Organics and Fruit Production, and Nursery related courses and workshops delivered by the industry.

I have completed the following training specific to the requirements of my current position:

- Assessment Techniques Fetac level 6
- Train the Trainer Fetac level 6
- IOS training
- Disability Awareness training
- FAS Supervisor training level 6
- Mental Health training
- Manual Handling Instructor

WORK EXPERIENCE

- My Work Experience includes managing 5 different Garden Centres and 3 Nurserys to date. Delivering forestry inventory for Coilte.
- FAS supervisor delivering Fetac levels 4/5.
- Horticultural consultant.
- I currently manage the commercial interests of the Hort Unit at NLN Bantry including a Nursery and a Garden Centre. I also deliver Horticulture modules Fetac level 4, Manual Handling Fetac level 4, and teach RHS Cert and Work Experience level 3.

ORGANISATIONS/CLUBS

- I have been a committee member of The Irish Wildlife Trust (Cork Branch)
- I have been a committee member of Bird Watch Ireland (Cork Branch)
- Cork Geological Society
- Botanical Society Of Britain and Ireland

RECENT PUBLICATIONS

- "Foraging in the Anthropocene" contributing article, BSBI NEWS, September 2015 Botanical Society Of Britain and Ireland

Legend

- Proposed Turbines
- Proposed Site Compound
- Proposed Borrow Pit Location
- Proposed Permanent Met Mast

Proposed Substation (separate application)

- Area of Proposed Substation
- Future Expansion Area
- Development Boundary
- EIS Study Area Boundary

Wind Farm Roads

- Upgrade Existing Roads
- Proposed New Access Tracks
- Common Pipistrelle Recorded Locations
- Derelict Building

Bat Commuting & Foraging Routes

- Prospective Commuting/Foraging Areas
- Confirmed Commuting/Foraging Areas

Date 01/05/2015

Name Of Client
Barna Wind Energy Ltd.

Name Of Job
Barnadavine Wind Farm

Title Of Figure
Common Pipistrelle Records & Bat CommutingForaging Routes

Scale Used 1:14,000

Figure No. LE1470202_0400_015 Rev A

FEHILY TIMONEY & COMPANY
CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Core House, Pouladuff Rd, Cork, Ireland.
T +353-21 4964133 F +353-21-4964
Unit 16, 15 Place, North Park Business Park, Dublin 11, Ireland
T +353-1 6503500 F +353-1 6503581
W www.fehilytimoney.ie, E. info@ftco.ie

2

3

4

Noonan Linehan Carroll Coffey

SOLICITORS

54 North Main Street
Cork
Ireland

www.nlcc.ie

Telephone 021 4270518
Fax 021 4274347
Email info@nlcc.ie
DX 2044 Cork

Addressee

The Secretary,
Planning Department,
Cork County Council,
County Hall,
Cork.

2nd February 2015
Our ref: 26310-14/JN/PW

RE: Planning Register Reference 14/6760
The construction of six wind turbines, with a maximum tip height of up to 131m and associated turbine foundations and hardstanding areas, 1 no. permanent meteorological mast up to 90m in height, upgrade of existing and provision of new site tracks and associated drainage, new access junction and improvements to public road to facilitate turbine delivery, 1 no. borrow pit, underground electrical and communications cables, permanent signage and other associated ancillary infrastructure. This application is said to be *'intended to replace'* development already granted permission under PL04.219620 (05/5907) and subsequently extended under 11/6605. This application is seeking a 10-year planning permission.
Development Address – Lackareagh and Garranereagh, Lissarda, and Barnadivane (Kneeves) Terelton, County Cork
Applicants – Barna Wind Energy (BWE) Ltd
Our clients – Denis Buckley and others known as Barna Wind Action Group, c/o Denis Buckley, Moneygoff East, Castletown, Enniskeane, Co Cork

---

Dear Sir/Madam,

We act on behalf of Denis Buckley and others, known collectively as Barna Wind Action Group, c/o Denis Buckley, Moneygoff East, Castletown, Enniskeane, County Cork. Our clients wish to make an observation in relation to this planning application. We **enclose** the appropriate observation fee of €20. Please acknowledge safe receipt.

We also **enclose** a number of petition forms signed by local residents who are part of the community and who wish to be associated with this observation. We would ask you to note the extent of the concern in the locality as evident from the number of people signalling opposition to the planning application.

This is directly relevant to the claim made on behalf of the applicant that this development is in some way a *'community partnership model'*. This claim is put forward at page 1 of the EIS Non-Technical

Summary. Contrary to that claim, the reality is that the community is not in partnership with the developer. Some individual property owners may well be in a form of commercial partnership with the developer, which would be an entirely different relationship.

1. The application is invalid

Remarkably the application is one of a series of at least three applications all dealing with individual elements of the same project. Based on public statements attributed to the developer, the project is designed to facilitate still more developments, the details of which are not yet disclosed to the public.

The developer applied on 26 September 2014 for permission for a large substation on the site – see your file PA Reg. Ref 14/00557. This was subject of an Order to grant permission made by Cork County Council on 13 January 2015, and that decision will be the subject of an appeal to An Bord Pleanála.

The developer is also seeking permission for a private road joining the R585 to the L6008 intended to facilitate the present application.

Finally the developer's parent company is quoted in the Southern Star (January 10. 2015) as stating that the greatly enlarged substation is designed to facilitate connections from other potential windfarms up to 25km distant. No further details are known to the public at this time however.

It is self-evident and undeniable that this is a classic case of project splitting.

The EIA Directive as implemented under domestic legislation obliges a planning authority to assess the likely significant environmental impacts (including impacts on local residents) of a project. In these circumstances, no assessment of the project is possible as the extent of the project is unknown. The project has been split to an exceptional degree: elements of it are spread across multiple planning applications, three of which are in the public domain so far, and other elements are as yet a mystery. Those unknown elements involve future windfarm developments and connection works over a huge area, up to a distance of 25 kilometres in all directions from this site.

Project splitting in the context of wind farm planning applications has been recently considered by the High Court.

In *Ó Grianna and others v An Bord Pleanála* [2014] IEHC 632 the Court quashed a permission granted in the absence of an EIA of the project in its entirety. Only impacts arising at the site of the proposed windfarm had been considered. The Board and developer claimed they were not obliged to consider impacts of the connection route running from the site of the windfarm development to the national grid, because that was not yet finalised and because the exact nature of the connection was not yet known. The Court rejected that defence. Both the windfarm and the connection to the grid were a single project. The entirety of the project had to be assessed at the earliest possible stage. If the developer had to wait to gather more information on the other element of the project, that was what he had to do. To do otherwise would be unlawful.

The present application is for a part of a larger project. It is not accompanied by an EIS for the entire project. The application before the Council is therefore invalid. It thus cannot be considered by the County Council. Everything that follows in this observation is submitted without prejudice to that overriding objection.

In conclusion on this point we refer to the Planner's Reports on the Council file regarding the substation application. We made a written observation dated 29 October 2014 on our clients' behalf alerting the Council to the project splitting issue. Nowhere is that issue mentioned, much less addressed, in the Planner's reports, the last of which is dated 12 January 2015, one day before the Council order approving the application was made.

Project splitting is not just a breach of the EIA Directive. It also poses practical problems. This approach makes it more difficult and more expensive for members of the public to participate in the assessment of the overall project. Apart from that, there is a serious difficulty for the local authority, as it is expected to make a decision on this application and on associated applications in a very short time frame, working with limited resources and in circumstances where it simply may not be possible for it to assess the accuracy and reliability of the claims put forward by or on behalf of the developer.

We acknowledge those constraints but they cannot be used as a reason for the mandatory legal rules that govern the assessment of the project to be set aside, lost in the blizzard of technical material or simply bypassed. The Council has to conduct and publish an EIA, identifying, describing and assessing the likely significant environmental impacts (including impacts on the people of the area) of the project. It cannot do so in this case.

2. No reliable planning precedent

The developer places considerable stress on the existence of a planning permission for 14 turbines and for a smaller substation on the site, which permission was sought in 2005, issued in 2007 and was extended in 2011.

Subsequent EU Court of Justice and Irish High Court judgements however have found that the assessment system in place at those times was legally unsound. The legal standards for assessment were not met, with the result that the 2005/2011 permission should not now be relied on as a valid planning precedent.

Specifically we refer to the judgement of the Court of Justice of the European Union in *Commission v. Ireland* case C-50/09. In its judgment delivered on 3 March 2011 the CJEU ruled that Ireland had failed properly to transpose the obligations under Article 3 of the EIA Directive. This was because it had failed to make it obligatory for any single body to conduct an EIA. The Court expressly rejected the State's defence that the system then in use was lawful. It was under that system that the site was approved for 14 turbines.

It follows that no lawful EIA was ever conducted in respect of development for which planning permission was granted in 2007. The extension fared no better in this context. No EIA was even claimed to be carried out at the time the Council extended the permission in 2011. Those decisions must therefore be viewed in the light of current awareness of their legal infirmity. They cannot be given planning precedent value.

We also rely in the judgment of the High Court in the case of *Kelly v. An Bord Pleanála* [2014] IEHC 400 delivered by the Court on 25th July 2014. That judgment emphasised (once again) the mandatory nature of the Habitats Directive obligations on planning authorities in relation in particular to the conduct of Appropriate Assessment.

The developer's EIS and AA Screening Report only address one aspect of what is clearly a larger project. As well as rendering the present planning application invalid for the reasons described above, this approach also fails to equip the Council and its Officials to meet the assessment requirements under the Habitats Directive. If the full project is not considered, then no proper Appropriate Assessment is possible. For that reason also the Council is legally prohibited from giving planning permission.

Separately, it is clear from an examination of the planning history that the developer's predecessor had originally sought planning permission for a far greater number of turbines at this location. It first intended to erect 27 turbines in its 2003 application. This was reduced to 23 in an attempt to assuage planner's concerns. See the Inspector's report **enclosed**. That application was refused by the Board.

The next application was for 18 turbines in 2005. The Board's Inspector recommended refusal *inter alia* on visual impact grounds. See report **enclosed**. She believed it would adversely affect local residential amenity. The Board gave permission for 14 turbines, going against that recommendation, saying that it was satisfied that the reduction in number and size of the turbines had addressed its reasons for the previous refusal. The present application is said by the applicant to be *'intended to replace'* the present permission. (That statement of intent is not legally binding of course and could change at any time.)

While the number of turbines proposed this time is reduced from the number sought in all previous applications, their height is dramatically increased from a maximum tip height of 105m to a maximum tip height of 131m. There is a major consequent increase in bulk, weight, footprint and foundation mass of the supporting tower, as can be seen in the **enclosed** illustration. It follows that the visual impact will be far greater at any given distance. It will in fact be overwhelming in the locality. Each one of these six turbines is roughly twice the height of County Hall.

3. Planning policy and related issues

Our clients have had the benefit of reading a submission filed with the Council dated 15th January 2015 by Mr Anthony Cohu, C. Arch, Ecological Planning, Landscape & Design, of Borlin, Bantry, County Cork. We respectfully endorse the content of Mr Cohu's submission and wish it to be adopted and considered as part of our clients' observation to avoid unnecessary repetition here.

The developer places great reliance on selected national policies in relation to renewable energy. He ignores other fundamental national policies supportive of people in rural Ireland, including the rights of citizens to respect for their bodily integrity, their family life and their property. Those policy principles derive from the State's ultimate policy document, Bunreacht na hÉireann. We suggest the Council should not be as selective as the developer in choosing which policy framework it applies. And even if it were only to have regard to renewable energy policy, it would have to take account of the recent step back at EU level from previous policy commitments, as well as considering the inordinate concentration of wind turbines in County Cork, and the growing awareness of the unsound economics underpinning the sector in Ireland.

Ireland's peak electrical power demand at any one time is about 5GW. Installed wind power generation capacity is already about 2GW. There is no need either in terms of EU policy on renewables or in terms of national economic benefit, for increasing the proportion of wind generation connected to the grid. On power station capacity and other sources such as interconnectors, as UCD Economist Colm McCarthy pointed out in Cork in October 2014:

'The new gas units were planned before the bust. There is now 3300 MW of modern gas capacity, plus 880 of peaking plant. Plus 500 MW of new interconnection to Wales. Plus almost 900 MW at coal-fired Moneypoint. Plus hydro at about 500 MW, plus peat at about 340, plus oil - the total dispatchable is 7400 MW. Non-dispatchable, mainly wind, adds 2400, grand total 9800, twice peak demand.'

So notwithstanding the claims made on behalf of the developer, neither Ireland nor Cork actually need this extra plant generating 6 x 3MW of electricity (and more) in order to meet energy policy goals.

4. Noise

Cork County Council is aware of serious unresolved noise nuisance complaints in various parts of the County, which arose despite the Council imposing certain noise conditions on wind turbine operators. Serious noise nuisance issues have arisen in other parts of the country also. The Planning Authority is obliged to have regard to that fact when assessing any such development. The steadily emerging problems of noise nuisance explains in part why the Government felt it necessary to review Windfarm Planning guidelines issued nine years ago at a time when turbines were smaller and less extensively promoted, and when their noise signature and its effect was less well understood. The departmental review is still underway, and is seeking to find new and appropriate measures of balancing competing interests, particularly focussing on separation distances, noise nuisance and nuisance from shadow flicker.

We refer to our submission to that review (copy **enclosed**) and ask you to treat that submission as part of this observation.

There is patently an emerging problem, with some exceptionally serious consequences in certain areas. The Council is bound to have regard to that fact when considering assurance put before it by or on behalf of this developer.

We refer to the **enclosed** Shirley Windfarm Study in this regard. This was unusual in that it was a study prepared on an agreed co-operative basis by a team of four independent acousticians, some of whom had mainly worked for wind turbine promoters, some of whom had worked more often for residents reporting adverse affects from turbine operation. The study found that noise limits in vogue currently do not adequately protect the public.

5. Other EIS issues

The EIS is unreliable as a basis for an informed assessment. It makes reassuring claims which do not stand up to being tested against current scientific knowledge. Noise nuisance is one important example. Residential property values will be adversely affected. We refer to the **enclosed** material from Keane Mahony Smith in this context. That is not acknowledged at all in the EIS but it is a profound immediate interference with third party property rights.

Another example to illustrate the point is its assessment of impact on bats. A more realistic objective picture of the likely impact emerges from the recent scientific study on that topic, by Cryan *et al*, published in the Proceedings of the National Academy of Sciences, a copy of which is **enclosed**.

The 2003 EPA Guidelines on Environmental Impact Statements say that an EIS should identify describe and assess what impacts are likely if all mitigation measures fail. The developer's EIS does not do this.

The Council should view each section of the EIS critically and methodically, rendering its own description and assessment of all relevant environmental effects including effects on residents, visitors, and workers within the area.

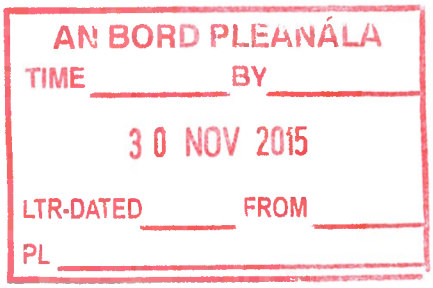
We ask the Council to refuse permission.

Yours faithfully,

Joe Noonan,
NOONAN LINEHAN CARROLL COFFEY

List of Enclosures:

1. Cheque in the sum of €20
2. Petition forms signed by local residents
3. Page 1 of EIS Non-Technical Summary
4. Southern Star Newspaper Article "Wind farm a second power-related blow to Lee Valley resident over 50 years on" by Catherine Ketch.
5. High Court Judgment of Mr Justice Michael Peart, O Grianna & Others v An Bord Pleanala, 12th December 2014.
6. Noonan Linehan Carroll Coffey Submission to Cork County Council Planning Department in relation to Planning Register Reference 14/557 dated 29th October 2014.
7. Judgment of Court of Justice of the EU in Commission v Ireland, case C-50/09 dated 3 March 2011.
8. High Court Judgment of Ms Justice Finlay Geoghegan, Kelly v. An Bord Pleanála, 25th July 2014.
9. Illustration showing the difference in size of the proposed turbines.
10. NLCC Submission to Department of Environment, Heritage & Local Government regarding draft Noise Guidelines, dated 21st February 2014.
11. A Cooperative Measurement Survey & Analysis of Low Frequency and Infrasound at the Shirley Wind Farm in Brown County, Wisconsin, 24th December 2012.
12. Letter of Current Market Value from Keane Mahony Smith, 2nd February 2015.
13. Behaviour of Bats at Wind Turbines by Cryan et al, University of New Mexico, 3rd September 2014.
14. An Bord Pleanala Inspector's Report, Appeal Ref No. PL04.204928
15. An Bord Pleanala Inspector's Report, Appeal Ref No. PL04.219620



Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

15-Jan-15

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Bappy O SULLIVAN	NEWCESTOWN
Helen O' Sullivan	Newcestown
Diarmuid [illegible]	[illegible]
Aine Linehan	Knockadoona, Templemartin
Kieran Loughlan	Knockadoona Templemartin
[illegible]	[illegible]
Mary Loughlan	Knockadoona Templemartin
Kieran O'Riordan	[illegible]
Mary Desmond	Farnalough, Newcestown
Michael Desmond	Farnalough, Newcestown
B. Burrows	Carr/ [illegible]

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

15-Jan-15

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Peter Bosman	Knockane Teerelton Macroom Co. Cork
Michael O'Donovan	Moneygoff East Coppeen. Cork.
Adam Chappell	Teerelton Macroom
Louise Chappell	Teerelton Macroom

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

15-Jan-15

AN BORD PLEANÁLA
TIME ______ BY ______
30 NOV 2015
LTR-DATED ______ FROM ______

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Mark Callanan	Bengour East Newcastown.
Nora Sheehan	Manogfgare
Nuala Lordan	Munigane
Maureen Cronin	Curradrinagh, D'way
Donal Daly	Lishcenleigh D'way
MARK KEHOE	GLOUN NORTH M Kehoe
Jane Kehoe.	GLOUN NORTH
Siobhan Mc Carthy	GLOUN NORTH,
John Mc Carthy	GLOUN NORTH.
Frank Collins	Shanacashel

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Edel Harrington-O'Sullivan	Farranmaleen, Enniskeane Co. Cork
Mary Cotter	Farranmaleen, Enniskeane, Co. Cork
Carol Ann Donnelly	Farranmaleen, Enniskeane, Co Cork.
Tom Donnelly	Farranmaleen Enniskeane Co Cork
J Shorten	Farranmaleen Enniskeane Co. Cork

Joe Noonan, Solicitor
Noonan Linehan Carroll, Coffey Solicitors
54 North Main St
Cork

AN BORD PLEANÁLA 15-Oct-14
TIME ____ BY ____
30 NOV 2015
LTR-DATED ____ FROM ____ PL ____

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/557 MADE BY ARRAN WINDFARM LTD TO CORK COUNTY COUNCIL AND WE SUPPORT THE OBSERVATIONVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Patrick Manning	Barnadwane, Tereltom,
[illegible]	Lisbee Kilnamartyra
Michael Cotter	Bengoure Coolea
SERGIO PORTUGAL	Rennaheragh, Tereltom Macroom
Edmond Neville	DUNMARKLUM,
David Forde	Ronacahora, Tereltom Macroom Co Cork
JOHN GALVIN	GURRANREIGH.
Denis Murphy	Ackravarn [illegible]
John Murphy	Ardamen[illegible]
Sinead Murphy	Ardamen[illegible]

Joe Noonan, Solicitor
Noonan Linehan Carroll, Coffey Solicitors
54 North Main St
Cork

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/557 MADE BY ARRAN WINDFARM LTD TO CORK COUNTY COUNCIL AND WE SUPPORT THE OBSERVATIONVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Frank Lynch	Dealtar
Pat Kelleher	Knockane.
John Warren	CASTLETOWN
Christy O'Callaghan	Coolduve
Dan Cronin	Caherdaly
Michael	Tore
Michael Manning	Ardaneen.
Dan Galvin	Currenreigh Lissarda
Pat Creed	Knockane
Noel Kelleher	Money CUSKER

Joe Noonan, Solicitor
Noonan Linehan Carroll, Coffey Solicitors
54 North Main St
Cork

15-Oct-14

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/557 MADE BY ARRAN WINDFARM LTD TO CORK COUNTY COUNCIL AND WE SUPPORT THE OBSERVATIONVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
John Wood	Knockane Terelton Macroom Co Cork
Karen Wood	Knockane Terelton Macroom Co Cork
[illegible]	[illegible]
[illegible]	[illegible]
Stephanie Lauten	Moneygave East Coppeen
Michael O'Donovan	Moneygoff East
Pat Sheehan	Moneygave East
Noelle Sheehan	Moneygave East
[illegible]	Moneygoff East
M. O'Sullivan	Bernadivane

Joe Noonan, Solicitor
Noonan Linehan Carroll, Coffey Solicitors
54 North Main St
Cork

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/557 MADE BY ARRAN WINDFARM LTD TO CORK COUNTY COUNCIL AND WE SUPPORT THE OBSERVATIONVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Marie Lynch	"Aitreabh" 57 Cork St, Macroom, Co Cork
Conor Lynch	No. 5 The Lawn, Mount Massey, Macroom, Co. Cork.
Peter	N°57 Aitreabh, Cork Street, Macroom. Co Cork
Jack Lynch	Cork ST, Macroom Co Cork
Geraldine Harley	Ashmore Home Hornhill Lissarda
Marcel Harley	Ashmore Home Hornhill Lissarda
Lottie Harley	Ashmore Home Hornhill Lissarda
Baelin Harley	Ashmore Home Hornhill Lissarda
Jerome Cohalan	Gurranreigh Lissarda Co Cork
Nickie Cohalan	Gurranreigh Lissarda Co Cork

Joe Noonan, Solicitor
Noonan Linehan Carroll, Coffey Solicitors
54 North Main St
Cork

15-Oct-14

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/557 MADE BY ARRAN WINDFARM LTD TO CORK COUNTY COUNCIL AND WE SUPPORT THE OBSERVATIONVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Hugh & Kathleen Harrington	Greenville, Terelton, Macroom.
Rita Harrington	Greenville Terelton
Donal Harrington	Terelton Macroom
John Wood	Knockane Terelton
Karen Wood	Knockane Terelton
Mary O'Donovan	FARRANMAREEN
Kevin O'Sullivan	Clearagh
George Rundell	Clearagh
Pat Browne	Clearagh
Martin Faherty	Clearagh

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

AN BORD PLEANÁLA
TIME . BY 15-Jan-15
3 0 NOV 2015
LTR-DATED FROM
PL

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Seán Bottimer	[illegible]
Diarmuid Cronin	Muingane Coppeen
[illegible] O'Callaghan	Money [illegible] Coppeen
Con Murphy	Shevenane
[illegible]	Slievereagh
Rita O'Mahony	Coppeen
Der Hurley	Coppeen
Theresa Hurley	Coppeen
Ina Hennessy	Coppeen
[illegible] Hennessy	Coppeen
Sinead Hennessy	Coppeen

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

AN BORD PLEANÁLA
TIME ______ BY ______
15-Jan-15
30 NOV 2015
LTR-DATED ______ FROM ______
PL

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Maria Hogarth	Ardbrae, Garranereagh, Lissarda, Co Cork
Ian Hogarth	Ardbrae, Garranereagh Lissarda, Co. Cork.
Paddy Healy	Bengour West Newcestown Bandon
[illegible] Healy	Bengour West Newcestown Bandon
Shane Healy	Bengour West Newcestown Bandon Co Cork
Cian Healy	Bengour West Newcestown Bandon Co Cork
Peter Durkin	Bengour East Newcestown Bandon Co Cork
[illegible] Dunlea	Bengour E
Joan Dunlea	Bengour E.
[illegible]	Bengour E.
Anla McCabe	Bengour

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

AN BORD PLEANÁLA
TIME ______ BY ______
15-Jan-15
30 NOV 2015
LTR-DATED ______ FROM ______
PL ______

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Brian Good	Rushfield, Enniskeane
Deirdre Good	Rushfield Enniskeane.
NEIL GRUNWELL	LISSAROURKE ENNISKEAN
Lucia Murphy	Lissarourke
Patrick Kelleher	"
Eileen Kelleher	"
Teresa Kelleher	"
Ann Galvin	Macroom Co Cork
Tessie Galvin	Gurraneigh
Mossie Galvin	Macroom Co Cork
JOHN GALVIN	COPPEEN

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Sheila Allen	Greenhill, Newcestown
Humphrey Allen	Greenhill Newcestown
Johnny Nyhan	Gurranreigh Lissarda Co. Cork
Máire O'Mahony	Gurranreigh Lissarda Co Cork
Patrick Daly	Monygaff East
Eugene Daly	Monygaff EST
Patricia Daly	Money Gaff East.
Anthony Deasy	Bengour
Ben Blake	Rushfield
Susan Blake	Rushfield
Carol Shorten	Rushfield.

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Ryan Hayes	Moneycrahy
Coral Hayes	Money crahy
Bob Bennett	Monycrahy
Noelle Sheehan	Moneygave Coppeen
Ciara O Carroll	Clearagh Lissarda
Nancie O Callaghan	Castletown
V + C CROSS	Coppeen
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Kevin O Sullivan	Clearagh
Jerry o Dwyer	Crookstown
Noel Leahy	Claughaun
Niall o Regan	Kilmurry
John Doyle	Brookstown
Sheila O'Connor	Crookstown
Christy Murphy	Ballymakeera
Maureen O Sullivan	Crookstown
[illegible]	Clerragh
[illegible]	Clerragh
[illegible]	Clerragh

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

AN BORD PLEANÁLA
TIME ____ BY ____ 15-Jan-15
30 NOV 2015
LTR-DATED ____ FROM ____
PL ____

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
[signature]	Greenhill, Bogragh West, Newmarket
[signature]	Greenhill, Bogragh West, Newmarket
Ann O'Gorman	Sonas Gurranreagh Lissarda
Mary Murphy	Greenhill
Tom Buckley	GREENHILL
Mary Buckley	Greenhill
Paula Buckley	Greenhill.
Jo Maloney	Greenhill
T Foreman	" "
Mark Allen	" "
John Allen	" "

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Yvonne Corkoran	Dunmarklum Lissarda
Mark Corkoran	Dunmarklum Lissarda
Margaret Murphy	Dunmarklum, Lissarda
Anthony Murphy	Dunmarklum, Lissarda
Philip Dawson	Dunmarklum, Lissarda
Mary Dawson	Dunmarklum, Lissarda
Catherine Dawson	Dunmarklum, Lissarda
PAT KELLEHER	Kilbarry Lissarda
Der. Hartnett	Kilbarry Lissarda
Tommie MURPHY	~~Dermot Brennan~~ Kilmore Lissarda
[illegible]	Tereveen Lissarda

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

15-Jan-15

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Denis Galvin	Kilmurry
John O'Mahony	Coolaghane
Ray Kelly	Kilmurry
Ann Cox	Kilmurry
Mary Mc Carthy	Kilmurry
Dave Mc Carthy	Kilmurry
Keith Mc Carthy	Kilmurry
Martin Mc Carthy	Kilmurry
Christopher & Ann O'Callaghan	Kilmurry
Kieran Murphy	5, Calvin Tce, Kilmurry Lissarda
Karin Oleman	11

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

AN BORD PLEANÁLA
15-Jan-15
TIME ____ BY ____
30 NOV 2015
LTR-DATED ____ FROM ____
PL ____

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Rachel Aitken Gush	11 Saint Mary, Kilmurry, Co Cork
Jane E Crowley	10 St Marys Tce, Kilmurry Co Cork
[illegible]	Gurranacart Upper, Symmons Kilmurry
Sharon O'Sullivan	Clearagh, Lissarda, Cork.
Jack O Sullivan	Clearagh Lissarda Co Cork
Liam O'Sullivan	Clearagh, Lissarda, Co. Cork
[illegible] Burke	7 the orchards, Chapel Hill, Macroom Cork
Caroline Burke	7 the Orchard, Chapel Hill, Macroom, Cork

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

AN BORD PLEANÁLA
TIME ____ BY ____
30 NOV 2015
LTR-DATED ____ FROM ____
PL

15-Jan-15

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Niales Downey	Leades Coachford
Caroline Downey	Leades Coachford
Kordie Downey	Leades Coachford
Eoin Walsh	17 Amlawn Muskerry Est
Finbarr O Sullivan	Hazelwood Est. Glanmire
Richard Hurley	Kornhill Lissarda
Marie O'Callaghan	Curraclough, Lissarda
Jackie O'Callaghan	The Old Schoolhouse Beal na Blath Co Cork
Gran O Callaghan	The Old Schoolhouse Beal na Blath
Cian O Callaghan	The Old Schoolhouse
Aisling O Callaghan	The Old Schoolhouse Beal na Blath Beal na Blath

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Kevin O'Callaghan	The Old School house Beal na Blath
Kieran O Callaghan	The Old Schoolhouse Beal na Blath
Denis Bradfield	Currabeha Crookstown Co Cork
David Crowley.	Coolduve, Lissarda, Co. Cork
Michael O Halloran	Clonmacow, Crookstown Co Cork
Anna O'Halloran	Clonmacow Crookstown.
[illegible] McSweeney	Clodagh - Crookstown
[illegible] McSweeney	Clodagh - Crookstown
Patrick Mc Sweeney	Clodagh - Crookstown
Clara McSweeney.	Clodagh - Crookstown.
Ava McSweeney.	Clodagh Crookstown.

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

15-Jan-15

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Ger O Sullivan	Currabeha House Crookstown Co Cork
Paul O'Sullivan	Currabeha House Crookstown Co Cork
PAUL O' SULLIVAN	CURRABEHA HOUSE CROOKSTOWN CO' CORK.
Sarah O' Sullivan	Currabeha House, Crookstown Co. Cork
[illegible signature]	Currabeha
Gerry Dineen	Currabeha
theresA Dineen	Carrabha
John Cullinane	
Aisling Geary	
Breda Kelly	Cleenagh Potunargid Lissarda
Mary Kelleher	Cleenagh, Lissarda, Co. Cork

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

15-Jan-15

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
[signature]	Clearagh Lissarda Cork
[signature]	Clearagh Lissarda. Co. Cork
[signature]	Clearagh Lissarda Co Cork
[signature]	KILBARRY, LISSARDA.
[signature]	KILBARRY LISSARDA
[signature]	KILBARRY Lissarda
[signature]	Kilbarry, Lissarda.
[signature]	KILBARRY, LISSARDA.
[signature]	KILBARRY, LISSARDA
[signature]	KILBARRY, LISSARDA
[signature]	KILBARRY, LISSARDA.

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

15-Jan-15

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
EAMONN Ó CALLAGHAN	KILBARRY, LISSARDA.
Niall O Regan	Kilbarry lissarda.
Dylan Keane	Kilbarry lissarda
Bernadette Keane	Kilbarry lissarda
Adela Sadowska	Kilmurry Lissarda
Allen Casey	Kilmurry Lissarda
Derek Nulty	Lissarda
Emma Barrett	kilmurry lissarda
Greg Barrett	Kilmurry Lissarda
Jim Barrett	kilbarry lissarda
Ann Barrett	Kilbarry Lissarda

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

15 Jan 15

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Aisling Connolly	Moneygaff East Coppeen, Enniskeen Co. Cork
Ger Connolly	Moneygaff East Coppeen, Enniskeane, Co. Cork.
Denise Crowley.	Moneygave East, Coppeen. Co. Cork.
JP O'Callaghan.	moneygave, Coppeen East. Co. Cork.
L. Swanton	Moneygoff, Coppeen.
J Swanton	Muncane Coppeen
Mary O' Brien	Moneygaff Coppeen.
Kai Anderer	Moneygave West Coppeen
COLETTE HILLIARD	MONEYGAFF EAST. COPPEEN.
Stephanie Hayes	Moneycrohy
Michelle Hayes	Moneycrohy

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

15-Jan-15

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Pat Shehan	Moneygaure
Dan Collins	Guranreigh Lissarda.
Mary O'Sullivan	11 11
Carmel Collins	Guranreigh, Lissarda.
Jeff Collins	Guranreigh Lissarda
Rosalia Collins	Guranreigh Lissarda
Maria Collins	Guranreigh, Lissarda
Rebecca Collins	Guranreigh, Lissarda
John M Sweeney	Guranreigh Lissarda
Trish M Sweeney	Guranreigh Lissarda
[illegible]	Guranreigh

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

15-Jan-15

AN BORD PLEANÁLA
TIME ______ BY ______
30 NOV 2015
LTR-DATED ______ FROM ______

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Kevin Lucey	Teeraveel, Lissarda, Co. Cork
Elaine Lucey	Teeravee, Lissarda, Co. Cork
Bernadette Buckley	Kilmurry Lissarda
Mary O'Sullivan	Cleenagh
Linda O'Sullivan	Cleenagh, Lissarda Co. Cork
[illegible]	Cleenagh, Lissarda [illegible]
J Bandon.	Donnacktain, Lissarda, Co. Cork
Pat Cohessy	Ardanenteen Lissardagh
Leslie Irwin	Kilmurry
Tim Irwin	Kilmurry
Theresa Crowley	Kilmurry

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

15-Jan-15

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Michael Moriarty	6a Great William O'Brien St.
Oliver Twohig	Currabeha, Crookstown
Mary Helen Carroll	Curraclough
Donncdha Carroll	Curraclough

Joe Noonan Solicitor
Noonan, Linehan, Carroll, Coffey Solicitors
54 North Main St
Cork

15-Jan-15

WE, THE UNDERSIGNED, OBJECT TO THE PLANNING APPLICATION REF 14/67/60 BY BARNA WIND ENERGY (BWE) LTD. TO CORK COUNCIL AND WE SUPPORT THE OBSERVATIONS BEING MADE BY ON OUR BEHALF BY JOE NOONAN SOLICITOR:

NAME	ADDRESS
Denis Carroll	Curraclough
Leaghanorah Carroll	Curraclough
Noreen Moss	Clonmacow
Maura M°Sweeney	Coolduff, Lissarda
Kathleen Hinchon	Clonmacow
Charles Burke	Clonmacow.
Sinéad Burke	Clonmacow
Margaret Burke	Clonmacow.
Alan Burke	Clonmacow

1 INTRODUCTION

Fehily Timoney & Company (FTC) was appointed by Barnadivane Wind Energy Ltd. to prepare the EIS for the proposed Barnadivane Wind Farm near Macroom, Co. Cork for submission to the competent authority, Cork County Council.

The proposed Barnadivane Wind Farm comprises 6 no. wind turbines with a maximum tip height of up to 131m. The site location for the proposed wind farm is as shown in Figure 1.1.

There is an existing 14 turbine development consented at this location, which the proposed development is intended to replace, if planning is granted. This 14 turbine development was granted by Cork County Council (planning reference 05/5907) and An Bord Pleanala (planning reference PL 04.219620). An extension of duration of this planning consent was granted by Cork County Council in 2011 (planning reference 11/6605).

The permitted development included permission for a 110 kV substation and switch station. Due to changes in Eirgrid requirements in the intervening period, it is now necessary to amend this substation and for that reason (and constraints at the permitted location) a separate planning application has been lodged by the developer with Cork County Council (planning reference 14/00557) for a 110 kV substation and ancillary infrastructure.

A grid connection offer is in place for the proposed development with a capacity of up to 22.5 MW. The study area for the proposed development is located in the townlands of Lackareagh, Garranereagh, Barnadivane (Kneeves) and Barnadivane, near Teerelton, Co. Cork. The proposed site is approximately 3 km northeast of Coppeen and 10 km south of Macroom. The nearest village is Teerelton, approximately 3 km to the north.

1.1 Applicant – Barna Wind Energy Ltd.

The applicant for the proposed development is Barna Wind Energy Ltd. The applicant company has been formed for the specific purpose of applying for and developing the proposed wind farm project but forms part of a larger group of companies owned by Enerco Energy Ltd., an Irish-owned, Cork-based company with extensive experience in the design, construction and operation of renewable energy developments throughout Ireland.

The project will follow a community partnership model, whereby the wind farm development company will develop and operate the project, while the landowners will receive an annual guaranteed payment and still retain full ownership of their land.

1.2 The Need for the Project

The need for the proposed development is driven by the following:

- EU and Ireland's commitment to limit greenhouse gas emissions under the Kyoto protocol
- meeting national renewable energy targets
- increasing national energy security
- provision of cost-effective power production
- increasing energy price stability

Under International, European Union, and Irish national policy, mandatory targets for the overall share of energy from renewable sources for each Member State have been set out.

Ireland's mandatory national target is to supply 16% of its overall energy needs from renewable sources by 2020. This target covers energy in the form of electricity, heat and transport fuels. For electricity alone, Ireland has set a national target of 40% by 2020 as outlined in Ireland's National Renewable Energy Action Plan (NREAP). Government policies identify the development of renewable energy, including wind energy, as a primary strategy in implementing national energy policy.

Wind farm a second power-related blow to Lee Valley resident over 50 years on

BY CATHERINE KETCH

ONE resident of the Lee Valley could find himself the victim of two separate power generation developments half a century apart.

Patrick Manning of Barnadvane, Terelton, was just three years and nine months when his family had to move from the Gearagh near Macroom when the Lee was flooded for hydroelectricity by the ESB in 1957.

'Thirteen families had to leave that area at that time and we came up to my mother's home place which is where I am now,' Patrick said.

It's here at Barnadivane that Patrick is now faced with a wind farm development less than 600m from his house. He is particularly concerned about the noise and unsightliness.

'You live in the country for a bit of peace and quiet. I'm 61 now since June and, in a few years, I would be hoping to retire. With that noise you couldn't open a window,' Patrick claimed.

'I might have to move again on account of these and it's all pertaining to power,' he added wearily.

Four existing turbines at Gurranereagh shocked locals when they were erected. 'They look horrible on the landscape. I don't know what it's like for people living near them,' Peter Kelleher, Knockane, said. The proposed unrelated turbines will be taller and more visible, he believes.

'Visually it's very intrusive. I will be looking straight at it, so it will devalue my property. It's ugly. It's totally inappropriate in the setting,' Stephanie Larkin, Moneygave East, said.

Barna Wind Energy (part of Enerco Energy, Lissarda) has permission for 14 turbines of 105m max at Barnadivane with planning for an 110kv substation. They applied on December 19th last to replace these with six larger turbines of 131m max.

Aran Wind Energy (also part of Enerco) applied in September for planning permission for a new 110kv substation in the same location. The Gate 3 connection is approved for 60MW.

A representative of Enerco Energy responded to queries this week, saying that the new substation Enerco says will replace that already permitted, fulfilling new EirGrid requirements regarding size, spacing and orientation.

The change in turbine number and size is down to economics with newer, more efficient machines suited to particular sites, they say. 'The new application and the new wind farm layout will give us a more efficient investment'.

Two companies are involved Enerco, he says, because the Barnadivane development, ongoing for 20 years, was originally owned by a number of farmers and Michael Murnane of Enerco. Enerco has more recently secured ownership of the entire project.

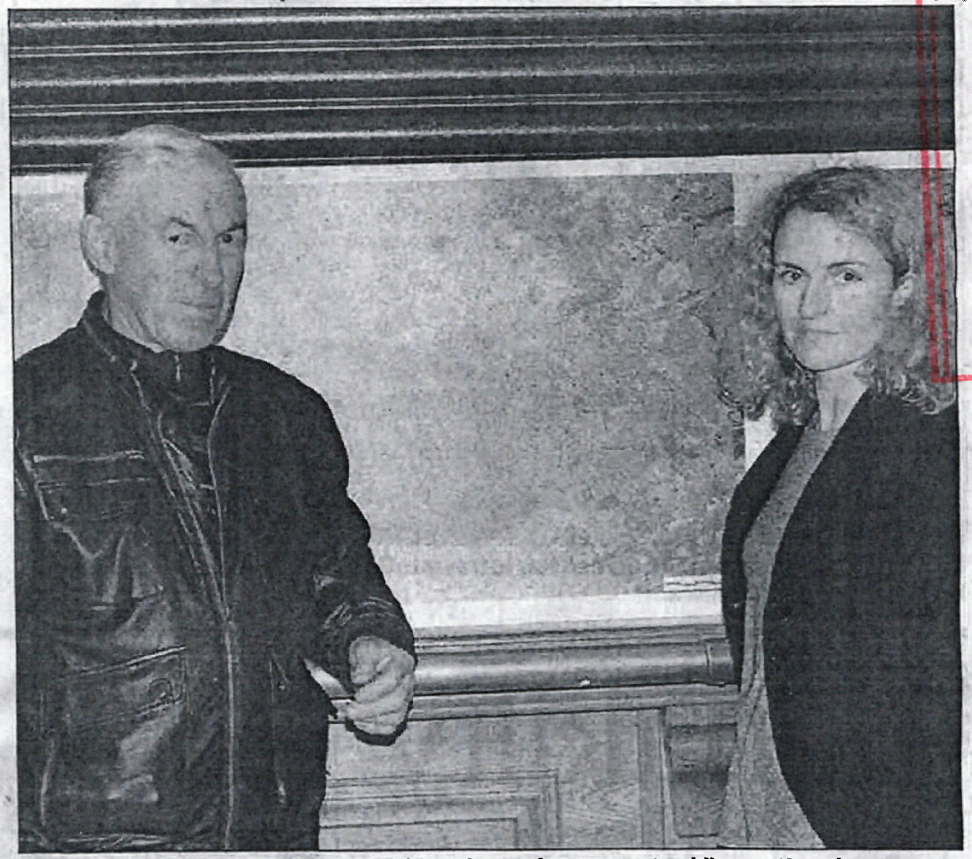
The proposed wind farm if built will be connected to the grid via the existing 110kv Clashavoon to Dunmanway power line which crosses the site. Enerco says they have no plans for further phases at the site. The 60MW Gate 3 connection (6 x 2.3MW yielding max 13.8MW) will, Enerco says, facilitate the connection of other potential developments within 25km of Barnadivane, via underground roadside cables.

On proximity, noise and visual intrusion Enerco says they design a project to show compliance with guidelines and leave it to the public and the planning authorities to assess, grant or refuse permission. If guidelines change, 'it would come down to whether the application was granted or not,' the spokesperson said.

Addressing concerns why a public meeting was held after submissions closed for the new substation Enerco said it would be normal to have public information meetings for wind farms, but not for substations.

In operation for over ten years and producing 230MW of generating capacity equal to 10% of Ireland's total, Enerco stresses they are a Macroom company, employing 20 locally, plus similar in the field.

They are currently accepting proposals for a community fund; €100,000 during the construction period, with €20,000 per annum during operation.



Patrick Manning and Stephanie Hawkins pictured at a recent public meeting about new plans for the Barnadivane Wind Farm at the Riverside Park Hotel, Macroom.
(Photo: Catherine Ketch)

Neutral Citation: [2014] IEHC 632

THE HIGH COURT

JUDICIAL REVIEW

Record Number: 2014 No. 2014 No.19 JR; 2014 No. 10 COM

IN THE MATTER OF AN APPLICATION UNDER SECTION 50 AND 50A OF THE PLANNING AND DEVELOPMENT ACT, 2000 (AS AMENDED)

BETWEEN:

POL O GRIANNA, GERALDINE UI DHUINNIN, AOIFE NI DHUINNIN, CLIODHNA NI DHUINNIN,BERNADETTE COTTER, TIM O'CONNELL, CAOIMHGHIN O BUACHALLA, PADRAIG D. KELLEHER, ALAN KING, XAK AROO

APPLICANTS

AND

AN BORD PLEANALA

RESPONDENT

AND

CORK COUNTY COUNCIL

FIRST NAMED NOTICE PARTY

AND

FRAMORE LIMITED

SECOND NAMED NOTICE PARTY

JUDGMENT OF MR JUSTICE MICHAEL PEART DELIVERED ON THE 12th DAY OF DECEMBER 2014:

1. The applicants all live close to an area in County Cork where Framore Limited, the second named notice party are proposing to erect 6 wind turbines and associated buildings and infrastructure for which it obtained a planning permission from An Bord Pleanala ("the Board") subject to 17 conditions on the 14th November 2013.

2. Cork County Council ("the Council") had previously decided to grant permission on 18th June 2013 subject to 28 conditions. The applicants, who had lodged observations with Cork County Council outlining their concerns regarding noise and visual impact in July 2012, appealed that grant of permission to An Bord Pleanala, which on the 14th November 2013 made a decision to grant permission for the development subject to a number of conditions.

3. This application for planning permission is one which had to be accompanied by an Environmental Impact Statement ("EIS"), since the Board was required to carry out an Environmental Impact Assessment ("EIA") under to the provisions of section 172(1) of the Planning and Development Act, 2000, as amended ("the Act of 2000"), the

velopment being one which fell within the scope of Part 2, Schedule 5 of the Planning and Development Regulations 2001, as amended.

4. In their 'Abridged Statement of Grounds' dated 14th February 2014 the applicants seek a Declaration that in making its decision the respondent failed to carry out a proper EIA in accordance with the provisions of Section 172 of the Planning and Development Act, 2000, as amended ("the Act of 2000"), as interpreted in accordance with the obligations imposed by Article 3 of Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment. A number of different complaints are made, but, essentially, all (except that related to 'project-splitting') are directed towards establishing that the EIA stated by the Board to have been carried out is a flawed assessment which is not in accordance with its obligations under the Act.

5. Section 171A(1) defines "environmental impact assessment" as "*an assessment, which includes an examination, analysis and evaluation, carried out by a planning authority or the Board, as the case may be, in accordance with this Part and regulations made thereunder, that shall identify, describe and assess in an appropriate manner, in the light of each individual case and in accordance with Articles 4 to 11 of the Environmental Impact Assessment Directive, the direct and indirect effects of a proposed development on the following: (a) human beings, flora and fauna, (b) soil, water, air, climate and the landscape, (c) material assets and the cultural heritage, and (d) the interaction between the factors mentioned in paragraphs (a), (b) and (c)"*(emphasis added). The applicants place considerable emphasis on the words "in the light of each individual case".

Section 172 contains a number of subsections dealing with the requirement that certain applicants must provide an EIA to the planning authority or the Board, as the case may be, and that either of the latter may seek further information from an applicant. Of some relevance to the present application is what is provided for in subsections (1G) to (1J) of section 172 which provide as follows:

> *"(1G) in carrying out an environmental impact assessment under this section the planning authority or the Board, as the case may be, shall consider – (a) the environmental impact statement; (b) any further information furnished to the planning authority for the Board pursuant to subsections (1D) or (1E); (c) any submissions observations validly made in relation to the environmental effects of the proposed development; (d) the views, if any, provided by any other Member State under section 174 or Regulations made under that section.*
>
> *(1H) in carrying out an environmental impact assessment under this section the planning authority or the Board, as the case may be, may have regard to and adopt in whole or in part any reports prepared by its officials or by consultants, experts or other advisers.*
>
> *(1I) where the planning authority or the Board, as the case may be, decides to grant consent for the proposed development, it may attach such conditions to the ground as it considers necessary, to avoid, reduce and, if possible, offset the major adverse effects on the environment (if any) of the proposed development.*
>
> *(1J) when the planning authority or the Board, as the case may be, has decided whether to grant or to refuse consent for the proposed development, it shall inform the applicant for consent and the public of the decision and shall make the following information available to the applicant for consent and the public: (a) the content of the decision and*

any conditions attached thereto; (b) the evaluation of the direct and indirect effects of the proposed development on the matters set out in section hundred and 171A; (c) having examined any submission or observations validly made (i) the main reasons and considerations on which the decision is based, and (ii) the main reasons and considerations for the attachment of any conditions, including reasons and considerations arising from or related to submissions observations made by a member of the public; (d) where relevant, a description of the main measures to avoid, reduce and, if possible, offset the major adverse effects; (e) any report referred to in subsection (1H); (f) information for the public on the procedures available to review the substantive and procedural legality of the decision, and (g) the views, if any, furnished by other Member States of the European Union pursuant to section 174."

6. The various grounds upon which the applicants rely for seeking an order of certiorari and a declaration that the Board failed to carry out an EIA in accordance with the requirements of section 172 of the Act of 2000 are set forth in their Abridged Statement of Grounds at paragraph E.1 and its various sub-paragraphs.

Failure to comply with obligations in relation to the Environmental Impact Assessment:

7. The applicants submit that the it is evident from the decision of the Board that in so far as it purports to have carried out an EIA as required by section 172 of the Act of 2000, it failed to do so "in the light of each individual case" as required by both Article 3 of Council Directive 2011/92/EU (the "EIA Directive") and as reflected in the definition of an EIA in section 171A of the Act of 2000 set forth already. It seems to be suggested by the applicants that instead of correctly examining, analysing and evaluating this particular case as far as the effect of noise levels on human beings are concerned, the Board effectively fettered its discretion by simply applying noise limits or other standards recommended under the 2006 Guidelines. In particular they say that the Board in its decision imposed noise limits without carrying out any assessment of the significance of the increase in noise over background noise at this location on human beings living in the vicinity of the proposed turbines.

8. The applicants submit also that in so far as the Board may have relied upon the assessment carried out by the appointed inspector who prepared a report for the Board, and agreed with it for the purpose of its own EIA, the inspector's assessment itself is flawed since he did not carry out an assessment of the significance of the increase in noise over background noise levels at the location of this particular proposed development. They complain that the inspector, and by extension the Board since it "generally adopted" the inspector's report, based his recommendations upon a statement in the 2006 Guidelines to the effect that noise will not "generally" be a problem where the separation distance between turbine and house is greater than 500m, and without having carried out any assessment of the actual anticipated noise impact on existing houses by reference to background noise levels, and that this constitutes a failure to comply with the Board's obligations under section 172 of the Act of 2000 to carry out an EIA in the light of the particular case at hand. In so far as it is argued by the Board that it relied upon the inspector's assessment and generally agreed with it, the applicants submit that that report contains no assessment of the significance of the increase in noise over background noise levels that would affect human beings residing in the vicinity as a result of noise emitted from the turbines, and therefore there has been no conclusion reached by the inspector or the Board as to whether the level of increase in noise would be significant or acceptable, and accordingly there has been no analysis or evaluation by the Board of the direct effects of the proposed development in the context of noise impact on human beings, as is required to be carried out by reference to the

efinition of "environmental impact assessment" contained in section 171A of the Act of 2000 already referred to.

9. The applicants also maintain that the inspector made a fundamental error in his report, and that this error has carried through to the Board's decision. The error they allege is in relation to what I shall refer to as Location 2. They say that the inspector failed to recognise that Location 2 is a 'low noise environment' according to the noise measurements set forth in the EIS. They state that the background noise levels recorded in relation to Location 2 bring it within the definition of a 'low noise environment' for the purpose of the 2006 Guidelines since the LA90 noise level at that location was measured at less than 30dB(A). That measurement for Location 2 was recorded at 29dB(A). They consider that the Board failed to have regard to the correct noise level measurement (LA90) for the purpose of determining both the background noise levels and the appropriate noise limits to be applied, and instead, erroneously relied upon what are referred to as the LAeq measurements in respect of both Location 1 and Location 2. The LAeq is a measurement which gives an averaged noise level whereas the LA90 measurement gives the noise level found at a location for at least 90% of the period monitored. The 2006 Guidelines recommend that daytime noise levels for a low noise environment should be limited to an absolute level within the range of 35-40 dB(A)LA90, whereas the Board has specified in Condition 12 of the permission that the noise from the wind turbines should not exceed the greater of 43dB(A) LA90, or 5dB(A) above background levels when measured externally.

10. The applicants accordingly submit that, in error, noise levels up to the greater of those two alternatives is permitted, and that either would exceed the 2006 Guidelines level of 29dB(A) LA90 for Location 2 (low noise environment), and therefore that a fundamental error has occurred in relation to the EIA carried out by the Board.

11. Complaint is also made about the failure to apply separate noise limits for day-time and night-time which again is said to be contrary to the Guidelines which state in that regard "*Separate noise limits should apply for day-time and for night-time*". In so far as the inspector has stated in his report that "*in conditions attached to wind farm permissions the Board as a matter of practice uses a fixed night time limit of 43dB(A) or 5 dB(A) above background levels (whichever is the greater)",* the applicants submit that this is contrary to the Guidelines which recommend the 43dB(A) level on its own for night time noise, and they refer to the fact that in relation to day time levels the Guidelines recommend "*a lower fixed limit of 45dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations*" which the applicants say means it is the lower of the two limits which applies.

Board's submissions:

12. In relation to this ground of complaint the Board makes the point that it is an expert body, and that it reached its decision following an assessment of proper planning and sustainable development, and having carried out a proper EIA in accordance with its statutory obligations. In so far as the applicants are saying that the Board failed to carry out an EIA in relation to this "individual case", the Board says that this assertion is manifestly incorrect, and points to the very detailed EIS that was before the Board, as well as the further information that was sought by the Board and which it received, each of which addressed, inter alia, the issue of noise in relation to this particular proposed development. It refers in particular to Request 6 in the Request for Further Information relating to noise which requested further information under six different separate paragraphs (a) to (f), the penultimate of which reads:

> *"(e) the background noise assessments at identified nearest noise sensitive locations should quantify over 10 minute periods the existing background noise levels having due regard to wind speed, wind direction*

and rainfall over the same time periods. Wind speed should be measured at, or derived for, the hub height of the proposed turbines. The applicant should also clarify the periods of noise data that were excluded from analysis due to periods of rainfall. Background noise levels as it varies with hub height wind speed should be quantified separately for daytime, evening time and night-time periods with sufficient data present in a wind direction downwind from the proposed turbines to the identified sensitive locations covering a range of wind speeds from the turbine cut-in speed to its rated power. Hub height wind speed should be converted to standardised 10m height wind speed before comparison with predicted and cumulative noise levels at sensitive locations."

13. Framore's detailed response of April 2013 to this Request includes a response to the above request at (e). Relevant to the question of whether the Inspector in his report, and the Board by generally agreeing with and adopting the inspector's report, failed to carry out an EIA because it failed to take proper account of the fact that Location 2 (otherwise referred to as H13) came within the category of a 'noise sensitive location' is part of the response to (e) which appears at page 24 of 62 of that response. It is there stated:

"The noise impact assessment contained in the EIS concluded that there was no negative operational impact expected from the Derragh Windfarm when assessed against the noise limits contained within the Department of Environment Heritage and Local Government (DoEHLG) 2006 Wind Energy Guidelines. The predicted noise levels at the modelled noise sensitive locations (NSLs) or receivers (all dwellings in this assessment) were less than 40 dB LA90 for fourteen of the eighteen locations, and indeed, as such, were less than the fixed daytime and night-time fixed limits. At the nearest NSLs (H1,H13,H14, and H18) all the predicted noise levels were less than the daytime fixed limit of 45 dB(A) and where baseline monitoring identified periods of 'quiet background noise' i.e. LA90 levels less than 30 dB, the predicted levels were less than the 35–40 dB LA90 fixed limit range. The night-time fixed limit of 43 dB(A) was exceeded at NSLs H13, H14 and H18 for a single modelled wind speed of 8 m/s.

It is worth noting that the exceedance at this wind speed was only 1 dB greater than the 43 dB LA90 limit.

More importantly, these NSLs will never experienced the predicted noise emission of 43dB(A) at 8 m/s or indeed, the other predicted noise levels at the other wind speeds. The noise prediction standard, ISO 9613 Attenuation of Sound during Propagation Outdoors, models all NSLs as if they were downwind of all noise sources at the same time. In reality, the turbine layout requires a range of wind directions from north–north westerly through to easterly for the NSLs to be downwind of all the turbines simultaneously which cannot occur." [emphasis added]

14. This is a point taken up by Tim Cowhig on behalf of the second named notice party (Framore Limited) in his verifying affidavit sworn on 7th March 2014 where at paragraph 18, having referred to certain noise level measurements in relation to Location 1 and Location 2, and in particular the fact that the LA90 noise level at Location 2 was measured at 29dB, he refers to what isstated in the EIS in relation to Location 2, namely:

"the predicted noise levels are compliant except at 8 m/s wind speed of where turbine noise is predicted at 44 dB(A) and the limit is 43 dB(A). While this does indicate that a non-compliance could occur at a wind speed of 8 m/s (standardised to 10m), it is unlikely that such a non-compliance

will occur as the predicted noise level assumes all turbines running a maximum rated power and all upwind of the respective receiver. It is not possible for receiver H13 [i.e. Location 2] to be downwind of all the turbines simultaneously due to its location relative to the turbines, therefore this location will never be subject to the full noise emission at 8 m/s as predicted in the model. Similarly, receivers H14 and H18 will not exceed 44 dB(A) at 8 to 9 m/s for the same reason."

15. The Board has submitted, as has Framore Limited, that it clear from a consideration of all the material which was before the Board including the EIS, the Further Information received, the submissions made and responses thereto, when taken together, that the Board's consideration of this material for the purposes of its EIA was in relation to this individual development, and that no evidence has been adduced to establish that the Board has not carried out an EIA in accordance with its obligations. The Board in its decision has stated that it carried out an EIA. The onus is on the applicants to establish that this is not a correct statement, and in my view they have failed to do so. There is ample evidence from within the materials before the Board and in the Board's own decision that a proper EIA was carried out..

16. The Board has not erred by generally adopting the inspector's report for the purpose of its own EIA. In fact it has not adopted it in its entirety, as can be seen by the variation in a couple of the conditions. There is no evidence to support the contention made that the Board erred in relation to its assessment in relation to Location 2 (H13). Even though the inspector's report refers to the LAeq measurement and not the LA90, as pointed out by the applicant, when addressing the level of background noise, and on the face of it therefore failed to consider Location 2 on the basis that it was a low noise environment (being less than 30 dB(A) LA90, and even though the inspector's report was generally adopted by the Board, it is entirely insufficient to indicate the sort of fundamental error on the part of the Board which should result in the Board's decision being quashed, when all the material is taken into account. The Board was entitled to take into account in its EIA the matters referred to in paragraphs 13 and 14 for example. It cannot in my view be said that the Board failed in its statutory duty in this regard by not slavishly adhering to the Guidelines recommendation in relation to a low noise environment. It was entitled to see the Guidelines as just that, i.e. guidelines. It is entitled to take other matters into account in relation to its consideration of the Guidelines, and how to apply them or not as the case may be, and to agree with what was stated in the EIS, namely that as a matter of actual fact the levels cannot not be exceeded because as Mr Cowhig has averred by reference to the EIS and the Franore response to the request for Further Information: *"it is not possible for receiver H13 [i.e. Location 2] to be downwind of all the turbines simultaneously due to its location relative to the turbines, therefore this location will never be subject to the full noise emission at 8 m/s as predicted in the model."*

Having read and considered the material that was before the Board, and having considered also the affidavits filed by the parties, and considered the legal submissions made in relation to this Ground put forward for quashing the decision of the Board, I am satisfied that the ground does not succeed.

Failure to have regard to the 2006 Guidelines in breach of Section 28 of the Act of 2000:

12. Section 28(1) and (2) of the Act of 2000 provide:

"(1) The Minister may, at any time, issue guidelines to planning authorities regarding any of their functions under this Act and planning authorities shall have regard to those guidelines in the performance of their functions.

(2) where applicable, the Board shall have regard to any guidelines issued to planning authorities under subsection (1) in the performance of its functions." (emphasis added)

The applicants submit that the Board was therefore required to have regard to the 2006 Guidelines when making its decision, and they say that it failed to do so since it either disregarded the Guidelines or misinterpreted them, and in either case cannot be properly said to have had regard to them. They say that the Board failed to have regard to the Guidelines because (a) it failed to have regard to the specific absolute daytime noise limit of 35-40 dB(A) recommended in the Guidelines in respect of a "low noise environment" for the reasons which I have already set forth above, and (b) the Board failed to have regard to the LA90 noise measurements to which the Guidelines refer as the relevant descriptor for the purposes of determining both the background noise levels and the appropriate noise limits to be applied, and instead, relying on the inspector's report, the Board relied upon the LAeq noise measurements for Location 1 and Location 2.

13. It is the LA90 measurements which, according to the 2006 Guidelines, are relevant for determining the existing background noise levels and the existing noise environment. In that regard, the applicants have referred to page 29 of the Guidelines. Having discussed the aerodynamic noise (swish) caused by rotator blades passing through the air, and purely mechanical noise created by the generator, the gear-box and other mechanical elements within a cover or housing (the nacelle), the advances in design and technology which have reduced noise emissions, and the effect of higher and lower wind speeds in masking to a greater or lesser extent (as the case may be) noise caused by the wind turbines, the Guidelines state as follows:

"Noise impact should be assessed by reference to the nature and character of noise sensitive locations. In the case of wind energy development, a noise sensitive location includes any occupied dwelling house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational amenity importance. Noise limits should apply only to those areas frequently used for relaxation or activities for which a quiet environment is highly desirable. Noise limits should be applied to external locations, and should reflect the variation in both turbine source noise and background noise with wind speed. The descriptor, which allows reliable measurements to be made without corruption from relatively loud transitory noise events from other sources, should be used for assessing both the wind energy development noise and background noise. Any existing turbines should not be considered as part of the prevailing background noise.

In general, a lower fixed limit of 45dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours. However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30dB(A), it is recommended that the daytime level of the LA90, 10min of the wind energy development noise be limited to an absolute level within the range of 35–40dB (A).

Separate noise limits should apply for day-time and for night-time. During the night the protection of external amenity becomes less important and

the emphasis should be on preventing sleep disturbance. A fixed limit of 43 dB(A) will protect sleep inside properties during the night.

In general, noise is unlikely to be a significant problem where the distance from the nearest turbine to any noise sensitive property is more than 500 metres. Planning authorities may seek evidence that the type(s) of turbines proposed will use best current engineering practice in terms of noise creation and suppression"(my emphasis).

14. I note in passing, and as noted by Ellen Morrin in her affidavit in support of the Board's Statement of Opposition, that the first named applicant, Pol O Grianna, in his grounding affidavit sworn on his own behalf and on behalf of all the other applicants and with their authority, has sworn in paragraph 4 thereof that "*the applicants are all residents in the townlands of Derragh, Eachros, Gortnabinne and Rathgaskig, Ballingeary, County Cork whose properties are located at distances between 527m and 1800m from the proposed turbine development …"* (my emphasis).

15. Finally under this ground, the applicants submit that where the Board departed from the 2006 Guidelines, it was obliged to give its reasons for doing so.

16. The onus is on the applicants to establish that the Board failed to have regard to the 2006 Guidelines. In my view they have failed to discharge that onus. Firstly, the materials before the Board, including the inspector's report were replete with references to the Guidelines. Secondly, The Board's decision itself on page 2 thereof specifically states that it had regard to those Guidelines. I accept of course that a Board cannot simply in some purely formulaic way recite that it had regard to the Guidelines when there is clear evidence from the Decision that it cannot have done so, and still be considered to have complied with its obligations under section 28 of the Act of 2000. But we are not dealing with such an extreme and improbable situation as that. The Board in this case has stated that it had regard to the Guidelines, and it is evident from the materials before it, including the inspector's report relied upon heavily by the Board, and the Decision itself, that it did so. The fact that it has not slavishly followed the Guidelines does not indicate that it has not had regard to them as it is required to do.

17. The second limb of the applicant's ground in relation to section 28 is that the Board has misinterpreted the Guidelines, and in so far as that is so, should be considered to have had regard to them. The applicants say that the inspector in his report used the LAeq measurement for Location 1 and Location 2 instead of the LA90 measurement, and that this led to the Board ignoring the Guidelines in relation to the fixing of a noise limit recommended for a low noise environment in relation to Location 2. In fact it is apparent from the Board's decision that it considered the Guidelines when including Condition 12 in relation to any noise sensitive location, and I note that the limit is set by reference to the LA90 measurement and not the LAeq. I do not regard the fact that the inspector referred to the LAeq measurement rather than the LA90 measurement as indicating such a misinterpretation of the Guidelines as to compel a conclusion that proper regard cannot have been had to the Guidelines. I have dealt with the reality of that issue in relation to the previous ground considered.

18. The parties have referred to the judgment of Quirke J. in *McEvoy v. Meath County Council* [2003] 1 I.R. 208. That was a case where the applicant had sought to quash the respondent's decision to make and adopt a development plan for County Meath on the basis that the council had failed to have due regard to the strategic planning guidelines for the greater Dublin area as required by law. Section 27 of the Act of 2000 at the relevant time required the council to have regard to those strategic planning guidelines when making and adopting its development plan, but Quirke J. held that the phrase "have regard to" did not require it to rigidly follow the Guidelines, and that it could even

:part from them for bona fide reasons consistent with the proper planning and development of its functional area. He also went on to state that "*if it had been the intention of the Oireachtas that section 27(1) should be construed as imposing upon planning authorities an obligation to 'comply' with regional planning guidelines then the enactment rendered subs. (2) of the same section superfluous*". Subs. (2) at the time provided that "*the Minister may, by order, determine that planning authorities shall comply with any regional planning guidelines in force for their area, or any part thereof, when preparing and making a development plan .....*". One can see in relation to the present case that while the Oireachtas had required that Guidelines be had regard to, it has not gone further and required that they be adhered to in every respect. It clearly could have done so if it had so wished. I am satisfied that despite the matters relied upon and argued by the applicants, it is clear from the evidence that the Board had regard to the 2006 Guidelines in accordance with its obligations under section 28.

19. The applicants have also argued that the Board's decision is flawed because neither the inspector nor the Board gave any reason for departing from the 2006 Guidelines, and that the Board was obliged to do so. However, I do not consider the Board's decision departs in any material or significant way from the Guidelines. I have already held that the Board is not obliged to slavishly or rigidly follow and apply the Guidelines, and it follows that it may exercise some discretion in relation to the Guidelines. This is consistent with the requirement that regard be had to them. But secondly, there is no statutory obligation on the Board to give reasons for not following a particular guideline even if it was the situation that they had been departed from. Section 28 imposes no requirement to give any such reasons. Other sections of the same Act do provide that where an authority or the Board is departing from a recommendation of a delegated person such as an inspector, it must include a statement of the main reasons for having done so – see for example section 34(10(b), and also section 37(2) (c) where the main reasons and considerations must be given where the Board decides to grant a permission even though it materially contravenes the development plan. The obligation under section 28 does not go that far.

Project-Splitting:

15. The applicants submit that the Board has failed to carry out an EIA in relation to the overall project of which the construction of the wind turbines is only the first stage, since there is a necessary second phase, namely the works necessary to connect the wind farm to the national grid. It is submitted by the applicants that the cumulative effect of the entire development on the environment should have been the subject of the Board's EIA, and that an impermissible 'project-splitting' has occurred thereby invalidating the decision-making process. They make the point that the connection to the national grid is a fundamental part of the overall development as, without such connection, the wind farm cannot operate, and that the two stages should be considered as a single project and be assessed as such on a cumulative basis before it can be seen as complying with the EIA Directive.

16. The EIS submitted with the planning application by the developer made reference at paragraph 3.1.2 thereof to the fact that a connection to the national grid would in due course be necessary, including the statement that "*it is not possible to determine the line or form (overhead or underground) of the grid connection at this stage as the design will be undertaken by ESB Networks*". The applicants say that whatever form the connection takes, whether overhead or underground, there are inevitable and significant consequences for the environment, and that the Board was required to consider these when considering the first stage of the development, in order to avoid the possibility of 'project-splitting', which in the applicants' submission is contrary to both Irish and EU law. They say that because the EIS did not contain any information as to the environmental impact of the second stage relating to the connection to the national grid,

ıe Board was prevented from giving any consideration to that factor, or the cumulative effect of both stages of the development, as is required under the Directive.

17. In so far as the Board and Notice Party may argue that the impact of the second stage can be considered at some later stage and that it was unnecessary for its impact to be considered by the Board when considering the present application, the applicants have made the point that it is quite possible that the connection to the national grid would constitute exempted development under Part 1, Schedule 2 of the Planning and Development Regulations 2001, as amended, and therefore there may well be no opportunity available for an EIS to be submitted in relation to the cumulative effects of the development under challenge and its connection to the national grid, as no further planning application would be required. They say that it is not sufficient for the developer in its EIS to simply state that the line and form of the connection is not yet known, and therefore cannot be assessed, and that the Board ought not to be permitted to treat the works related to the grid connection as an entirely separate project, but rather as an integral part of the subject development.

18. The EIS submitted by the developer stated the following regarding the connection of the proposed turbines to the national grid:

> *"The grid connection from the proposed turbines will be via underground cable connections to the on-site substation. The cables will be buried adjacent to the site tracks where possible. The location of the proposed substation is shown on Figure 3.1. The developer has a grid connection offer as part of the Commission for Energy Regulation (CER) Gate 3 processing group. It received a connection offer (DG418 and DG419) on 30th June 2011 from ESB Networks. The connection offer states that the electricity generated at Derragh Wind Farm will connect to the national grid at a 110 kV substation at Coomataggart. The grid connection will operate at 20 kV. It is not possible to determine the line or form (overhead or underground) of the grid connection at this stage as the design will be undertaken by ESB Networks. A 20 kV overhead line is usually constructed with a single wooden pole and does not typically require steel lattice masts. It is of relatively low impact and does not normally require planning permission."*

19. The Inspector merely notes in this regard at para. 9.13.9 of his report:

> *"Having regard to the scale of the project and the need to obtain a connection to the national grid (something that may be beyond the control of the applicant), it would be appropriate to allow a 10-year planning permission as sought by the applicant. This is not unusual in relation to wind farm applications."*

20. In its submissions, the Board refers to the fact that it addressed the issue of the connection to the national grid at Condition 4 of the Board's decision which states: "*This permission shall not be construed as any form of consent or agreement to a connection to the National Grid. Reason: in the interest of clarity*." The second named Notice Party pleads that the precise grid connection that will be available to it is outside its control and will be the subject of further consideration, including with regard to its environmental impact, at some stage in the future when the plans and specifications for that connection have become clear. The Court has not been provided with any evidence of any attempt which may have been made to get a design for the grid connection from ESB Networks, so it can be presumed that there has been no such attempt as yet.

21. The Board accepts that so-called 'project-splitting' must be avoided so as to ensure that objectives of the EIA Directive are not frustrated. But central to the Board's

gument is that in the present case the subject development and the later connection of that development to the national grid do not constitute one project, but rather are separate projects in respect of which their respective environmental impacts may be assessed at the relevant time. It says that when the separate project in relation to the grid connection becomes the subject of a consent application, the cumulative effects of that development will be assessed, including by reference to its cumulative effect with the subject development, and in that way, even if the entire project is considered to be a single project, the effects of both will be assessed. The Board makes the additional point that no development requiring an EIA can be exempted development by virtue of the amendment (by substitution) of section 4 of the Act of 2000 which now provides:

> *"(4) Notwithstanding paragraphs (a), (i), (ia) and (l) of subsection (1) and any regulations under subsection (2), development shall not be exempted development if an environmental impact assessment or an appropriate assessment of the development is required".*

22. Accordingly, it is submitted, any connection to the national grid would have to be assessed so that consideration was given to the direct and indirect effects of the connection to the national grid, both in and of itself as well as cumulatively with the subject development, and where there was likely to be a significant environmental effect an EIA would be required under Part X of the Planning and Development Regulations 2001, as amended. It makes the point that if it was not considered that there would, even cumulatively, be any significant environmental effects from the second phase, then no environmental prejudice would exist. In this way, it is submitted that the objectives and provisions of the EIA Directive will be fulfilled in relation to the future connection of the subject development to the national grid, notwithstanding that at the present time the plans and details relating to the future connection are not yet known, and therefore have not as yet been the subject of an EIA.

23. Notice Party (Framore) supports the submissions made on behalf of the Board. It refers to the fact that where no proposals have yet been formulated by ESB Networks for the grid connection design, it simply was not possible for it to include a consideration of same in its EIS, and consequently it was not possible for the Board to assess the potential environmental impact of the works associated with that phase of the development. Framore also refers to the Planning Guidelines which at para. 4.3 state in this regard that "*the planning authority should note that it may not be possible, due to reasons outside the applicant's control, to provide information on indicative grid connections at the pre-planning consultation or planning application stage of the wind energy development*". One should note, however, the context of that statement which appears from the following paragraph which states: "*It is therefore inappropriate for the planning authority or An Bord Pleanala on appeal to attach conditions to planning permissions for wind energy developments in regard to the location of the connection to the grid. In these instances, a separate application for grid connection will be necessary*" [my emphasis]. It refers to the fact that the inspector in his report noted that the connection to the national grid is a matter outside the control of the developer, and that accordingly by generally adopting the inspector's report, the approach taken by the Board in relation to the environmental impact of the connection to the national grid was appropriate, and in accordance with the Guidelines.

24. Framore have referred to the Opinion of Lord Hodge in the Outer House, Court of Session, Scotland in *Skye Windfarm Action Group Limited v. Highland Council* [2008] C.O.S.H.19 in support of its submission that where there are two phases involved in a development, even where the second is integral to the overall project, it will not always be the case that the EIA must encompass the cumulative environmental effects of the overall project, and that each case must be considered on its own particular facts in order to decide whether those cumulative effects are such that the matters should be

onsidered together. In Skye, Lord Hodge noted that it was not disputed between the parties that certain 'borrow pits' from which aggregate was to be extracted to provide on-site roads, and for which a separate planning application was lodged, were part of the overall wind farm project, and that normally their cumulative impact should have been considered as part of the EIA. However, he went on to state that he was not satisfied that it was illegal to separate the borrow pits from the assessment of the wind farm, noting that previous assessments carried out in 2002 and 2006 had not identified any significant environmental effects of the borrow pits whether considered alone or cumulatively with the wind farm. In those circumstances he saw "*no practical reason for an environmental impact assessment of the borrow pits other than in the context of the wind farm application.*" He noted that his approach was consistent with the approach taken by Advocate General Gulmann in *Bund Naturschutz in Bayern v. Freistaat Bayern* (Case C-396/92) [1994] ECR 1 – 3717, namely that each case will be fact-sensitive as to whether the case must be considered cumulatively with a related application.

25. It is worth noting that in Skye the initial wind farm application had included within its scope certain proposals to excavate stone but that the developer at that point had made no decision as to the source of material for the construction of the site words. The initial planning permission granted contained a condition which required the developer, before the development commenced, to submit detailed proposals for the sourcing of materials including any necessary planning applications. Thereafter, two separate planning applications for the borrow pits were lodged, but the developers asked for what is referred to as a "screening opinion" as to whether the applications for the borrow pits would require an EIA. The developer was informed that the planning authority "*opined that such an assessment would not be required*". Lord Hodge noted that no challenge had been taken to that screening opinion. Three years later, a second amended proposal was lodged by the developer which included an assessment of the cumulative impact of the wind farm and the borrow pits. In their amended proposal, the developer give a summary of the cumulative impacts of the wind farm and the borrow pits and concluded by stating that they had not identified any likely significant cumulative environmental effects over and above the assessed environmental effects of the wind farm. That conclusion was not challenged by the petitioners in the case. Lord Hodge in those circumstances indicated that there had been no breach of the Regulations in relation to the borrow pits as anybody entitled to do so, had not been deprived of an opportunity to comment on the environmental assessment in relation to the borrow pits, and he concluded also that "*because of the screening opinion, the borrow pits were not EIA applications".* But one should note that at paragraph 76 of his opinion, Lord Hodge stated:

> *"[76] It is undisputed that the borrow pits formed an integral part of the wind farm development and Swale Borough Council and BAA plc support the view that part of a development in such circumstances should not normally be considered in isolation. But I am not satisfied that it was illegal to separate the borrow pits from the assessment of the wind farm. The initial assessment end 2002 and the August 2006 assessment did not identify any significant environmental effects of the borrow pits whether considered alone or cumulatively with the wind farm. It is consistent with Advocate General Gulmann's approach in Bund Naturschutz that the court should look at the particular circumstances of each case in deciding whether a cumulative assessment is needed to fulfil the purposes of the Directive. While, as Mr Campbell argued, the cumulative effects of the wind farm and the borrow pits are cumulative, I see no practical reason for an environmental impact assessment of the borrow pits other than in the context of the wind farm application.*

[77] In any event the problem, if such it was, was remedied. Having received legal advice and reconsidered to the matter, the respondents appear to have encouraged AMEC to present a cumulative assessment in the second amended proposal. AMEC presented that assessment. The respondents were able therefore to consider the cumulative impact of the wind farm and the borrow pits before the grant of planning permission to the wind farm.

.....

[79] The 1999 Regulations are concerned with achieving a proper environmental assessment in which the public have the opportunity to participate. In this case, in contrast with the circumstances in BAA plc, the unchallenged conclusion of the cumulative impact assessment was that the borrow pits would not give rise to any significant environmental effects beyond those identified in the assessment of the wind farm. I am not satisfied that there has been any failure to assess cumulative environmental effects or that democratic participation in the assessment has been thwarted in any way. The challenge appears to be a technical one rather than one with substantive content and I am not persuaded that the technical challenge is justified. The 1999 regulations are not designed to create an obstacle course for a developer or a planning authority. This ground of challenge fails."

26. I consider that the decision in Skye is distinguishable from the present case in so far as there was in fact an assessment made at an earlier screening stage that there were no significant environmental impacts deriving from the borrow pits such that a cumulative assessment was required, and that opinion was not challenged. But Lord Hodge was able to take comfort also from the fact that the authority requested the developer to provide a cumulative assessment, and that was provided and considered. I do not think it is authority for any general proposition that even though one development is integral to a second there is nothing illegal about separating one from the other, and thereby avoid a cumulative assessment of significant environmental effects of both. Each case will have to be considered in the light of its own specific facts, and as I have said, the Skye facts are very different from the facts in the present case where it has been stated by the developer, and apparently accepted by the inspector and the Board, that it was not possible at the time the application was being considered for the potential environmental effects of the works required in order to make the connection to the national grid to be included in an EIS and then assessed, as the route/design for that connection was not known precisely at the time, and in any event it was a matter outside the control and knowledge of the developer at the time, being a matter for ESB Networks to determine. Therefore, unlike the Skye case, there has not been any assessment of the potential environmental impact of that second phase of the wind farm development at all. There have been some views expressed that it is unlikely that there would be any significant impact to the environment by the works required for the connection to the national grid, but it cannot be said that there has been an assessment as such, since the details have not yet been made available.

27. I am satisfied that the second phase of the development in the present case, namely the connection to the national grid, is an integral part of the overall development of which the construction of the turbines is the first part. This is not a case such as in *R (Littlewood) v. Bassetlaw District Council* [2008]'s E.W.H. C. 1812 where the development in question was a stand-alone project within a larger Master Plan development, the full details of which had not yet been finalised. In that case it was held that phase 1 was not dependent or reliant upon the completion of any other part of the master plan, and therefore the cumulative effects of the entire master plan did not need

) be assessed. The present case is different. The wind turbine development on its own serves no function if it cannot be connected to the national grid. In that way, the connection to the national grid is fundamental to the entire project, and in principle at least the cumulative effect of both must be assessed in order to comply with the Directive. In this regard the applicants have referred to the judgment of Clarke J. in*Arklow Holidays Limited v. An Bord Pleanala and others* [2006] IESC 15, albeit a judgment on the question only as to whether the applicants had established substantial grounds for their challenge to a decision to grant permission for the development of a waste water treatment plant, inter alia on the ground that "*the environmental impact statement submitted by the Urban District Council in support of its application for planning permission omitted from its considerations any potential impact on the environment of all aspects of the project other than those directly connected with the waste water treatment plant itself*". What had been omitted was any assessment of the environmental impact of certain aspects of the project which were outside the waste water treatment plant itself, the inspector taking the view in his report that by virtue of the fact that the rising mains and pumping stations were not located in environmentally sensitive areas, they were unlikely to have a significant environmental impact and therefore did not consider that the Board should require a new E.I.S. In deciding that a substantial ground had been raised in this regard by the applicants, Clarke J. stated:

> *"It may well have been within the competence of the Board to take the view that the potential environmental impacts of those aspects of the project outside the waste water treatment plant itself were much less significant than those from the plant. It may well also have been within the competence of the Board to take the view that the impacts that might be associated with those aspects outside the waste water treatment plant itself were not, of themselves, significant. However, what is required to be assessed is the totality of the impact of the project taken as a whole. It is, therefore, at least arguable sufficient for the purposes of leave, that aspects of a project which might not have impacts which would be significant in themselves might, when taken on a cumulative basis, and when added to the impacts of other aspects of the same project, give rise to an overall view that the environmental impacts taken as a whole were such as should lead to a refusal of development consent or, indeed, the imposition of more stringent conditions."*

28. It seems to me that the fact that the developer is at the mercy of ESB Networks as far as the details of the plans for that connection to the grid is concerned, cannot absolve the developer from compliance with the Directive in every respect. Presumably at some future date all of the grid connection details will be ascertained, so that a decision can be made as to whether there will or will not be any significant environmental impact either on its own, or cumulatively with the wind turbine development itself. The question is whether that cumulative assessment, or even a decision as to whether any such cumulative assessment is required at all, should be made prior to permission being granted for the first stage of the development (i.e. the construction of the turbines), or whether the construction of the turbines can be allowed to proceed, and then in due course when the details of the connection to the national grid are known, a cumulative assessment of the environment mental impact of both can be carried out – running the risk from the developer's point of view, that in the event that he proceeds with the construction of the turbines, it would be all in vain should there be a negative cumulative assessment when it comes to considering the connection to the national grid.

29. If, in the latter event, where a decision is made by the authority to refuse permission for the connection to the national grid in view of a perceived significant environmental impact cumulatively, and the first phase had at that stage already been completed and was ready to be operated once the connection to the national grid was completed, there

ould be a significant prejudice to the developer such that it would probably make no commercial sense to proceed with the completion of the turbines until such time as a connection to the national grid was guaranteed by a relevant permission. For that reason, Framore submits that in reality there is nothing to prevent a cumulative assessment of the environmental impact of the connection to the national grid being carried out later when the details are known. They point also to the fact that the planning permission itself, which they have already obtained, makes it clear that the granting of that planning permission is not to be taken as any assurance that a connection to the national grid will be permitted. But, it must be borne in mind that Condition 4 is not a condition which makes the construction of the turbines conditional upon the consent being given for the connection to the national grid.

30. The applicants on the other hand fear that if the turbines are erected pursuant to the present permission, it would be more difficult for the authority to refuse permission in respect of the connection to the grid. In other words, the fear is that Framore would be seen to have "*a foot in the door*" such that any objections that the applicants might raise in relation to the second phase would be less likely to succeed than if the project was assessed cumulatively now before the developer has invested heavily in phase 1. In this regard, the applicants also refer to the fact that in the EIA Directive at recital 2 thereof that is stated:

> *"pursuant to Article 191 of the Treaty on the Functioning of the European Union, Union policy on the environment is based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should, as a priority, be rectified at source and that the polluter should pay. Effects on the environment should be taken into account at the earliest stage in all the technical planning and decision-making processes" [Emphasis added].*

The applicants submit that the "earliest stage" is now, and prior to permission being granted for phase 1, and that otherwise there a risk that the requirements of the Directive will be avoided by no cumulative assessment of the overall project being carried out, particularly where it is probable that phase 2 on its own will be seen as exempted development requiring no planning consent.

31. The respondent in its written submission has stated:

> *"57. For the Applicants" case to have any merit, it must be on the basis that the development and the national grid connection constitute the one "project" and thus, that such a project has been granted development consent in defiance of the EIA Directive because such has arisen prior to a complete EIA.*
>
> *58. If, of course, the subject matter development and the future connection to the national grid are viewed as one project, then it stands to absolute reason that development consent has not been given for that project. Indeed, Condition 4 is clear on this."*

32. In that regard, I have already concluded that in reality the wind farm and its connection in due course to the national grid is one project, neither being independent of the other as was the case on *R (Littlewood) v. Bassetlaw District Council* [supra] for example. The Board's submissions are very much predicated on the contrary argument, and on the fact as submitted also by Framore that at this point in time there have been no proposals formulated by ESB Networks for the design and route of the connection to the national grid. That argument does not, it seems to me, justify treating phase 1 as a stand-alone project when in truth it is not. Rather, it points to a prematurity in the seeking of permission for the construction of the wind farm ahead of the detailed

roposals for its connection to the national grid from ESB Networks. I appreciate that Framore have indicated that it simply is not possessed of the necessary information in this regard and could not include it in its EIS. But that does not mean that given more time and further contact with ESB Networks it could not be achieved so that it could be included in an EIS which addressed the impact of the environment of the total project "at the earliest stage". It may mean that the developer must wait longer before submitting its application for planning permission. But it seems to me likely at least that even if a phase 1 permission is granted with a condition such as Condition 4 contained therein, no sensible developer would complete phase 1 of the development without having been granted permission for the connection to the national grid, or without having been assured that the connection phase is exempted development. In that way, it is difficult to see any real prejudice to the developer by having to wait until the necessary proposals are finalised by ESB Networks so that an EIS for the entire project can be completed and submitted, and so that a cumulative assessment of the likely impact on the environment can be carried out in order to comply with both the letter and spirit of the Directive.

33. I will therefore grant the reliefs at D1 and D2 of the Abridged Statement of Grounds dated 14th February 2014.

The Secretary,
Planning Department,
Cork County Council,
County Hall,
Cork.

29th October 2014
Our ref: 26310-14/JN/PW

RE: Planning Register Reference – 14/557 Barnadivane Kneeves Terelton Co. Cork Permission for construction of an electricity substation compound, this application is intended to replace the substation already granted permission under PL04.219620 (05/5907) and subsequently extended under 11/6605. The electricity substation layout includes 3 no. control buildings, associated electrical plan and equipment, security fencing and ancillary works. This application is seeking a 10 year planning permission. Applicants – Arran Windfarm Limited

Our clients –

1. **Stephanie Larkin of Moneygaff East, Castletown, Enniskeane, County Cork**
2. **Michael O'Donovan of Moneygaff East, Castletown, Enniskeane, County Cork**
3. **Denis Buckley of Moneygaff East, Castletown, Enniskeane, County Cork**
4. **Noelle Sheehan of Moneygave, Coppeen, Enniskeane, County Cork**
5. **Pat Sheehan of Moneygave, Coppeen, Enniskeane, County Cork**
6. **Nora Sheehan of Moneygave, Coppeen, Enniskeane, County Cork**
7. **Aisling Connolly of Moneygaff East, Enniskeane, County Cork**
8. **Gerard Connolly of Moneygaff East, Enniskeane, County Cork**
9. **JP O'Callaghan of Moneygaff East, Enniskeane, County Cork**
10. **Dan Galvin of Gurranreigh, Lissarda, County Cork**
11. **Patrick Manning of Barnidivane, Terelton, Macroom, County Cork**
12. **Sabrina Hurley of Moneygaff East, Enniskeane, County Cork**

Dear Sir/Madam,

We act on behalf of the above named and on their behalf we wish to make the following Observations on the above planning application. Enclosed please find cheque in the sum of €20 being your fee herein.

The application is stated to relate to a previously permitted wind farm development incorporating an electricity substation. The relevant reference numbers are cited in the heading to this letter. Figure 1.2 of the Applicant's Environmental Report helpfully shows the comparative size of the permitted and the proposed substations. The proposed substation site is substantially greater in area.

The following explanation is offered by the Applicant for the necessity to seek permission for the present substation:

> *'The original wind farm planning application included for a substation, however, since receiving the original planning consent new Eirgrid standards have been adopted which require 110kV substations to have a larger development footprint which includes available land for potential future expansion. As a consequence, a new planning application is required for this substation.'*

The present substation is considerably larger in scale than the previously permitted substation. It is also being moved to a more visually prominent location. The existing site is said to be unsuitable as it is 'constrained' to the east (by the road) and to the west (by a 110kv line). However it is not constrained to the north or to the south. In addition so far as the eastern 'constraint' goes, proximity to the 110kv line is an advantage, not a constraint. As the Applicant says in the Environmental Report (p.20)

> *'Proximity to transmission system:*
> *The substation site needs to be capable of connecting directly to the existing 110kV overhead cable traversing the site, and therefore needs to be along the line of the cable.'*

None of the elements of the previously permitted development has yet been constructed. Indeed permission was about to lapse when an application for extension to the original five year term was made. This was duly granted under reference no. 11/6605.

It is noted that the applicant for this new substation asks for a ten year permission. It is not clear why construction of a substation requires a ten year permission. Such a long duration is in principle undesirable as it creates uncertainty and risks creating planning blight. We note in this regard the Applicant says that Barnadivane Wind Farm is scheduled for a connection to the national grid in 2015. There is no reason therefore for a ten year permission.

The substation is clearly an integral part of a yet to be built wind farm. The related wind farm is one which is subject to the mandatory EIA provisions under Irish and European Law and to mandatory requirements arising under the Habitats Directive including the carrying out of an appropriate assessment. Despite that, the Applicant, who has submitted an Environmental Report, asserts in his planning application form (at Question 22) that the application does not require an EIS. We disagree.

The Applicant has presented a limited Appropriate Assessment Screening Report. We submit that this is wholly inadequate. The obligations on planning authorities in relation to appropriate assessment have recently been helpfully clarified in the High Court Judgement of Finlay Geoghegan

J. in *Kelly .v. An Bord Pleanála* delivered 25th July 2014 Record Number: 2013/802JR. We refer the Council to that decision.

The decision of the High Court in the Kelly case establishes that the previous practice of planning authorities did not meet the legal standard required under the Habitats Directive. That therefore means that the Council can place no reliance on the previous planning permission when considering the present application. It was granted under a procedure now seen to be unlawful, and it related to a 14 turbine windfarm that may be unlikely to bear much resemblance to what is intended for this site.

The European Court of Justice has made it clear that there can be no piecemeal approval of elements of a larger EIA type development which when taken together with the remaining elements would require EIA or AA. Trying to obtain so-called salami style development consents, where an overall development is broken down into smaller elements which of themselves appear not to trigger the EIA or Habitats Directive obligations and so which would defeat the purpose of the directives is legally impermissible as well as contrary to proper planning and sustainable development principles. Ireland has been condemned by the Court for failing to ensure that this approach is respected in its planning legislation, as you will be aware.

We submit that this salami style approach is what appears to be happening here. The proposed substation cannot be seen in isolation, yet that is how it has been presented to Cork County Council Planning Department.

We submit that the Council is obliged therefore to either refuse the application outright or alternatively to require the applicant to disclose their full plans, accompanied by an EIS, so that the entire picture can be seen and assessed.

The original substation was presented as being adequate to handle the power output of the currently permitted wind farm. The Applicant has not shown why this larger substation is necessary to handle the power from the permitted windfarm. Its justification is presented in terms of needing a larger site allowing for future needs that may be imposed by EirGrid, as well as some apparent (but undisclosed) change in *'design standards'*. In the circumstances it appears reasonable to suggest that the enlarged electrical infrastructure is intended to serve a windfarm having a greater power output – and which has not yet been the subject of planning scrutiny. We therefore ask the Council to ask the developer as to its intentions in this regard. We submit that no permission can validly be given at present.

The Applicant has submitted an Environmental Report, prepared with, it is claimed, some regard to EIA guidance, but the Report tells the public nothing at all about the impact of the turbines that will be connected to the new substation. The inference is that those turbines will be as already permitted, but nowhere is that expressed in any binding way. Our clients do not accept that they will be the same turbines (in terms of number, size, scale or power output) as those that were the subject of a planning permission sought almost ten years ago. The Council as Planning Authority and the public are entitled to know what is proposed. At present, only the Applicant has that knowledge. That is

legally unacceptable by reference to the EIA Directive, the Habitats Directive and the Aarhus Convention as incorporated into EU and Irish Law. It is also we submit undesirable in planning terms.

The following additional observations relate some further specific physical planning issues and policy issues of concern to our clients:

1. Though it may be the case, there is a lack of clarity on whether this development is intended to replace and therefore make obsolete, the previously permitted substation. This must be clarified.

2. Visual intrusion on landscape. This development is on a very prominent hillside location. The site is the size of a GAA pitch and it is on the brow of a hill. It will be highly visually obtrusive over the area. It is industrial in nature and therefore entirely at odds with its rural surroundings. Of itself and in terms of precedent, it is not in keeping with the proper planning and sustainable development of the area.

3. There is a lack of clarity on the necessity for having two control buildings with the same layout: offices, staff facilities, toilets and both with control rooms. According to the planning application there will be no onsite staff. These facilities mean extra development has to take place to accommodate all these extra buildings but also for water and waste water treatment. The nature of these buildings seems to be very much at odds with the idea of an electrical substation which would be unmanned. They increase the size of the site unnecessarily and pose the question of what other activities might be envisaged for this site by the Applicant.

4. This is a scenic walk route and an important amenity in the area. Putting this huge industrial site on it will detract massively from the scenic and rural nature of the route both for visitors to our area and for locals. This is in conflict with the relevant provisions of the County Development Plan, both in its current form and in its latest Draft form.

5. The field of the proposed substation is a wintering ground for Golden Plover, Curlew, flocks of Red Wing and Fieldfare. This again underlines the necessity for appropriate assessment of all likely significant environmental impacts arising under the overall development.

6. As the site is sloping excavation will have to take place to level it. This will produce a lot of traffic from large vehicles. The one lane road infrastructure will be unable to cope.

On national energy needs, Ireland's peak electrical power demand is about 5GW. Installed wind power generation capacity is already about 2GW. There is no need either in terms of EU policy on renewables or in terms of national economic benefit, for increasing the proportion of wind generation connected to the grid. On power station capacity and other sources such as interconnectors, as UCD Economist Colm McCarthy pointed out in Cork just this month:

'The new gas units were planned before the bust. There is now 3300 MW of modern gas capacity, plus 880 of peaking plant. Plus 500 MW of new interconnection to Wales. Plus almost 900 MW at coal-fired Moneypoint. Plus hydro at about 500 MW, plus peat at about 340, plus oil - the total dispatchable is 7400 MW. Non-dispatchable, mainly wind, adds 2400, grand total 9800, twice peak demand.'

So notwithstanding the fine claims made under the heading of Need in the Environment Report, neither Ireland nor Cork actually need this extra plant, whatever size its promoters may have in mind for it ultimately.

We ask the Council to refuse the application as invalid in the absence of adequate information as required under the EIA and Habitats Directives and/or because the development is not in keeping with the proper planning and sustainable development of the area.

Yours faithfully,

Joe Noonan,
NOONAN LINEHAN CARROLL COFFEY

JUDGMENT OF THE COURT (First Chamber)

3 March 2011 (*)

(Failure of a Member State to fulfil obligations – Directive 85/337/EEC – Obligation of the competent environmental authority to carry out an assessment of the effects of certain projects on the environment – More than one competent authority – Need to ensure an assessment of the interaction between factors likely to be directly or indirectly affected – Application of the directive to demolition works)

In Case C-50/09,

ACTION under Article 226 EC for failure to fulfil obligations, brought on 4 February 2009,

European Commission, represented by P. Oliver, C. Clyne and J.-B. Laignelot, acting as Agents, with an address for service in Luxembourg,

applicant,

v

Ireland, represented by D. O'Hagan, acting as Agent, assisted by G. Simons SC and D. McGrath BL, with an address for service in Luxembourg,

defendant,

THE COURT (First Chamber),

composed of A. Tizzano, President of the Chamber, J.-J. Kasel, A. Borg Barthet, M. Ilešič and M. Berger (Rapporteur), Judges,

Advocate General: J. Mazák,

Registrar: N. Nanchev, Administrator,

having regard to the written procedure and further to the hearing on 24 June 2010,

having decided, after hearing the Advocate General, to proceed to judgment without an Opinion,

gives the following

Judgment

1 By its action, the Commission of the European Communities requested the Court to declare that:

– by failing to transpose Article 3 of Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (OJ 1985 L 175, p. 40), as amended by Council Directive 97/11/EC of 3 March 1997 (OJ 1997 L 73, p. 5) and by Directive 2003/35/EC of the European Parliament and of the Council of 26 May

2003 (OJ 2003 L 156, p. 17; 'Directive 85/337');

– by failing to ensure that, where Irish planning authorities and the Environmental Protection Agency ('the Agency') both have decision-making powers on a project, there will be complete fulfilment of the requirements of Articles 2 to 4 of that directive; and

– by excluding demolition works from the scope of its legislation transposing that directive,

Ireland has failed to fulfil its obligations under that directive.

Legal context

European Union legislation

2 Article 1(2) and (3) of Directive 85/337 provide:

'(2) For the purposes of this Directive:

"project" means:

– the execution of construction works or of other installations or schemes,

– other interventions in the natural surroundings and landscape including those involving the extraction of mineral resources;

...

"development consent" means:

the decision of the competent authority or authorities which entitles the developer to proceed with the project.

(3) The competent authority or authorities shall be that or those which the Member States designate as responsible for performing the duties arising from this Directive.'

3 Under Article 2(1) to (2a) of Directive 85/337:

'(1) Member States shall adopt all measures necessary to ensure that, before consent is given, projects likely to have significant effects on the environment by virtue inter alia, of their nature, size or location are made subject to an assessment with regard to their effects. These projects are defined in Article 4.

(2) The environmental impact assessment may be integrated into the existing procedures for consent to projects in the Member States, or, failing this, into other procedures or into procedures to be established to comply with the aims of this Directive.

(2a) Member States may provide for a single procedure in order to fulfil the requirements of this Directive and the requirements of Council Directive 96/61/EC of 24 September 1996 on integrated pollution prevention and control ...'

4 Article 3 of Directive 85/337 provides:

'The environmental impact assessment will identify, describe and assess in an appropriate manner, in the light of each individual case and in accordance with Articles 4 to 11, the direct and indirect effects of a project on the following factors:

– human beings, fauna and flora,

– soil, water, air, climate and the landscape,

– material assets and the cultural heritage,

– the interaction between the factors mentioned in the first, second and third indents.'

5 Article 4(1) and (2) of Directive 85/337 are worded as follows:

'1. Subject to Article 2(3), projects listed in Annex I shall be made subject to an assessment in accordance with Articles 5 to 10.

2. Subject to Article 2(3), for projects listed in Annex II, the Member States shall determine through:

(a) a case-by-case examination,

or

(b) thresholds or criteria set by the Member State

whether the project shall be made subject to an assessment in accordance with Articles 5 to 10.

Member States may decide to apply both procedures referred to in (a) and (b).'

6 Articles 5 to 7 of Directive 85/337 concern the information which must be gathered and the consultations which must be undertaken for the purposes of the assessment procedure. Article 5 deals with the information which the developer must supply, Article 6 deals with the obligation to consult, on the one hand, authorities with specific environmental responsibilities and the public, on the other, and Article 7 covers the obligation, in the case of a cross-border project, to inform the other Member State concerned. Article 8 of the directive states that the results of those consultations and the information gathered must be taken into consideration in the development consent procedure.

7 Articles 9 to 11 of Directive 85/337, relating to the decision taken at the conclusion of the consent procedure, cover, respectively, informing the public and the Member States concerned, respect for commercial and industrial confidentiality, the right of members of the public to bring proceedings before a court and the exchange of information between Member States and the Commission.

8 Under Article 12(1) of Directive 85/337, in its original version, the Member States were obliged to comply with that directive's provisions by 3 July 1988 at the latest. With regard to the amendments made to it by Directives 97/11 and 2003/35, the Member States were obliged to bring them into force at the latest by 14 March 1999 and 25 June 2005 respectively.

National legislation

The Planning and Development Act 2000

9 The Planning and Development Act 2000, as amended by the Strategic Infrastructure Act 2006 ('the PDA'), lays down the legal framework for issuing development consent for most of the project categories listed in Annexes I and II to Directive 85/337. For some projects, development consent under the PDA, which is termed 'planning permission' and granted, as a rule, by a local author , is the only form of consent required for a project to proceed. In such cases, the PDA provides that the decisions taken by local authorities may be appealed against to An Bord Pleanála (The Planning Appeals Board; 'the Board').

10 Part X of the PDA, comprising sections 172 to 177, is devoted to environmental impact assessments. Section 176 provides for ministerial regulations to identify projects requiring such an assessment. Section 172 provides that, for projects covered by regulations made under section 176, applications for planning permission are to be accompanied by an environmental impact statement. Under section 173, where a planning authority receives an application for planning permission accompanied by an environmental impact statement, that authority and, on appeal, the Board must have regard to that statement. Section 177 provides that the information to be included in such a statement is to be prescribed by ministerial regulation.

11 Detailed measures for the implementation of the PDA are set out in the Planning and Development Regulations 2001, as amended by the Planning and Development Regulations 2008 ('the PDR'), which were adopted pursuant to, among others, sections 176 and 177 of the PDA.

12 Part 2 of the PDR concerns projects which are exempt from an environmental impact assessment. Article 6 thereof refers in that regard to Part 1 of Schedule 2 to the PDR, which, in Category 50, refers to 'the demolition of a building or other structure'. Articles 9 and 10 of the PDR lay down the conditions under which a project as a rule exempted must none the less be made subject to a consent procedure.

13 Part 10 of the PDR is devoted to environmental impact assessments. Article 93 thereof, in combination with Schedule 5 thereto, defines the categories of projects for which such an assessment is required. Article 94 of the PDR, which lists the information that should be found in an environmental impact statement, is worded as follows:

'An environmental impact statement shall contain:

(a) the information specified in paragraph 1 of Schedule 6,

(b) the information specified in paragraph 2 of Schedule 6 to the extent that

(i) such information is relevant to a given stage of the consent procedure and to the specific characteristics of the development or type of development concerned and of the environmental features likely to be affected, and

(ii) the person or persons preparing the statement may reasonably be required to compile such information having regard, among other things, to current knowledge and methods of assessment, and,

(c) a summary in non-technical language of the information required under paragraphs (a) and (b).'

14 Schedule 6 to the PDR specifies the information to be contained in an environmental impact statement. Paragraph 2(b) of Schedule 6 stipulates that it must contain:

'A description of the aspects of the environment likely to be significantly affected by the proposed development, including in particular:

– human beings, fauna and flora,

– soil, water, air, climatic factors and the landscape,

– material assets, including the architectural and archaeological heritage, and the cultural heritage,

– the inter-relationship between the above factors.'

15 Under Article 108 of the PDR, the competent planning authority is obliged to establish whether the information contained in an environmental impact statement complies with the requirements laid down in the PDR.

The Environmental Protection Agency Act 1992

16 The Environmental Protection Agency Act 1992 ('the EPAA') introduced, among other things, a new system of integrated pollution control under which many industrial activities require a licence granted by the Agency. Where the activity is new and/or involves new construction, it must also obtain planning permission as provided for by the PDA.

17 Section 98 of the EPAA, which precluded planning authorities from taking into consideration aspects connected with pollution risks in considering an application for planning permission, was amended by section 256 of the PDA to the effect that, whilst it precluded planning authorities from including any pollution control conditions in planning permissions for activities also requiring a licence from the Agency, they could nevertheless, where appropriate, refuse to grant planning permission on environmental grounds. Section 98 of the EPAA, as amended, provides that planning authorities may ask the Agency for an opinion, in particular on an environmental impact statement. However, the Agency is not required to respond to such a request.

18 Under the Environmental Protection Agency (Licensing) Regulations 1994 ('the EPAR'), the Agency may notify a planning authority of a licence application. There is, however, no obligation on the planning authority to respond to such a notification.

The National Monuments Act 1930

19 The National Monuments Act 1930 ('the NMA') governs the protection of Ireland's most culturally significant archaeological remains, which are classed as 'national monuments'. It was amended by the National Monuments (Amendment) Act 2004, to relax the constraints imposed under earlier legislation concerning proposals to alter or remove national monuments.

20 Section 14 of the NMA confers on the Irish Minister for the Environment, Heritage and Local Government ('the Minister') discretion to consent to the destruction of a national monument. Where a national monument is discovered during the carrying out of a road development which has been subject to an environmental impact assessment, section 14A of the NMA provides that it is, in principle, prohibited to carry out any works on the monument pending directions by the Minister. Those directions can relate to 'the doing to the monument of [various] matters', including its demolition. There is no provision for any assessment to be made, for the adoption of such directions, of the effects on the environment. However, section 14B of the NMA provides that the Minister's directions must be notified to the Board. If those directions envisage an alteration to the approved road development, the

Board must consider whether or not that alteration is likely to have significant adverse effects on the environment. If it is of that opinion, it must require the submission of an environmental impact statement.

Pre-litigation procedure

21 Following the examination of a complaint regarding Ireland's transposition of Directive 85/337, the Commission took the view that Ireland had failed to ensure its full and correct transposition and, by letter of 19 November 1998, gave Ireland formal notice, to submit its observations, in accordance with the procedure for failure to fulfil Treaty obligations. A further letter of formal notice was sent to Ireland on 9 February 2001.

22 After examining the observations received in response to those letters, the Commission, on 6 August 2001, sent the Irish authorities a reasoned opinion in which it claimed that Ireland had not correctly transposed Articles 2 to 6, 8 and 9 of Directive 85/337. In reply, Ireland stated that the legislative amendments necessary to bring about the transposition were being adopted and requested that the proceedings be stayed.

23 Following further complaints, the Commission, on 2 May 2006, sent an additional letter of formal notice to Ireland.

24 As the Commission was not satisfied with the replies received, on 29 June 2007 it addressed an additional reasoned opinion to Ireland in which it claimed that Ireland had not correctly transposed Directive 85/337, in particular Articles 2 to 4 thereof, and called upon it to comply with that reasoned opinion within a period of two months from the date of its receipt. In reply, Ireland maintained its position that the Irish legislation in force now constitutes adequate transposition of that directive.

25 The Commission then brought the present action.

The action

The first complaint, alleging failure to transpose Article 3 of Directive 85/337

Arguments of the parties

26 According to the Commission, Article 3 of Directive 85/337 is of pivotal importance, since it sets out what constitutes an environmental impact assessment and must therefore be transposed explicitly. The provisions relied upon by Ireland as adequate transposition of Article 3 of the directive are insufficient.

27 Thus, section 173 of the PDA, which requires planning authorities to have regard to the information contained in an environmental impact statement submitted by a developer, relates to the obligation, under Article 8 of Directive 85/337, to take into consideration the information gathered pursuant to Articles 5 to 7 thereof. By contrast, section 173 does not correspond to the wider obligation, imposed by Article 3 of Directive 85/337 on the competent authority, to ensure that there is carried out an environmental impact assessment which identifies, describes and assesses all the matters referred to in that article.

28 As for Articles 94, 108 and 111 of, and Schedule 6 to, the PDR, the Commission observes that they are confined, first, to setting out the matters on which the developer must supply information in its environmental impact statement and, second, to specifying the obligation on the competent authorities

to establish that the information is complete. The obligations laid down by those provisions are different from that, imposed by Article 3 of Directive 85/337 on the competent authority, of carrying out a full environmental impact assessment

29 With regard to the relevance of the Irish courts' case-law on the application of the provisions of national law at issue, the Commission points out that while those courts may interpret ambiguous provisions so as to ensure their compatibility with a directive, they cannot plug legal gaps in the national legislation. Moreover, the extracts from the decisions cited by Ireland concern, in the Commission's submission, not the interpretation of that legislation but the interpretation of Directive 85/337 itself.

30 Ireland disputes the significance which the Commission attaches to Article 3 of that directive. It submits that that provision, drafted in general terms, is confined to stating that an environmental impact assessment must be made in accordance with Articles 4 to 11 of the directive. By transposing Articles 4 to 11 into national law, a Member State thereby, in Ireland's submission, ensures the transposition of Article 3.

31 Ireland maintains that Article 3 of Directive 85/337 is fully transposed by sections 172(1) and 173 of the PDA and Articles 94 and 108 of, and Schedule 6 to, the PDR. It points out that the Supreme Court (Ireland) has confirmed, in two separate judgments of 2003 and 2007, namely *O'Connell* v *Environmental Protection Agency* and *Martin* v *An Bord Pleanála*, that Irish law requires planning authorities and the Agency to assess the factors referred to in Article 3 and the interaction between them. Those judgments, which, Ireland submits, should be taken into account when assessing the scope of the national provisions at issue, do not fill a legal gap but are confined to holding that the applicable national legislation imposes an obligation on the competent authorities to carry out an environmental impact assessment of a development in the light of the criteria laid down in Article 3 of Directive 85/337.

32 In the alternative, Ireland refers to the concept of 'proper planning and sustainable development' referred to in section 34 of the PDA. It is, in Ireland's submission, the principal criterion which must be taken into consideration by any planning authority when deciding on an application for planning permission. That concept is in addition to all the criteria referred to in section 34 of the PDA, as well as in other provisions of that Act, including section 173, the application of which it reinforces.

33 Finally, Ireland submits that the Commission does not respect the discretion which a Member State enjoys under Article 249 EC as to the form and methods for transposing a directive. By requiring the literal transposition of Article 3 of Directive 85/337, the Commission is disregarding the body of legislation and case-law built up in Ireland over 45 years surrounding the concepts of 'proper planning' and 'sustainable development'.

Findings of the Court

34 At the outset, it is to be noted that the Commission and Ireland give a different reading to Article 3 of Directive 85/337 and a different analysis of its relationship with Articles 4 to 11 thereof. The Commission maintains that Article 3 lays down obligations which go beyond those required by Articles 4 to 11, whereas Ireland submits that it is merely a provision drafted in general terms and that the details of the process of environmental impact assessment are specified in Articles 4 to 11.

35 In that regard, whilst Article 3 of Directive 85/337 provides that the environmental impact assessment is to take place 'in accordance with Articles 4 to 11' thereof, the obligations referred to by those articles differ from that under Article 3 itself.

36 Article 3 of Directive 85/337 makes the competent environmental authority responsible for carrying out an environmental impact assessment which must include a description of a project's direct and indirect effects on the factors set out in the first three indents of that article and the interaction between those factors (judgment of 16 March 2006 in Case C-332/04 *Commission* v *Spain*, paragraph 33). As stated in Article 2(1) of the directive, that assessment is to be carried out before the consent applied for to proceed with a project is given.

37 In order to satisfy the obligation imposed on it by Article 3, the competent environmental authority may not confine itself to identifying and describing a project's direct and indirect effects on certain factors, but must also assess them in an appropriate manner, in the light of each individual case.

38 That assessment obligation is distinct from the obligations laid down in Articles 4 to 7, 10 and 11 of Directive 85/337, which are, essentially, obligations to collect and exchange information, consult, publicise and guarantee the possibility of challenge before the courts. They are procedural provisions which do not concern the implementation of the substantial obligation laid down in Article 3 of that directive.

39 Admittedly, Article 8 of Directive 85/337 provides that the results of the consultations and the information gathered pursuant to Articles 5 to 7 must be taken into consideration in the development consent procedure.

40 However, that obligation to take into consideration, at the conclusion of the decision-making process, information gathered by the competent environmental authority must not be confused with the assessment obligation laid down in Article 3 of Directive 85/337. Indeed, that assessment, which must be carried out before the decision-making process (Case C-508/03 *Commission* v *United Kingdom* [2006] ECR I-3969, paragraph 103), involves an examination of the substance of the information gathered as well as a consideration of the expediency of supplementing it, if appropriate, with additional data. That competent environmental authority must thus undertake both an investigation and an analysis to reach as complete an assessment as possible of the direct and indirect effects of the project concerned on the factors set out in the first three indents of Article 3 and the interaction between those factors.

41 It follows therefore both from the wording of the provisions at issue of Directive 85/337 and from its general scheme that Article 3 is a fundamental provision. The transposition of Articles 4 to 11 alone cannot be regarded as automatically transposing Article 3.

42 It is in the light of those considerations that the Court must consider whether the national provisions upon which Ireland relies constitute proper transposition of Article 3 of Directive 85/337.

43 It can be seen from the wording of section 172 of the PDA and of Article 94 of, and Schedule 6 to, the PDR that those provisions relate to the developer's obligation to supply an environmental impact statement, which corresponds, as the Commission correctly claims, to the obligation imposed upon the developer by Article 5 of Directive 85/337. Article 108 of the PDR imposes no obligation on the planning authority other than that of establishing the completeness of that information.

44 As regards section 173 of the PDA, according to which the planning authority, where it receives an application for planning permission accompanied by an environmental impact statement, must take that statement into account as well as any additional information provided to it, it is clear from the very wording of that article that it is confined to laying down an obligation similar to that provided for in Article 8 of Directive 85/337, namely that of taking the results of the consultations and the information

gathered for the purposes of the consent procedure into consideration. That obligation does not correspond to the broader one, imposed by Article 3 of Directive 85/337 on the competent environmental authority, to carry out itself an environmental impact assessment in the light of the factors set out in that provision.

45 In those circumstances, it must be held that the national provisions invoked by Ireland cannot attain the result pursued by Article 3 of Directive 85/337.

46 Whilst it is true that, according to settled case-law, the transposition of a directive into domestic law does not necessarily require the provisions of the directive to be enacted in precisely the same words in a specific, express provision of national law and a general legal context may be sufficient if it actually ensures the full application of the directive in a sufficiently clear and precise manner (see, in particular, Case C-427/07 *Commission* v *Ireland* [2009] ECR I-6277, paragraph 54 and the case-law cited), the fact remains that, according to equally settled case-law, the provisions of a directive must be implemented with unquestionable binding force and with the specificity, precision and clarity required in order to satisfy the need for legal certainty, which requires that, in the case of a directive intended to confer rights on individuals, the persons concerned must be enabled to ascertain the full extent of their rights (see, in particular, *Commission* v *Ireland*, paragraph 55 and the case-law cited).

47 In that regard, the judgment of the Supreme Court in *O'Connell* v *Environmental Protection Agency* gives, admittedly, in the passage upon which Ireland relies, an interpretation of the provisions of domestic law consistent with Directive 85/337. However, according to the Court's settled case-law, such a consistent interpretation of the provisions of domestic law cannot in itself achieve the clarity and precision needed to meet the requirement of legal certainty (see, in particular, Case C-508/04 *Commission* v *Austria* [2007] ECR I-3787, paragraph 79 and the case-law cited). The passage in the judgment of the same court in *Martin* v *An Bord Pleanála*, to which Ireland also refers, concerns the question of whether all the factors referred to in Article 3 of Directive 85/337 are mentioned in the consent procedures put in place by the Irish legislation. By contrast, it has no bearing on the question, which is decisive for the purposes of determining the first complaint, of what the examination of those factors by the competent national authorities should comprise.

48 As regards the concepts of 'proper planning' and 'sustainable development' to which Ireland also refers, it must be held that, even if those concepts encompass the criteria referred to in Article 3 of Directive 85/337, it is not established that they require that those criteria be taken into account in all cases for which an environmental impact assessment is required.

49 It follows that neither the national case-law nor the concepts of 'proper planning' and 'sustainable development' can be invoked to remedy the failure to transpose into the Irish legal order Article 3 of Directive 85/337.

50 The Commission's first complaint in support of its action must therefore be held to be well founded.

The second complaint, alleging failure to ensure full compliance with Articles 2 to 4 of Directive 85/337 where several authorities are involved in the decision-making process

Arguments of the parties

51 For the Commission, it is of the essence that the environmental impact assessment be carried out as part of a holistic process. In Ireland, following the Agency's creation, certain projects requiring such an assessment are subject to two separate decision-making processes: one process involves decision-

making on land-use aspects by planning authorities, while the other involves decision-making by the Agency on pollution aspects. The Commission accepts that planning permission and an Agency licence may be regarded, as has been held in Irish case-law (*Martin* v *An Bord Pleanála*), as together constituting 'development consent' within the meaning of Article 1(2) of Directive 85/337 and it does not object to such consent being given in two successive stages. However, the Commission criticises the fact that the Irish legislation fails to impose any obligation on planning authorities and the Agency to coordinate their activities. In the Commission's submission, that situation is contrary to Articles 2 to 4 of Directive 85/337.

52 As regards Article 2 of Directive 85/337, the Commission notes that it requires an environmental impact assessment to be undertaken for a project covered by Article 4 'before consent is given'. The Commission submits that there is a possibility under the Irish legislation that part of the decision-making process will take place in disregard of that requirement. First, the Irish legislation does not require that an application for planning permission be lodged with the planning authorities before a licence application is submitted to the Agency, which is not empowered to undertake an environmental impact assessment. Second, the planning authorities are not obliged to take into account, in their assessment, the impact of pollution, which might not be assessed at all.

53 Referring to the Court's case-law (see, in particular, judgment of 20 November 2008 in Case C-66/06 *Commission* v *Ireland*, paragraph 59), the Commission states that it is not obliged to wait until the application of the transposing legislation produces harmful effects or to establish that it does so, where the wording of the legislation itself is insufficient or defective.

54 As regards Article 3 of Directive 85/337, the Commission submits that where there is more than one competent body, the procedures followed by each of them must, when taken together, ensure that the assessment required by Article 3 is fully carried out. The strict demarcation of the separate roles of the planning authorities on the one hand and the Agency on the other, as laid down by the Irish legislation, fails to take formally into account the concept of 'environment' in the decision-making. None of the bodies involved in the consent process is responsible for assessing and taking into consideration the interaction between the factors referred to in the first to third indents of Article 3, which fall respectively within the separate spheres of the powers of each of those authorities.

55 In that regard, the Commission, referring to section 98 of the EPAA, as amended, and to the EPAR, observes that there is no formal link, in the form of an obligation, for the competent authorities, to consult each other between the process of planning permission followed by the planning authority and the licensing process followed by the Agency.

56 In order to illustrate its analysis, the Commission refers to the projects relating to the installation of an incinerator at Duleek, in County Meath, and to the wood-processing factory at Leap, in County Offaly.

57 Referring to Case C-98/04 *Commission* v *United Kingdom* [2006] ECR I-4003, Ireland contests the admissibility of the Commission's second complaint in support of its action, on the ground that, in Ireland's submission, the Commission has failed to indicate precisely the reason why Ireland's designation of two competent authorities infringes the requirements of Directive 85/337. Ireland submits that the failure has interfered with the preparation of its defence.

58 On the substance, Ireland contends that the consequence of involving a number of different competent authorities in the decision-making process, which is permitted by Articles 1(3) and 2(2) of Directive 85/337, is that their involvement and their obligations will be different and will occur at different stages prior to 'development consent' being given. Relying on *Martin* v *An Bord Pleanála*, Ireland contends

that nowhere in that directive is it in any sense suggested that a single competent body must carry out a 'global assessment' of the impact on the environment.

59 Ireland denies that there is a strict demarcation between the powers of the two decision-making bodies and submits that there is, rather, overlap between them. The concept of 'proper planning and sustainable development', to which the PDA refers, is a very broad one, which includes, in particular, environmental pollution. Planning authorities are required to assess environmental pollution in the context of a decision relating to planning permission. They are moreover empowered under various provisions to refuse planning permission on environmental grounds.

60 Replying to the Commission's argument that it is possible for a licence application to be made to the Agency before an application for planning permission has been made to the planning authority, and thus before an environmental impact assessment has been carried out, Ireland contends that under Irish law 'development consent' requires both planning permission from the competent planning authority and a licence from the Agency. In those circumstances, there is no practical benefit in the developer applying for a licence from the Agency without making a contemporaneous application to the planning authority; such separate applications do not therefore occur in practice.

61 In addition, Ireland argues that, contrary to the Commission's assertion that the Agency cannot undertake an environmental impact assessment, there is in several instances an obligation, particularly for waste recovery or waste disposal licence applications and for applications for integrated pollution control and prevention licences, to submit an environmental impact statement to the Agency independently of any earlier application for planning permission lodged with a planning authority. In addition, in such cases the Agency is expressly empowered to request further information from an applicant and may therefore request information which is substantially similar to that contained in an environmental impact statement.

62 Ireland submits that an obligation on the planning authority and the Agency to consult in every case would be inappropriate. It would be more appropriate to allow such consultation whilst affording a discretion to the relevant decision-makers as to whether, in each particular case, to undertake such consultation.

63 Finally, the judgment in Case C-66/06 *Commission* v *Ireland*, to which the Commission refers in order to avoid having to adduce proof of its allegations, is not relevant to the present case. In Ireland's submission, the alleged infringement, in that case, concerned the manner in which Directive 85/337 had been transposed into Irish domestic law, whereas the present case concerns the application of the legislation transposing that directive. Whilst a comprehensive scheme has been put in place by the Irish legislation on the environmental impact assessment, the Commission claims that that legislation may not always be applied properly in practice. In that regard, the onus of proof lies with the Commission, which has failed to discharge it. The references to the projects at Duleek and Leap offer no support whatsoever for the Commission's allegations.

Findings of the Court

– Admissibility of the second complaint

64 It is settled case-law that, in the context of an action brought on the basis of Article 226 EC, the reasoned opinion and the action must set out the Commission's complaints coherently and precisely in order that the Member State and the Court may appreciate exactly the scope of the infringement of European Union law complained of, a condition which is necessary in order to enable the Member

State to avail itself of its right to defend itself and the Court to determine whether there is a breach of obligations as alleged (see, in particular, *Commission* v *United Kingdom*, paragraph 18, and Case C-66/06 *Commission* v *Ireland*, paragraph 31).

65 In this case, it is apparent from the documents in the court file that, in the pre-litigation procedure, both paragraphs 3.2.2 to 3.2.5 of the reasoned opinion of 6 August 2001 and paragraphs 2.17 and 2.18 of the additional reasoned opinion of 29 June 2007 set forth the reason for which the strict demarcation between the separate roles assigned to the planning authorities, on the one hand, and the Agency, on the other, does not satisfy, in the Commission's submission, the requirements of Directive 85/337. It is there explained that such sharing of powers is incompatible with the fact that the concept of 'environment', as it must be taken into account in the decision-making process laid down by that directive, involves taking into consideration the interaction between the factors falling within the separate spheres of responsibility of each of those decision-making authorities.

66 That complaint is set out in identical or similar terms in paragraphs 55 et seq. of the application in this action which, in addition, contains, in its paragraphs 9 to 20, a summary of the relevant provisions of the Irish legislation.

67 It follows from those findings that the Commission's allegations in the course of the pre-litigation procedure and the proceedings before the Court were sufficiently clear to enable Ireland properly to defend itself.

68 Accordingly, Ireland's plea of inadmissibility in respect of the Commission's second complaint must be rejected.

– Substance

69 At the outset, it is to be noted that, by its second complaint, the Commission is criticising the transposition by the Irish legislation at issue of Articles 2 to 4 of Directive 85/337, on the ground that the procedures put in place by that legislation do not ensure full compliance with those articles where several national authorities take part in the decision-making process.

70 Consequently, Ireland's line of argument that the Commission has not adequately established the factual basis for its action must immediately be rejected. As the Commission claimed, since its action for failure to fulfil obligations is concerned with the way in which Directive 85/337 has been transposed, and not with the actual result of the application of the national legislation relating to that transposition, it must be determined whether that legislation itself harbours the insufficiencies or defects in the transposition of the directive which the Commission alleges, without any need to establish the actual effects of the national legislation effecting that transposition with regard to specific projects (see Case C-66/06 *Commission* v *Ireland*, paragraph 59).

71 Article 1(2) of Directive 85/337 defines the term 'development consent' as 'the decision of the competent authority or authorities which entitles the developer to proceed with the project'. Article 1(3) states that the competent authorities are to be that or those which the Member States designate as responsible for performing the duties arising from that directive.

72 For the purposes of the freedom thus left to them to determine the competent authorities for giving development consent, for the purposes of that directive, the Member States may decide to entrust that task to several entities, as the Commission has moreover expressly accepted.

73 Article 2(2) of Directive 85/337 adds that the environmental impact statement may be integrated into the existing procedures for consent to projects or failing that, into other procedures or into procedures to be established to comply with the aims of that directive.

74 That provision means that the liberty left to the Member States extends to the determination of the rules of procedure and requirements for the grant of the development consent in question.

75 However, that freedom may be exercised only within the limits imposed by that directive and provided that the choices made by the Member States ensure full compliance with its aims.

76 Article 2(1) of Directive 85/337 thus states that the environmental impact assessment must take place 'before the giving of consent'. That entails that the examination of a project's direct and indirect effects on the factors referred to in Article 3 of that directive and on the interaction between those factors be fully carried out before consent is given.

77 In those circumstances, while nothing precludes Ireland's choice to entrust the attainment of that directive's aims to two different authorities, namely planning authorities on the one hand and the Agency on the other, that is subject to those authorities' respective powers and the rules governing their implementation ensuring that an environmental impact assessment is carried out fully and in good time, that is to say before the giving of consent, within the meaning of that directive.

78 In that regard, the Commission maintains that it has identified, in the Irish legislation, a gap arising from the combination of two factors. The first is the lack of any right on the part of the Agency, where it receives an application for a licence for a project as regards pollution aspects, to require an environmental impact assessment. The second is the possibility that the Agency might receive an application and decide on questions of pollution before an application is made to the planning authority, which alone can require the developer to make an environmental impact statement.

79 In its defence, Ireland, which does not deny that, generally, the Agency is not empowered to require a developer to produce such a statement, contends that there is no practical benefit for a developer in seeking a licence from the Agency without simultaneously making an application for planning permission to the planning authority, since he needs a consent from both those authorities. However, Ireland has neither established, nor even alleged, that it is legally impossible for a developer to obtain a decision from the Agency where he has not applied to the planning authority for permission.

80 Admittedly, the EPAR give the Agency the right to notify a licence application to the planning authority. However, it is common ground between the parties that it is not an obligation and, moreover, an authority which has received such notification is not bound to reply to it.

81 It is therefore not inconceivable that the Agency, as the authority responsible for licensing a project as regards pollution aspects, may make its decision without an environmental impact assessment being carried out in accordance with Articles 2 to 4 of Directive 85/337.

82 Ireland contends that, in certain cases, relating particularly to licences for the recovery or disposal of waste and integrated pollution control and prevention licences, the Agency is empowered to require an environmental impact statement, which it must take into account. However, such specific rules cannot fill the gap in the Irish legislation identified in the preceding paragraph.

83 Ireland submits also that planning authorities are empowered, since the amendment of the EPAA by section 256 of the PDA, to refuse, where appropriate, planning permission on environmental grounds and that the concepts of 'proper planning' and 'sustainable development' confer on those authorities,

generally, such power.

84 Such an extension of the planning authority's powers may, as Ireland argues, create in certain cases an overlap of the respective powers of the authorities responsible for environmental matters. None the less, it must be held that such an overlap cannot fill the gap pointed out in paragraph 81 of the present judgment, which leaves open the possibility that the Agency will alone decide, without an environmental impact assessment complying with Articles 2 to 4 of Directive 85/337, on a project as regards pollution aspects.

85 In those circumstances, it must be held that the Commission's second complaint in support of its action for failure to fulfil obligations is well founded.

The third complaint, alleging failure to apply Directive 85/337 to demolition works

Arguments of the parties

86 In the Commission's submission, demolition works may constitute a 'project' within the meaning of Article 1(2) of Directive 85/337, since they fall within the concept of 'other interventions in the natural surroundings and landscape'. However, in the PDR, Ireland purported to exempt nearly all demolition works from the obligation to carry out an environmental impact assessment. After the end of the two-month period laid down in the additional reasoned opinion of 29 June 2007, Ireland admittedly notified the Commission of new legislation, which amended the PDR by significantly narrowing the scope of the exemption for demolition works. However, that legislation cannot, the Commission submits, be taken into account in the present infringement action.

87 The Commission claims that Ireland's interpretation that demolition works fall outside the scope of the directive is reflected in the NMA, and refers in that regard to sections 14, 14A and 14B of that Act which relate to the demolition of a national monument.

88 By way of illustration of how, in contravention of Directive 85/337, the exclusion of demolition works allowed, by virtue of section 14A of the NMA, a national monument to be demolished without an environmental impact assessment being undertaken, the Commission cites the ministerial decision of 13 June 2007 ordering the destruction of a national monument in order to permit the M3 motorway project to proceed.

89 As a preliminary point, Ireland objects that the Commission's third complaint is, in so far as it concerns section 14 of the NMA, inadmissible, since that provision was not mentioned in the additional reasoned opinion of 29 June 2007.

90 In Ireland's submission, demolition works do not fall within the scope of Directive 85/337, since they are not mentioned in Annex I or II thereto. In addition, Ireland submits that section 10 of the PDA and Article 9 of the PDR, when read together, make clear that the exemption from the obligation to obtain planning permission in respect of demolition works can apply only if the project is unlikely to have significant effects on the environment.

91 As regards the obligation to carry out further assessments, Ireland argues that the essence of Directive 85/337 is that the environmental impact assessment be carried out at the earliest possible stage, before the development starts. The only occasion when it is ever necessary to carry out a fresh assessment is, in accordance with the first indent of point 13 in Annex II to the directive, where the development project has been changed or extended.

92 With regard to the scope of ministerial directions issued under section 14A of the NMA, Ireland states that that provision applies only in the context of a road development previously approved by the Board, on the basis of an environmental impact assessment. Only the Board may authorise an alteration a road development and it must in such a case assess whether that alteration is likely to have adverse environmental consequences. In those circumstances, the Minister's power to issue ministerial directions cannot be equated with the giving of consent for the motorway project. Those directions are issued only, if at all, following the commencement of the development works and the discovery of a new national monument and are designed only to regulate how the newly discovered national monument is to be dealt with. Also, Ireland denies that a ministerial decision was taken ordering the destruction of a national monument in order to allow the M3 motorway project to proceed.

Findings of the Court

– Admissibility of the third complaint

93 According to the Court's settled case-law, the subject-matter of proceedings brought under Article 226 EC is delimited by the administrative pre-litigation procedure governed by that article and the application must be founded on the same grounds and pleas as those stated in the reasoned opinion (see, in particular, Case C-340/02 *Commission* v *France* [2004] ECR I-9845, paragraph 26 and the case-law cited).

94 In this case, it is clear from the wording of the additional reasoned opinion of 29 June 2007 that the Commission, in paragraphs 2.34 to 2.38 thereof, complained that Ireland had excluded demolition works from the scope of the national legislation transposing Directive 85/337. In paragraphs 2.39 and 2.40 of the same opinion, the Commission stated that Ireland's interpretation of that directive was reflected not only in the PDA, but also in other more specific legislative provisions, such as the NMA, and it took as an example the carrying-out of the M3 motorway project.

95 It follows that, while the Commission did not expressly refer to section 14 of the NMA in that reasoned opinion, it none the less referred clearly to the decision-making mechanism laid down by that section as part of its analysis of the deficiencies which, in its submission, that Act entails.

96 In those circumstances, Ireland's plea of inadmissibility against the Commission's third complaint must be rejected.

– Substance

97 As regards the question whether demolition works come within the scope of Directive 85/337, as the Commission maintains in its pleadings, or whether, as Ireland contends, they are excluded, it is appropriate to note, at the outset, that the definition of the word 'project' in Article 1(2) of that directive cannot lead to the conclusion that demolition works could not satisfy the criteria of that definition. Such works can, indeed, be described as 'other interventions in the natural surroundings and landscape'.

98 That interpretation is supported by the fact that, if demolition works were excluded from the scope of that directive, the references to 'the cultural heritage' in Article 3 thereof, to 'landscapes of historical, cultural or archaeological significance' in point 2(h) of Annex III to that directive and to 'the architectural and archaeological heritage' in point 3 of Annex IV thereto would have no purpose.

99 It is true that, under Article 4 of Directive 85/337, for a project to require an environmental impact

assessment, it must come within one of the categories in Annexes I and II to that directive. However, as Ireland contends, they make no express reference to demolition works except, irrelevantly for the purposes of the present action, the dismantling of nuclear power stations and other nuclear reactors, referred to in point 2 of Annex I.

100 However, it must be borne in mind that those annexes refer rather to sectoral categories of projects, without describing the precise nature of the works provided for. As an illustration it may be noted, as did the Commission, that 'urban development projects' referred to in point 10(b) of Annex II often involve the demolition of existing structures.

101 It follows that demolition works come within the scope of Directive 85/337 and, in that respect, may constitute a 'project' within the meaning of Article 1(2) thereof.

102 According to settled case-law, the question whether a Member State has failed to fulfil its obligations must be determined by reference to the situation in that Member State as it stood at the end of the period laid down in the reasoned opinion (see, in particular, Case C-427/07 *Commission* v *Ireland*, paragraph 64 and the case-law cited).

103 Ireland does not deny that, under the national legislation in force at the date of the additional reasoned opinion, demolition works were not subject, as a general rule, to an environmental impact assessment but, on the contrary, were entitled to an exemption in principle.

104 It is clear from the rules laid down in sections 14 to 14B of the NMA as regards the demolition of a national monument that, as the Commission claims, they take no account of the possibility that such demolition works might constitute, in themselves, a 'project' within the meaning of Articles 1 and 4 of Directive 85/337 and, in that respect, require a prior environmental impact assessment. However, since the insufficiency of that directive's transposition into the Irish legal order has been established, there is no need to consider what that legislation's actual effects are in the light of the carrying-out of specific projects, such as that of the M3 motorway.

105 As regards the legislative changes subsequent to the action for failure to fulfil obligations being brought, they cannot be taken into consideration by the Court (see, in particular, Case C-427/07 *Commission* v *Ireland*, paragraph 65 and the case-law cited).

106 In those circumstances, the Commission's third complaint in support of its action must be held to be well founded.

107 Accordingly, it must be declared that:

– by failing to transpose Article 3 of Directive 85/337;

– by failing to ensure that, where planning authorities and the Agency both have decision-making powers concerning a project, there will be complete fulfilment of the requirements of Articles 2 to 4 of that directive; and

– by excluding demolition works from the scope of its legislation transposing that directive,

Ireland has failed to fulfil its obligations under that directive.

Costs

108 Under Article 69(2) of the Rules of Procedure, the unsuccessful party is to be ordered to pay the costs if they have been applied for in the successful party's pleadings. Since the Commission has applied for costs and Ireland has been unsuccessful the latter must be ordered to pay the costs.

On those grounds, the Court (First Chamber) hereby:

1. **Declares that:**

   – **by failing to transpose Article 3 of Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment, as amended by Council Directive 97/11/EC of 3 March 1997 and by Directive 2003/35/EC of the European Parliament and of the Council of 26 May 2003;**

   – **by failing to ensure that, where Irish planning authorities and the Environmental Protection Agency both have decision-making powers concerning a project, there will be complete fulfilment of the requirements of Articles 2 to 4 of Directive 85/337, as amended by Directive 2003/35; and**

   – **by excluding demolition works from the scope of its legislation transposing Directive 85/337, as amended by Directive 2003/35,**

   Ireland has failed to fulfil its obligations under that directive;

2. **Orders Ireland to pay the costs.**

[Signatures]

---

* Language of the case: English.

THE HIGH COURT

[2013 No. 802 J.R.]

BETWEEN

EAMON (TED) KELLY

APPLICANT

AND

AN BORD PLEANÁLA

RESPONDENT

AND

ROSCOMMON COUNTY COUNCIL, GALETECH ENERGY DEVELOPMENTS LIMITED, SKY VALLEY CONCERNED RESIDENTS GROUP, WIND TURBINE ACTION GROUP SOUTH ROSCOMMON, THE DEPARTMENT OF ARTS, HERITAGE AND THE GAELTACHT, SKY VALLEY WIND COMPANY, THE HERITAGE COUNCIL AND THE COMMISSION FOR ENERGY REGULATION, PAUL DONOHUE, JAMES FRANCIS FALLON, THOMAS BURKE, MARIA DONNELLY, TOM AND FIONA FARRELL, LIAM KILDEA SKY VALLEY CONCERNED RESIDENTS GROUP, THE HERITAGE COUNCIL AND THE COMMISSION FOR ENERGY REGULATION

NOTICE PARTIES

JUDGMENT of Ms. Justice Finlay Geoghegan delivered on the 25th day of July 2014.

1. The applicant, supported by one notice party, namely, the Department of Arts, Heritage and the Gaeltacht ("the Department") in this judicial review, seeks, by way of primary relief orders of *certiorari,* to quash two decisions of the respondent to grant planning permission for wind turbine developments in County Roscommon. The challenged decisions are:

> "(1) A decision made on the 9th of September, 2013, to grant permission for a development comprising sixteen wind turbines with a hub height of 85m,

rotor diameter of 100m at Croan, Gortaphuill, Mullaghardagh, Dysart, County Roscommon (Appeal Reference PL20.239759 Planning Register Ref. 10/541) ("Phase 1 Decision").

(2) A decision made on the 13th of September, 2013, to grant planning permission for a development comprising nineteen wind turbines with a hub height of 85m, rotor diameter of 100m and overall height of 135m and 85m anemometer mass and 110kv substation a Milltown, Skeavally, Tawnagh, Tobermacloghlin, County Roscommon (Appeal ref. PL20.241069 Planning Register Ref. 11/273) ("Phase 2 Decision").

2. Galetech Energy Developments Ltd. ("Galetech"), a notice party, is the applicant for the planning permissions that are the subject of the Phase 1 and Phase 2 Decisions. It supports the respondent, An Bord Pleanála ("the Board") in opposing the present application.

3. As appears, the applications for planning permission relate to two developments of wind turbines in County Roscommon. The applicant is resident in Dysart, County Roscommon, is the Chairman of a group of local residents called the Wind Turbine Action Group South Roscommon and was an appellant before the Board in relation to each appeal.

Background

4. In 2010, Galetech applied for planning permission for a development comprising 16 wind turbine at Dysart, County Roscommon. In 2011, it applied for permission for the development of 19 wind turbines at Milltown, Skeavalley, County Roscommon. The two developments are in the same vicinity and are contended by the applicant to comprise two phases of the same development. They will be referred

to as Phase 1 and Phase 2 in this judgment. Roscommon County Council granted permissions for the two developments and appeals were made to the Board.

5. The proposed developments are in the vicinity of a number of European sites, both Special Areas of Conservation (SAC) and Special Protection Areas (SPA). There are ten conservation sites within 10km of the Phase 1 site. These include three Natura 2000 sites, Loghcroan SAC, Four Road Turlough CSAC and the River Suck Callows SPA. Those sites have important numbers of wetland and water birds, including Whooper Swan, Golden Plover and Greenland White Fronted Geese, all Annexe 1 species. Within 15km of the Phase 2 site, there are 14 Natura sites including the three Natura 2000 sites already mentioned.

6. The Board appointed a Planning Inspector to prepare a report on the appeal in relation to Phase 1, Ms. Kelly. Ms. Kelly reported on 11th March, 2012. She recommended refusal of planning permission.

7. The Board appointed Ms. MacGabhann as Inspector in relation to the Phase 2 appeal. Ms. MacGabhann reported on 6th February, 2013. She also recommended refusal of planning permission.

8. The Board considered each of the appeals at a meeting of the Board held on 8th August, 2013, and decided by a majority of 4:1 to grant permission for each of the proposed developments in accordance with reasons, considerations and decisions set out in the respective written decisions. It is those decisions, and the procedure leading to them, that are the subject matter of the present application for judicial review.

Grounds of Challenge

9. The applicant has delivered a lengthy and detailed statement of grounds. Pursuant to directions of the Court, it summarised the legal grounds upon which relief is sought as follows:

"(1) The Environmental Impact Statements (EIS) accompanying the applications for planning permission were inadequate and did not meet the requirements of national and European law. The Board erred in law in considering the statements to be adequate and proceeding to grant permission.

(2) The Natura Impact Statements (NIS) accompanying the applications for permission were inadequate and did not meet the requirements of national and European law. The Board erred in law in considering the statements to be adequate and proceeding to grant permission.

(3) The Board failed to carry out a proper environmental impact assessment of the proposed development as is required under Irish and European law.

(4) The Board failed to carry out a proper appropriate assessment of the proposed development as is required under Irish and European law.

(5) The Inspectors in each appeal recommended a refusal of permission for the proposed development, the Board erred in failing to have any or any proper regard to these recommendations and in particular the scientific doubt expressed in these recommendation.

(6) The Board failed to properly or at all record its conclusions or to give any or any proper statement of its reasons or considerations contrary to national and European law.

(7) The Board erred in applying an incorrect test in its purported appropriate assessment.

(8) The Board's decision was irrational."

10. At the hearing, counsel indicated that the applicant was not pursuing grounds (1) and (2).

11. The Department supports the applicant on his grounds of challenge which relate to compliance with the requirements of the Council Directive 92/43/EEC (as amended) (the "Habitats Directive") and the relevant implementing national legislation identified in grounds (4), (5), (6) and (7) above.

12. As appears, the primary ground relied upon by both the applicant and the Department is that the decisions of the Board to grant each planning permission were made in breach of the requirements of Article 6(3) of the Habitats Directive as transposed into national law by Part XAB of the Planning and Development Act 2000 (as amended) ("the PDA"). The main contention is that the Board, as competent authority, failed to carry out an appropriate assessment in either appeal in accordance with Article 6(3) and the decisions of the Court of Justice of the European Union (CJEU), or to give reasons for the determination made in the course of the purported appropriate assessments.

13. The applicant pursued ground (3) in relation to the alleged failure by the Board to carry out an environmental impact assessment as required by Directive 2011/92/EU ("EIA Directive") as implemented by the PDA.

14. Whilst I propose, initially, considering the grounds which relate to the alleged breach of the requirements of Article 6(3) of the Habitats Directive, as transposed into Irish law, it is necessary to set out in summary all relevant parts of the Statutory

Scheme which applied to the challenged decisions taken by the Board to consider appropriately the Board decisions.

Statutory Framework

15. The ultimate decisions taken by the Board on the appeals were whether or not to grant planning permission for the developments that were the subject of each of the appeals pursuant to s. 37 of the PDA. In taking those decisions, by reason of the nature and location of the proposed developments, there were three separately identifiable requirements deriving from Statute (in part enacted to give effect to EU obligations) with which the Board had to comply:

(i) Consideration of what might be termed normal or general planning requirements under the PDA and compliance with its procedural requirements; and

(ii) The carrying out of an environmental impact assessment required by the EIA Directive as implemented by Part X of the PDA; and

(iii) The carrying out of an appropriate assessment as required by Article 6(3) of the Habitats Directive implemented by Part XAB of the PDA including making a determination.

Planning Requirements

16. The Board assigned an Inspector to report to it on each appeal pursuant to s. 146(1) of the PDA. The Inspector's Report must include a recommendation to the Board, which it is obliged to consider before determining the appeal (s. 146(2)).

17. In accordance with s. 34(10) of the PDA, the Board must state the main reasons and considerations on which the decision is based. Also, as where, in this case, the decision on the appeal is different to the recommendation in the Inspector's

Report, the decision of the Board must "indicate the main reasons for not accepting the recommendation in the report or reports to grant or refuse permission".

Environmental Impact Assessment

18. Where, as on the facts of these appeals, the Board is also obliged to carry out an environmental impact assessment (EIA), the obligations imposed on it by the EIA Directive, as implemented, are set out in Part X of the PDA. Section 171A(1) defines an environment impact assessment, for the purposes of Part X, as:

> "An assessment which includes an examination, analysis and evaluation carried out by . . . the Board . . . in accordance with this Part and Regulations made thereunder, that shall identify, describe and assess in an appropriate manner, in light of each individual case and in accordance with Articles 4 to 11 of the Environmental Impact Assessment Directive, the direct and indirect effects of a proposed development on the following:
>
> (a) human beings, flora and fauna;
>
> (b) soil, water, air, climate and the landscape;
>
> (c) material assets and the cultural heritage and
>
> (d) the interaction between the factors mentioned in paragraphs (a), (b) and (c)."

19. Section 172(1H) permits the Board, in carrying out an EIA, to "have regard to and adopt in whole or in part any reports prepared by its officials or by consultants, experts or other advisers". This includes its Inspector's Reports.

20. Section 172(1J) obliges the Board, when it has decided whether to grant or refuse consent for the proposed development, to inform the applicant and the public of the decision and to make the following information available to them:

> "(a) The contents of the decision and any conditions attaching thereto;

(b) an evaluation of the direct and indirect effects of the proposed development on the matters set out in section 171A;

(c) having examined any submission or observation validly made:

(i) the main reasons and considerations on which the decision is based and

(ii) the main reasons and considerations for the attachment of any conditions, including reasons and considerations arising from or related to submissions or observations made by members of the public;

(d) where relevant, description of the main measures to avoid, reduce and, if possible, offset the major adverse effects;

(e) any report referred to in sub-section (1H);

(f) information for the public on the procedures available to review the substantive and procedural legality of the decision, and

(g) the views, if any, furnished by other Member States of the European Union pursuant to s. 174."

21. The definition of an EIA as being "an examination, analysis and evaluation" carried out by the Board and the obligation of the Board pursuant to s. 172(1J)(b) to make available to the public its evaluation of the direct and indirect effects of the proposed development on the matters set out in s. 171A are of particular relevance to the matters in dispute.

Appropriate Assessment

22. In these appeals, the third statutory requirement imposed on the Board relates to its obligations and in particular the carrying out of an appropriate assessment

pursuant to Article 6 of the Habitats Directive as implemented by Part XAB of the PDA. There is some dispute as to the extent of the obligations imposed and in particular the nature of the reasons which must be given by the Board.

23. Whilst the provisions of Part XAB are more detailed than Article 6 of the Habitats Directive, it was common case between the parties at the hearing that they are intended to and do impose similar obligations on the Board to those imposed by Article 6(3) of the Habitats Directive as construed by reference to the case law of the CJEU.

24. Article 6 of the Habitats Directive, insofar as relevant, provides:

> "2. Member States shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive.
>
> 3. Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.

4. If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted."

25. As appears Article 6(3) envisages a two-stage process which is implemented in greater detail by ss. 177U and 177V of the PDA:

(i) a screening for appropriate assessment in accordance with s. 177U;

(ii) if, on a screening, the Board determines that an appropriate assessment is required then it must carry out an appropriate assessment in accordance with s. 177V.

26. There is a dispute between the parties as to the precise obligations imposed on the Board in relation to the stage 1 screening by s.1777U but its resolution is not strictly necessary in these proceedings. There is agreement on the nature and purpose of the screening process which is well explained by Advocate General Sharpston in Case C-258/11 *Sweetman* at paras 47-49:

"47. It follows that the *possibility* of there being a significant effect on the site will generate the need for an appropriate assessment for the purposes of Article 6(3). The requirement at this stage that the plan or project be likely to have a significant effect is thus a trigger for the obligation to carry out an appropriate assessment. There is no need to *establish* such an effect; it is, as Ireland observes, merely necessary to determine that there *may be* such an effect.

48. The requirement that the effect in question be 'significant' exists in order to lay down a *de minimis* threshold. Plans or projects that have no appreciable effect on the site are thereby excluded. If all plans or projects capable of having *any* effect whatsoever on the site were to be caught by Article 6(3), activities on or near the site would risk being impossible by reason of legislative overkill.

49. The threshold at the first stage of Article 6(3) is thus a very low one. It operates merely as a trigger, in order to determine whether an appropriate assessment must be undertaken on the implications of the plan or project for the conservation objectives of the site [. . .]"

27. The applicant submitted that s. 177U is mandatory and obliges the Board to carry out a screening and make a formal determination as to whether or not an appropriate assessment is required in all cases, and that it did not do so in the appeals, the subject matter of these proceedings. The Board in response does not assert that it conducted a stage 1 formal screening but disputes that it was under an obligation to carry out a screening and issue a formal determination in circumstances where the planning applications were accompanied by a Natura impact statement. It referred to s. 177U(6)(c) and submitted that this is intended to reflect the practical reality of the situation which pertains in these appeals where the requirement to carry out a full appropriate assessment had been established before the planning authority.

28. Sub-sections 177U(1) and (2), in their terms, impose a mandatory obligation on a competent authority, such as the Board, to carry out screening for appropriate assessment before consent is given for a proposed development. These sub-sections, insofar as relevant, provide:

> "177U. - (1) A screening for appropriate assessment of . . . [an] application for consent for proposed development shall be carried out by the competent authority to assess, in view of best scientific knowledge, if that . . . proposed development, individually or in combination with another plan or project is likely to have a significant effect on the European site.
>
> (2) A competent authority shall carry out a screening for appropriate assessment under subsection (1) before-
>
> (a) . . ."

Sub-section (3) permits the competent authority to request information from the applicant to enable it carry out the screening. Sub-sections (4) and (5) set out the determinations which may be made by the Board in that screening process in the following terms:

> "(4) The competent authority shall determine that an appropriate assessment . . . of a proposed development, . . . is required if it cannot be excluded, on the basis of objective information, that the . . . proposed development, individually or in combination with other plans or projects, will have a significant effect on a European site.
>
> (5) The competent authority shall determine that an appropriate assessment of . . . a proposed development, . . . is not required if it can be excluded, on the basis of objective information, that the . . . proposed development, individually or in combination with other plans or projects, will have a significant effect on a European site."

29. Sub-section (6) then provides for the notification of a determination made by a competent authority. However, it only expressly requires notification to be given where a competent authority makes a determination that an appropriate assessment is

required. When it does so, it must give notice of the determination, including reasons for the determination to the applicant, persons who have made submissions or observations and a party to an appeal. However, sub-section (c) then provides "paragraph (a) shall not apply in a case where the application for consent for the proposed development was accompanied by a Natura impact statement".

30. Whilst the above statutory scheme appears in its express terms to impose a mandatory obligation under sub-sections (1) and (2) on the Board to carry out a screening for appropriate assessment prior to giving consent for a all proposed developments, sub-section (6), in its express terms, only appears to require notice of its determination with reasons to be given to certain persons where it reaches a positive conclusion that an appropriate assessment is required and then relieves the Board of giving notice of its determination in circumstances where the application for consent was accompanied by a Natura impact statement. As I have already observed, it is not necessary, for the determination of this judicial review application, to decide the proper construction of these provisions as the Board accepted an appropriate assessment was required. It is, however, relevant to the subsequent issues in dispute in relation to the nature of the full appropriate assessment which must be carried out and the reasons which must be given therefor, to note that an appropriate assessment is the second stage of a two-stage process and only arises where the first stage or screening process has either determined (or it was at least implicitly accepted) that the proposed development, alone or in combination with other plans or projects, is likely to have a significant effect on a European site within the meaning of the low threshold set out by Advocate General Sharpston in *Sweetman*.

31. Unlike, in the case of an environmental impact assessment, s. 177V does not contain a stand alone definition of an "appropriate assessment". Sub-section 177V(1)

provides that "An appropriate assessment carried out under this Part shall include a determination by the competent authority under Article 6.3 of the Habitats Directive as to whether or not a . . . proposed development would adversely affect the integrity of a European site". The Board is the competent authority for the purposes of Part XAB in relation to a planning appeal. If as expressly required by s.177V(1) the determination to be made as part of the appropriate assessment is to meet the requirements of Article 6.3 of the Habitats Directive, it follows that the full appropriate assessment must meet the requirements of Article 6.3 of the Habitats Directive as construed in CJEU case law.

32. Sub-section 177V(1) also expressly requires the appropriate assessment to be carried out before consent is given for a proposed development. Further Sub-section (3) provides that "Notwithstanding any other provision in this Act [and other named Acts] the Board shall give consent to a proposed development"only after having determined that the . . .or proposed development shall not adversely affect the integrity of a European site". Sub-section (4) then "subject to the other provisions of the Act" permits consent to be given where modifications or conditions are attached and the Board has determined that "the proposed development would not adversely affect the integrity of the European site if it is carried out in accordance with the consent and the modifications or conditions attaching thereto. On the facts herein no such determination was made in either appeal and s.177V(4) is not relevant to the issues to be determined.

33. As appears, the respective effects on the decision making process of the Board of the environmental impact assessment and the appropriate assessment (where both have to be carried out by the Board prior to taking its planning decision) are quite different. In carrying out an environmental impact assessment, the Board is required

to conduct an examination, analysis and evaluation of and identify the direct and indirect effects of the proposed developments on the matters specified in section 171A(1). However, the outcome of that examination, analysis, evaluation and identification informs rather than determines the planning decision which should or may be made. The Board has jurisdiction in its discretion to grant consent regardless of the outcome of the EIA though of course it impacts on how it should exercise its discretion.

34. In contrast, the Board, in carrying out an appropriate assessment under Article 6(3) and s.177V, is obliged, as part of same, to make a determination as to whether or not the proposed development would adversely affect the integrity of the relevant European site or sites in view of its conservation objectives. The determination which the Board makes on that issue in the appropriate assessment determines its jurisdiction to take the planning decision. Unless the appropriate assessment determination is that the proposed development will not adversely affect the integrity of any relevant European site, the Board may not take a decision giving consent for the proposed development unless it does so pursuant to Article 6(4) of the Habitats Directive. It is agreed that the decisions made by the Board herein were not taken pursuant to Article 6(4) of the Habitats Directive. Hence, for the purposes of these appeals, the Board was precluded from granting consent for the proposed developments unless, having conducted an appropriate assessment in accordance with Article 6(3), as construed by the CJEU, it reached a determination that the proposed development will not adversely affect the integrity of the European sites.

Nature of Appropriate Assessment

35. The requirements of an appropriate assessment and of the legal test that the proposed development "will not adversely affect the integrity of a European site"

have been considered by the CJEU in a number of cases. In *Waddenzee (Case C-127/02)* [2004] E.C.R. I-7405, at para. 61 of its judgment, it stated:

> "... under Article 6(3) of the Habitats Directive, an appropriate assessment of the implications for the site concerned of the plan or project implies that, prior to its approval, all the aspects of the plan or project which can, by themselves or in combination with other plans or projects, affect the site's conservation objectives must be identified in the light of the best scientific knowledge in the field. The competent national authorities, taking account of the appropriate assessment of the implications of mechanical cockle fishing for the site concerned in the light of the site's conservation objectives, are to authorise such an activity only if they have made certain that it will not adversely affect the integrity of that site. That is the case where no reasonable scientific doubt remains as to the absence of such effects."

36. This formulation as to the nature of the obligations imposed under Article 6(3) of the Habitats Directive has been affirmed and expanded upon in subsequent decisions of the CJEU. In *Commission v. Spain (Case C-404/09)* [2011] E.C.R. I-11853, the CJEU referred again to the obligation to identify the affects of the proposed development on the European sites conservation objectives "in the light of the best scientific knowledge in the field" and referred again to the test that "no reasonable scientific doubt remains as to the absence of such effects". At paras. 99 and 100, the CJEU stated:

> "99. Under Article 6(3) of the Habitats Directive, an appropriate assessment of the implications for the site concerned of the plan or project implies that, prior to its approval, all aspects of the plan or project which

can, by themselves or in combination with other plans or projects, affect the site's conservation objectives must be identified in the light of the best scientific knowledge in the field. The competent national authorities are to authorise an activity on the protected site only if they have made certain that it will not adversely affect the integrity of that site. That is the case where no reasonable scientific doubt remains as to the absence of such effects (see, in particular, *Commission v Ireland*, at paragraph 243).

100. An assessment made under Article 6(3) of the Habitats Directive cannot be regarded as appropriate if it contains gaps and lacks complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the works proposed on the SPA concerned (see, to that effect, Case C-304/05 *Commission v Italy* [2007] ECR1-7495, paragraph 69."

37. More recently, the CJEU, in *Sweetman (Case C-258/11)*, provided further guidance as to what is required of an appropriate assessment at para. 44 where it stated:

"44. So far as concerns the assessment carried out under Article 6(3) of the Habitats Directive, it should be pointed out that it cannot have lacunae and must contain complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the works proposed on the protected site concerned (see, to this effect, Case C-404/09 *Commission v Spain*, paragraph 100 and the case-law cited). It is for the national court to establish whether the assessment of the implications for the site meets these requirements."

38. Whilst all parties accepted for an appropriate assessment to be lawful it must comply with the requirements set out by the CJEU, as summarised in the above extracts from the relevant judgments, there was some dispute as to what was required by reason, in particular, of the wording of s. 177V(1) which only provides that it shall "include" a determination by the competent authority under Article 6.3 of the Habitats Directive as to whether or not ". . . a proposed development would adversely the integrity of a European site" and the absence of any provision analogous to the definition of an environmental impact assessment as contained in section 171A(1) that such an assessment must include "an examination, analysis and evaluation carried out by . . . the Board".

39. Section 177V(1) must be construed so as to give effect to Article 6(3) of the Habitats Directive, and hence, an appropriate assessment carried out under the section must meet the requirements of Article 6(3) as set out in the CJEU case law. If an appropriate assessment is to comply with the criteria set out by the CJEU in the cases referred to, then it must, in my judgment, include an examination, analysis, evaluation, findings, conclusions and a final determination.

40. It must be recalled that the appropriate assessment, or a stage two assessment, will only arise where, in the stage one screening process, it has been determined (or it has been implicitly accepted) that the proposed development meets the threshold of being considered likely to have significant effects on a European site. Where that is the position, then, in accordance with the preceding case law, the appropriate assessment to be lawfully conducted in summary:

(i) Must identify, in the light of the best scientific knowledge in the field, all aspects of the development project which can, by itself or in combination with other plans or projects, affect the European site in the

light of its conservation objectives. This clearly requires both examination and analysis.

(ii) Must contain complete, precise and definitive findings and conclusions and may not have lacunae or gaps. The requirement for precise and definitive findings and conclusions appears to require analysis, evaluation and decisions. Further, the reference to findings and conclusions in a scientific context requires both findings following analysis and conclusions following an evaluation each in the light of the best scientific knowledge in the field.

(iii)May only include a determination that the proposed development will not adversely affect the integrity of any relevant European site where upon the basis of complete, precise and definitive findings and conclusions made the Board decides that no reasonable scientific doubt remains as to the absence of the identified potential effects.

41. Hence in my judgment the full appropriate assessment required by s.177V(1) must include all of the above elements and not just the determination expressly referred to in the sub-section.

42. In *Sweetman (Case C-258/11)*, the CJEU also gave guidance as to the scope of the expression "adversely affect the integrity of the site". It is unnecessary to consider this in detail save to note that the Board is legally constrained as to how it should address the issue. The Court at para. 39 of its judgment, stated:

> "Consequently, it should be inferred that in order for the integrity of a site as a natural habitat not to be adversely affected for the purposes of the second sentence of Article 6(3) of the Habitats Directive, the site needs to be preserved at a favourable conservation status; this entails, as the

Advocate General has observed in points 54 to 56 of her Opinion, the lasting preservation of the constitutive characteristics of the site concerned that are connected to the presence of a natural habitat type whose preservation was the objective justifying the designation of that site in the list of SCIs in accordance with the Directive."

43. At para56, the Advocate General had stated:

"56. It follows that the constructive characteristics of the site that will be relevant are those in respect of which the site was designated and their associated conservation objectives. Thus, in determining whether the integrity of the site is affected, the essential question the decision-maker must ask is 'why was *this particular site* designated and what are its conservation objectives?' . . ."

Appropriate Assessment and Reasons

44. It is agreed that the Board is under an express obligation pursuant to s. 177V(5) of the PDA to give reasons for the determination made under Article 6(3) of the Habitats Directive as to whether or not the proposed development would adversely affect the integrity of a European site. The dispute relates to the extent or nature of the reasons which must be given. The applicant and the Department submit that where as in these appeals, the determination is that the proposed development would not adversely affect the integrity of any European site in view of the conversation objectives of those sites that the reasons must include complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the proposed development on the European sites in the light of the conservation objectives of the sites. It submits that such reasons are required in order

that the court may, in an application for judicial review, be able to ascertain whether or not an appropriate assessment has been conducted in accordance with the requirements of Article 6(3) of the Habitats Directive, as explained in the case law of the CJEU. They refer by analogy to the purpose of the requirement to state reasons as explained by the CJEU in *Mellor (Case C-75/08)* [2009] E.C.R. I-3799 in relation to an implied duty to give reasons for a negative screening decision under the Environmental Impact Assessment Directive. In that judgment, at paras. 57 to 60, the CJEU stated:-

> "57. It is apparent, however, that third parties, as well as the administrative authorities concerned, must be able to satisfy themselves that the competent authority has actually determined, in accordance with the rules laid down by national law, that an EIA was or was not necessary.
>
> 58. Furthermore, interested parties, as well as other national authorities concerned, must be able to ensure, if necessary through legal action, compliance with the competent authority's screening obligation. That requirement may be met, as in the main proceedings, by the possibility of bringing an action directly against the determination not to carry out an EIA.
>
> 59. In that regard, effective judicial review, which must be able to cover the legality of the reasons for the contested decision, presupposes in general, that the court to which the matter is referred may require the competent authority to notify its reasons. However where it is more particularly a question of securing the effective protection of a right conferred by Community law, interested parties must also be able to defend that right under the best possible conditions and have the possibility of deciding, with a full knowledge of the relevant facts, whether there is any point in applying to the courts.

Consequently, in such circumstances, the competent national authority is under a duty to inform them of the reasons on which its refusal is based, either in the decision itself or in a subsequent communication made at their request (see Case 222/86 *Heylens and Others* [1987] ECR 4097, paragraph 15).

60. That subsequent communication may take the form, not only of an express statement of the reasons, but also of information and relevant documents being made available in response to the request made."

45. They also relied upon the principles stated by Clarke J. in the High Court in *Christian v. Dublin City Council* [2012] 2 I.R. 506, in relation to the extent of the obligation to give reasons in Irish law. The underlying rationale and extent of the obligation as explained by Clarke J. appears to me to be similar if not identical to that explained by the CJEU in *Mellor*. In that judgment at p. 540, para. 78, Clarke J. explained it in the following terms:-

"The underlying rationale of cases such as *Meadows v. Minister for Justice* [2010] IESC 3 (in that respect) and *Mulholland v. An Bord Pleanála (No. 2)* [2005] IEHC 306 is that decisions which affect a person's rights and obligations must be lawfully made. In order to assess whether a relevant decision is lawful, a party considering a challenge, and the court in the event of a challenge being brought, must have access to a sufficient amount of information to enable an assessment as to lawfulness to be made. What that information may be, may vary enormously depending on the facts under consideration or the nature of the decision under challenge. However, the broad and underlying principle is that the court must have access to sufficient information to enable the lawfulness of the relevant measure to be assessed."

46. I note that similar statement s of principle have been repeated by Clarke J in the Supreme Court in judgments with which other members of the Court agreed in relation to the extent or type of reasons which must be given in *Rawson v Minister for Defence* [1012] IESC 26 at para 6.8 , and *EMI Records (Ireland)& Ors v Data Protection Commissioner* 2013 IESC 34 at paras 6.3-6.5.

47. The Board, supported by Galetech, did not dispute the above principles or their applicability to its obligation to give reasons for its determination in the appropriate assessment. It referred, however, to the Irish case law, and in particular, that relating to s. 34 of the PDA and the obligation on the Board where it departs from its inspectors' recommendations to state "the main reasons" for the departure. In particular, the Board noted case law establishing not only the position that the reasons need not be discursive but also that they should be read from the perspective of an intelligent person who has participated in the proceedings and should give sufficient information to enable an appeal of the decision while demonstrating that the decision maker adequately turned his/her mind to the matters in issue (*O'Neill v. An Bord Pleanála* [2009] IEHC 202 at paras. 27 to 34). Also Counsel for the Board tied the interpretative approach urged by the respondent to the judgment of Kelly J. in *Mulholland v. An Bord Pleanála (No.2)* [2005] IEHC 306, [2006] 1 I.R. 453. In particular, he noted the comments of Kelly J. at p. 464, paras. 30 to 32, that while new obligations in respect of when reasons are given were introduced by s. 34 of the PDA, the jurisprudence in respect of the content of reasons given by a planning authority had been left unchanged by the legislature. Counsel submitted this position is indicative of a continuing legal position in Irish law on the content of reasons required to be given by a planning authority and, as such, requires that the same interpretation

should be given to the statutory obligations in respect of reasons arising under s. 177V(5) of the PDA.

48. On this issue I have concluded that the submission made on behalf of the applicant and Department is correct. First, the essential principle is that the reasons must be such as to enable an interested party assess the lawfulness of the decision and in the event of a challenge being brought, the court must have access to sufficient information to enable an assessment as to lawfulness to be made On the facts of this judicial review, the challenged decisions are those to grant planning permissions. However, the grounds of challenge include the failure of the Board to carry out a proper or lawful appropriate assessment under Article 6(3) as implemented in Ireland. For the reasons already stated in this judgment the Board could not make a lawful decision to grant planning permission unless it had reached a lawful determination, in an appropriate assessment lawfully conducted, that the proposed development would not adversely impact on the European sites in question. In accordance with the CJEU decision in *Sweetman*, it is for the national court to determine whether the appropriate assessment (including the determination) was lawfully carried out or reached, and to do so, it appears to me that the reasons given for the Board's determination in an appropriate assessment must include the complete, precise and definitive findings and conclusions relied upon by the Board as the basis for its determination. They must also include the main rationale or reason for which the Board considered those findings and conclusions capable of removing all scientific doubt as to the effects of the proposed development on the European site concerned in the light of the its conservation objectives. In the absence of such reasons, it would not be possible for a court to decide whether the appropriate assessment was lawfully concluded or whether the determination meets the legal test required by the judgments of the CJEU.

49. Secondly it appears to me that whilst the requirement for an appropriate assessment has been implemented in Ireland by amendment of the Planning Acts and requires to be carried out *inter alia* as part of the planning process the determination which must be made by the Board as competent authority it is not a "planning decision" in the sense used in the judgments relating to reasons relied upon by the Board. In such a planning decision the Board is exercising a jurisdiction with a very wide discretion. By contrast the determination it must make as part of an appropriate assessment is significantly narrower and legally constrained as explained in the CJEU cases cited. It also determines the Board's continuing jurisdiction to grant planning consent and therefore a decision which goes to its jurisdiction. The application of the principles set out by Clarke J in *Christian, Rawson* and *EMI* to the different types of decision results as envisaged therein in a requirement for reasons of a different order in relation to the different types of decison.

50. In reaching that conclusion I am not deciding that the findings and conclusions always have to be ones made by the Board itself. Where the Board appoints an inspector to prepare a report and the inspector carries out an appropriate assessment as part of his or her report, it may be that if the Board on consideration accepts the relevant findings made and conclusions reached by its Inspector in his or her report that the production of the report may satisfy some or all of the obligation of the Board to give reasons for its determination. This would depend upon the relevant facts.

51. It is now intended to apply the above principles and consider the lawfulness of the appropriate assessment including the determination made conducted by the Board in relation to each of the challenged decisions and the adequacy of the reasons given for its determinations. It is necessary to consider each decision separately.

Phase 1 Decision and Appropriate Assessment

52. The evidence adduced by the Board in relation to its phase 1 decision and the appropriate assessment conducted in that appeal is primarily the Board decision (PL 20.239759), the Board direction relating to that decision and the Inspector's Report and the documents referred to therein. The Board direction states that the submissions on this file and on the file relating to the phase 2 decision were considered at the same Board meeting of 8th August, 2013. I accept that fact.

53. The structure of the Board's decision is that it commences by stating its planning decision; it then identifies the matters considered; it then appears to include a number of paragraphs relating to the environmental impact assessment, it carried out; and then in two paragraphs identifies the appropriate assessment conducted and its reasons for the determination reached therein before returning to its final planning assessment and then sets out the conditions to be attached to the grant of permisson. Counsel on behalf of the Board submitted that this was the structure of the decision. The two paragraphs expressly referring to the appropriate assessment are in the following terms:-

> "The Board completed an Appropriate Assessment in relation to potential impacts on Natura 2000 sites and having regard to the Natura Impact Statement submitted including mitigation measures proposed and the reports of the Inspector in relation [to] the current file and to file register reference number PL20.241069, the further information submitted to An Bord Pleanála and to other submissions on file the Board concluded that on the basis of the information available that the proposed development either individually or in

combination with other plans or projects would not adversely affect the integrity of any European site in view of the conservation objectives of this sites.

The Board did not agree with the Inspector's conclusions set out in section 32.3.6 of her report regarding the adverse effects of the proposed development on feeding/roosting/commuting area and natural flight lines of certain water birds in the light of the comprehensive additional data in this regard submitted as further information to the Board on the 6th day of June 2013. The Board did not agree with the further conclusion of the Inspector in relation to the adverse effects of the proposed development on the integrity of European sites at Lough Croan SAC (Site No. 000610) and Lough Croan SPA (Site No. 004139). The Board considered that it could not reasonably be concluded on the basis of the information on ground conditions and other material submitted; the nature of the proposed development and the use of normal good construction practice, that the integrity of these sites would be adversely affected by the proposed development."

54. Earlier in its decision, the Board had stated in relation to the Inspector's Report:-

"The Board generally adopted the report of the Inspector except in relation to the following items (see section 44E of the Inspector's Report):

- landscape and visual impacts
- hydrology and groundwater quality and flows, and
- bird movements in the area,

for the reasons set out below."

55. Section 44E of the Inspector's Report forms part of the environmental impact assessment conducted by the Inspector. It is not expressly part of the appropriate assessment conducted by her. The landscape and visual impacts are of no relevance to the appropriate assessment. Both hydrology and groundwater quality and flow and bird movements in the area are of direct relevance. The reasons included by the Board in its decision in the context of the environmental impact assessment as to why it did not adopt the report of the inspector in relation to these items are explained in the following terms:-

> "The Board considered the subject of hydrology and the potential for adverse impact by the proposed development on groundwater quality and flow in this karst area. The Board is satisfied taking into account the information supplied by the applicant including the resistivity test date submitted to the planning authority at further information stage that subject to normal good construction practice turbine foundations can be developed at this location without significant impacts on the hydrology or hydrogeology of the area.
>
> The Board is satisfied on the basis of the survey information submitted to the planning authority (Chapter 8, EIS) and the further information submitted on 6th day of June 2013 to An Bord Pleanála in relation to bird movements in the area that the proposed development is unlikely to have any significant impacts on avifauna including species of water birds of conservation interest. While the Board reached this view independently of the applicant's proposed use of a radar detection system as an additional mitigant it is of the view that this system may be of valued as an aid to minimising impacts on specific bird species in the area."

56. I accept the submission made on behalf of the Board that those two paragraphs in the decision should not be considered as part of the appropriate assessment conducted by the Board but rather form part of the environmental impact assessment. However, that does not assist the Board in relation to the validity of the appropriate assessment conducted, save that it should not be considered as evidence of the application of an incorrect legal test as was submitted by the applicant.

57. The two paragraphs included by the Board in its decision in relation to the appropriate assessment must be considered in the context of that part of the Inspector's Report, which includes the appropriate assessment conducted by her and her findings and conclusion. It assists in identifying the relevant sites, their conservation objectives and potential impacts of the proposed developments.

58. The Inspector set out the appropriate assessment conducted by her at section 32 of her report. It commences by identifying ten Natura 2000 sites in the area of the proposed development. She then gives a short summary of the five nearest conservation sites, their objectives and the impacts on them in the following terms:-

> "32.1.2 The following is a short summary of the five conservation sites nearest the appeal site based on the site synopses.
>
> 1. Lough Croan - part turlough / part floating fen; supports multitude of highly diverse vegetation, including Red Data - Northern Yellow Cress; important ornithological site; species using site include Whooper Swan, Golden Plover, Greenland White-Fronted Goose (River Suck population), Shoveler, Bewick Swan, Wigeon, Gadwall, Teal, Mallard, Pintail, Lapwing, Curlew, Blackheaded Gull; wintering water fowl numbers are large and site is especially useful to dabbling

duck; important site due to its overall size, birdlife and rare plant communities and the species it supports;

2. Four Roads Turlough - very important site as refuge and feeding area for wildfowl and waders; bird numbers variable; can be very large; extensively used by Greenland White-Fronted Goose (River Suck population); other species include Wigeon, Teal, Shoveler; Bewicks Swan, Golden Plover, Lapwing, Curlew; occasional use by Whooper Swan;

3. River Suck Callows - extensive linear site (70km) that floods each winter; important for Greenland White-Fronted Geese (flock of international importance), Whooper Swan, Golden Plover, Wigeon, Lapwing, Mute Swan, Teal, Pintail, Curlew, Black-headed Gull as well as Otter and Hare. There is a wild fowl sanctuary north of Ballyforan;

4. Lough Funshinagh - classified as turlough; water levels fluctuate significantly; important for wintering waterfowl including Whooper Swan, Bewicks Swan, Golden Plover, Wigeon, Teal, Mallard, Shoveler, Pochard, Tufted Duck, Coot, Lapwing and Curlew and also used by River Suck, Greenland White-Fronted Geese;

5. Lisduff Turlough - important for waders and wintering wildfowl; Bewick Swan, Golden Plover, Dunlin, Pintail, Pochard, Lapwing, Curlew, Snipe.

The conservation objectives for these sites are:

- Lough Croan - (i) maintain Annex I habitat - Turlough; (ii) maintain or restore favourable conservation conditions for Shoveler, Golden

Plover and Greenland White-Fronted Geese; (iii) additional conservation interest for Wetlands and Water birds;

- Four Roads - (i) maintain Annex I habitat - Turlough; (ii) maintain or restore favourable conservation conditions for Golden Plover and Greenland White-Fronted Geese; (iii) additional conservation interest for wetlands and water birds;
- River Suck - (i) maintain special conservation interest for Whooper Swan, Greenland White-Fronted Geese, Wigeon, Lapwing, Wetlands and Water birds;
- Louth Funshinagh - (i) maintain Annex I habitat - Turlough;
- Lisduff Turlough - (i) maintain Annex I habitat - Turlough;

32.2 Direct and Indirect Impacts

32.2.1 I consider the main direct impacts will be from

- Displacement of Golden Plover and Lapwing in the short term due to construction noise and loss of habitat and in the long term due to the sight, noise and vibration of turbines;
- Disturbance of feeding/ roosting/ commuting area and interference with natural flight lines of Whooper Swans, Greenland White-Fronted Geese and Golden Plover;
- Bird strikes due to collision with wind turbines;

32.2.2 I consider the main indirect impact in the short and long term will be from

- Change in turlough habitat."

59. The Inspector then assessed the direct and indirect impacts under each of the above headings as follows:-

"32.3 Assessment

32.3.1 Displacement of Golden Plover and Lapwing within and in the vicinity of the site

32.3.2 Both the notes from the Bird Survey and the NIS state that Golden Plover were regularly observed near the site but not in the immediate area of the proposed development. Some 3,000 were observed in a flock at Lough Croan during the winter surveys and Lapwing were observed during the winter surveys including on wet grassland in the region surrounding Lough Croan. Table 8.5.4.1, (Ornithology Section, EIS) lists both species as being observed in and around the survey area but considered that neither species to be at risk. They are not discussed in the NIS. In view of the extensive, alternative habitat available in the area to this species, I consider that there is unlikely to be a significant long-term impact.

32.3.3 Disturbance of feeding/ roosting/ commuting area and natural flight lines of Whooper Swan, Greenland White-Fronted Geese, Golden Plover and Water birds

32.3.4 The conservation areas in the vicinity of the site support a large population of wintering birds, including Whooper Swan; Greenland White-Fronted Geese, Golden Plover and Water birds. All five are noted as using the River Suck, Four Roads Turlough, Lough Croan and Lough Funshinagh, whilst Lisduff Turlough supports Golden Plover and water birds. Greenland White-Fronted Goose are known to be highly faithful to a site. The Synopses describe them as based on the River Suck, but also note that they regularly utilise Four Roads Turlough, Lough Croan and Lough Funshinagh.

32.3.5 The conservation areas provide a cluster of wetland areas. They are supported by the non-conservation wetland sites in the area, including Thomas Street Turlough, Lough Feacle Loughs Cuilleenirwan and Coolagarry and the Ballyglass Canal, as well as the smaller flooded area adjoining the site. The data submitted refers to the large number of Whooper Swans at Lough Feacle and along the Ballyglass Canal. I am satisfied from my inspection and other appeal submissions that Whooper Swan also use Thomas Street Turlough and the flooded lands east of the site. Together, these wetlands provide an extensive network of feeding and roosting areas for the Whooper Swan and Greenland White-Fronted Goose.

32.3.6 The surveys do not address the interconnections between the conservation sites and provide no information on the movement of Greenland White-Fronted Geese in the area. The 2007/2008 census indicates that there are still significant numbers on the River Suck, notwithstanding a decline in numbers. Overall, I would be concerned that the level of information provided is lacking in detail, is unduly focussed at Lough Feacle, due to the separate application in this area and does not provide a definitive picture of the flight paths of protected species in the area of the site, as they move between the different wetlands in the area. Furthermore, I do not consider the applicant has provided adequate information to prove beyond reasonable scientific doubt that the wind farm will not impact on the feeding/ roosting/ commuting area and natural flight lines of Whooper Swan, Greenland White-Fronted Geese, Golden Plover and Water birds, and would not have an adverse impact on these protected species and on the integrity of the three conservation sites,

River Suck, Lough Croan and Four Roads Turlough, nearest the proposed wind farm.

32.3.7 Bird strikes due to collision with wind turbines

32.3.8 The applicant proposes to install a Merlin Avian Radar System that once trained, will provide constant monitoring of bird movements in the area of the site and eliminate potential bird strike by providing advance warning and allowing necessary turbine shut down. Information submitted (30/01/12) shows that the system is in use at a number of coastal wind farm sites including six in Europe. None of these sites would be similar to the area of the appeal site, which is an inland, moderately undulating site with a-network of wetland systems within a relatively small area, that support important populations of wintering birds. They would also not be similar in terms of weather patterns and topography. A report submitted by Appellant l, which reviews use of the radar system at a site in Sweden, also indicates problems of blind spots, echoes and ground clutter that can mask bird activity. DAHG have also expressed concerns as to the efficacy of the system. . I consider the information provided to date has not demonstrated that the use of a radar system can effectively mitigate bird strikes at the site.

32.3.9 It is argued that Whooper Swan generally fly at heights well below the minimum rotor sweep of 35m proposed and that the risk of collision is therefore very small. A reduction in turbine height and concomitant reduction in rotor sweep will increase the risk of bird strike. I do not consider the proposed turbine height is acceptable in the mixed hilly, flat farmland, where the development is located and consider, therefore that this argument is not acceptable. Overall, I consider the applicant has not proven beyond reasonable

scientific doubt that adverse effects on the integrity of the site with respect to its impact on conservation species in terms of bird strike will not occur.

32.3.10 Changes in turlough habitat

32.3.11 Four of the conservation sites nearest to the appeal site are turloughs. Turloughs are seasonal lakes found in karstified limestone areas where rainfall disappears directly underground through the fissures and conduits in the rock. They fill when the groundwater rises in the autumn and empty as water levels fall in the spring and some are also fed by rivers and streams flowing into them. The water flow rate through karstified rock can be quite rapid and water from a turlough may flow underground to a spring at a rate of l 00m per hour or more. They have a unique flora and can be important bird haunts, in particular Greenland White-Fronted Geese, Whooper Swan, Widgeon, Teal and many waders. Turloughs are priority Annex I habitat (3180) and the habitat is almost unique to Ireland.

32.3.12 There are a number of turloughs on the lower lands immediately below the site as well as the cluster of conservation sites in the wider area. The nearest turlough conservation site is Lough Croan. It is an extensive, linear wetland about l.1k n from the nearest turbine. The turlough habitat, which underpins the conservation species in the area, and the potential impact of the development on the habitat is not discussed in the NIS.

32.3.13 The site is located on karst limestone and all rainwater falling on the site recharges directly to groundwater through the fissures and conduits in the underlying bedrock. The results of 2-D resistivity testing indicate that further investigations are required to determine the depth to competent rock and inform the design of the base, at ten of the turbine sites. At a number of sites,

excavation may extend below groundwater level. The potential to alter the pattern of recharge within the site as a result of the depth of excavation into the karstic layer or by the proposals to discharge surface water throughout the site is not addressed in the application. It is stated that these matters will be addressed following further investigations necessary to determine the detailed design of the turbine base. Turloughs are a relatively shallow habitat. A small alteration in the pattern of recharge has the potential to have a significant impact on the ecology of the area. Furthermore, given that turloughs generally occur in an area with an extensive groundwater system and where water can flow rapidly over significant distances, I consider that a higher burden of proof is required to demonstrate that the development will not have adverse impacts on Lough Croan the nearest conservation site to the proposed development. I consider that the development raises significant concerns. and it has not been established beyond reasonable scientific doubt that adverse effects on the integrity of Lough Croan will not occur.

32.3.14 On the basis of the Appropriate Assessment, I consider it reasonable to conclude, on the basis of the information available, that the proposed development would adversely affect the integrity of the European sites Lough Croan Turlough SAC, Site No. 000610 and Lough Croan Turlough SPA, Site No. 004139 in view of these sites' conservation objectives."

60. As appears from the above, the appropriate assessment conducted by the Inspector cannot be considered as one which includes complete, precise and definitive findings and conclusions that are capable of removing all scientific doubt as to the effects of the proposed development on at least the five closest European conservation sites concerned. On the contrary, her assessments under the headings of:

(i) disturbance of feeding/roosting/commuting area and natural flight lines of Whooper Swan, Greenland White Fronted Geese, Golden Plover and water birds;

(ii) bird strikes due to collision with wind turbines; and

(iii) changes in turlough, habitat,

either identify *lacunae* in the information provided in the NIS or reach negative conclusions.

61. Subsequent to the Inspector's Report, the Board obtained further information. That information was a wintering bird survey undertaken between January and March 2013. It was furnished in response to a letter seeking further information from the Board dated 7th December 2012. The survey related to Whooper swans and Greenland white-fronted geese. Whilst, in the course of the hearing, there were submissions made by counsel for the Department and the Board for and against the adequacy of the survey as a response to the request dated 7th December, 2012, and in particular, the absence of any survey of Golden Plover, that issue need not be decided as part of the present consideration of the lawfulness or otherwise of the appropriate assessment conducted by the Board.

62. Returning to the evidence before the Court of the appropriate assessment conducted by the Board, taking into account the appropriate assessment conducted by the Inspector, it consists only of the four sentences in the two paragraphs in the Board Decision, together with what is stated by the Inspector in section 32 of her report, insofar as the Board has not disagreed with same. There is uncertainty as to how much of the appropriate assessment conducted by the Inspector or the findings made or conclusions reached by her is accepted by the Board in its decision by reason of the

general statement of acceptance save in relation to matters the matters specified but not by reference to the appropriate assessment part of the Inspector's report.

63. In the Board's own appropriate assessment, set out in its Decision, the first sentence is simply the statement of its determination and the identification of the material upon which the determination was based. Of the material identified, the only part which may constitute evidence of an assessment made by or on behalf of the Board, as distinct from information which the Board might have taken into account in making its assessment, is the Inspector's Report.

64. One of the consequences of the absence of any formal screening for an appropriate assessment pursuant to s. 177U as to whether the proposed development is likely to have a significant effect on the European site is that there is no identification, in advance of carrying out the appropriate assessment, of the reasons for which it is has been determined that the proposed developments meet the, admittedly low, threshold of being likely to have a significant effect on the European sites, having regard to their conservation objectives and require an appropriate assessment. On the facts herein, the Inspector, in her report, identified the potential direct and indirect effects in relation to wintering waterfowl and waders under the headings of 'Displacement', 'Disturbance of Feeding/Roosting/Commuting Areas and Interference with Natural Flight Lines and Bird Strikes', and in addition, a change in turlough habitat, the latter being by reason, principally, of the karst limestone underlying the site of the proposed development, the extensive ground water system and potential to alter the pattern of recharge.

65. In relation to the potential impact on the water fowl and waders by reason of disturbance of feeding/roosting/commuting area and interference with natural flight lines and potential bird strikes, the only evidence of any assessment conducted by the

Board itself is its statement in its decision that it "did not agree with the Inspector's conclusions set out in s. 32.3.6 of her report regarding the adverse effects of the proposed development on feeding/roosting/commuting area and natural flight lines of certain water birds in the light of the comprehensive additional data in this regard submitted as further information to the Board on the 6th day of June 2013". There is no evidence of any analysis or evaluation conducted by the Board of the further information or findings made by it.

66. In relation to the effects of potential changes in the turlough habitat identified by the Inspector in paras. 32.3.11 to 32.3.13 of her report, the Board does not, in its Decision, provide any evidence of any further or different assessment conducted by it and simply states it did not agree with the conclusion reached by the Inspector at para. 32.3.14 of her report that the proposed development would adversely affect the integrity of three of the named sites in the light of those sites' conservation objectives and then adds its conclusion "that it could not reasonably be concluded on the basis of the information on ground conditions and other material submitted; the nature of the proposed development and the use of normal good construction practice, that the integrity of these sites would be adversely affected by the proposed development".

Conclusion on Phase 1 Appropriate Assessment

67. My conclusion is that, on the evidence before the Court, the Board has failed to carry out an appropriate assessment which meets the requirements of Article 6(3) of the Habitats Directive, as explained by the CJEU. There is no evidence before the Court of an assessment conducted by the Board (or through its Inspector) which meets the criteria set out at paragraph 40 of this judgment and identifies, in the light of the best scientific knowledge in the field, all aspects of the proposed development which,

by itself, or in combination with other plans or projects which affect the ~~European~~ sites and contains complete, precise and definitive findings and conclusions which the Board considers capable of removing all reasonable scientific doubt as to the effects of the proposed development on the integrity of a number of Natura 2000 sites close to the site of the proposed development.

68. For the reasons set out earlier in this judgment, the determination made by the Board that the proposed development, individually or in combination with other plans or projects, would not adversely affect the integrity of any European site in view of the conservation objectives of those sites cannot be considered lawful unless such determination is made as part of an appropriate assessment which is lawfully conducted. Further, in the absence of such a lawful determination, the Board did not have jurisdiction to grant planning permission for the proposed development pursuant to s. 177V(3) of the PDA. It follows that the applicant is entitled to an order of *certiorari* of the Phase 1 decision.

69. I have also concluded on the same evidence that the Board failed to give reasons for its determination in the appropriate assessment which meets the requirements set out earlier in this judgment.

Phase 2 Decision and Appropriate Assessment

70. The evidence adduced by the Board in relation to the Phase 2 Decision is primarily the Board Decision (PL20.241069), the Board Direction relating to that Decision, and the Inspector's Report of Ms. Deirdre MacGabhann, which, whilst dated 6th February, 2012, it is agreed was, in fact, finalised on 6th February, 2013 and the documents referred to therein.

71. The Board Decision follows the same format as that in Phase 1. The Department and applicant laid emphasis upon the fact that, unlike the Decision in relation to Phase 1, there is no reference to the additional information by way of bird survey furnished to the Board on 6th June, 2013, either in the list of matters to which the Board had regard or in those paragraphs of the Decision which appear to constitute the appropriate assessment. I will return to this.

72. In relation to the appropriate assessment, the Board stated, in its Decision:

> "The Board completed an Appropriate Assessment in relation to potential impacts on Natura 2000 sites and, having regard to the Natura Impact Statement submitted, including mitigation measures proposed and the reports of the Inspector in relation [to] the current file and to file register reference number PL20.239759, the further information submitted to the planning authority on the 8th day of June, 2012 and to other submissions on file, the Board concluded, on the basis of the information available, that the proposed development, either individually, or in combination with other plans or projects, would not adversely affect the integrity of any European site in view of the conservation objectives of those sites. The Board did not agree with the Inspector's conclusions, as set out in section 11 of her report, regarding the adverse effects of the proposed development on bird species utilising the site in the light of the comprehensive data in this regard submitted with the application as referenced above. With regard to impacts on karst limestone bedrock the Board considered that it could not reasonably be concluded, on the basis of the information on ground conditions and other material submitted, the nature of the proposed development and the use of normal good

construction practice, that the integrity of these sites would be adversely affected by the proposed development. Finally, with regard to the impact of the proposed development on bats, the Board noted the substantial survey work completed prior to the application as well as the further information submitted to the planning authority on the 8th day of June, 2012 and considered that, subject to the implementation of the proposed mitigation measures, the residual impacts of the proposed development on bats would be minimal."

73. Firstly, in so far as relevant to dispose of the question as to whether the Board indicated that it did have regard to the bird survey furnished in relation to the Phase 1 appeal in June 2013, it appears to me that whilst there is no reference to this in the first paragraph above, it may be that it is being referred to in the first sentence of the second paragraph. The further information was provided to the Board in connection with the Appeal Reference No. PL. 20.239759, and this appeal appears to be referred to in the first sentence of the second paragraph as "the application as referenced above". I am accepting, for the purposes of this judgment, that the Board did have regard to that additional data.

74. Similar to Phase 1, there is no formal screening determination. However, also similarly, the Inspector (who was a different Inspector to that appointed in respect of the Phase 1 appeal) conducted an appropriate assessment from paras. 10.124 to 10.163 of her report. The Inspector states at para. 10.128 that she followed the Department of Environment's guidance document on appropriate assessment and the European Commission's advice on appropriate assessment. She also refers to the earlier part of her report which, she states, sets out much of the information required for the appropriate assessment and then summarises the key aspects of the

development as it relates to the appropriate assessment. The Inspector considers in some detail the short and long-term, indirect and cumulative impacts which are likely to arise from the construction and operational phases of the development from paras. 10.136 to 10.153. She then considers certain mitigation issues. It is unnecessary to set these out in full. She identifies the residual impacts and states her appropriate assessment conclusion at paras. 10.160 to 10.163 in the following terms:

> "10.160 Based on my assessment above, I consider that two key residual impacts remain. Firstly, in the absence of:
>
> a. Detailed geo-technical investigations regarding the construction of the proposed turbine bases and sub-station in areas of karstified limestone and
>
> b. Detailed design solutions for the site specific disposal of surface water arising on site,
>
> 10.161 There is a risk that the construction of the wind farm will impact on groundwater flow paths within the karst landscape which may in turn affect the hydrology/hydrogeology of the network of designated wetland systems (notably turloughs) in the vicinity of the site and their associated habitats and species.
>
> 10.162 Secondly, in the absence of detailed survey information on the use of the appeal site by bird species listed of Conservation Interest in the surrounding network of SPA's there is a risk that the proposed development will adversely impact on these species by virtue of disturbance, barrier effects to movement and collision risk arising from the construction and operation of the wind farm. These impacts could disrupt factors which maintain the favourable conditions for the species in the wider environment and in the network of SPAs in particular.

10.163 In view of the above, I consider that it is not reasonable to conclude on the basis of the information available that the proposed development would not individually, and in combination with other projects, adversely affect the integrity of the European sites in the vicinity of the appeal site (Lough Croan Turlough SPA, site code 004139; Four Roads Turlough SPA, site code 004140; River Suck Callows SPA, site code 004097) in view of the site's conservation objectives."

75. The Inspector, finally, in s. 11 of her report, sets out her overall summary and conclusions which, obviously, go beyond the appropriate assessment. Paras. 11.1 to 11.3 and 11.6 relate to the appropriate assessment:

"**11 SUMMARY AND CONCLUSION**

11.1 International and national policies actively support and encourage the growth of renewable energy sources and wind energy development in particular. However, the government's guidelines on wind energy development state that the implementation of renewable energy policies must have regard for the environment, specifically the legally binding requirements of the EU Directives on Birds and Habitats.

11.2 The appeal site lies within 15km of 14 statutorily designated European sites as part of the European Natura 2000 network and the site itself hosts bird species of national Importance and bird species which are listed of Special Conservation Interest in the 3 no. Special Protection Areas in the vicinity of the site. On the basis of the information provided by the applicant, I am not satisfied that the applicant has demonstrated that the proposed development will not adversely impact on bird species

utilising the site, by way of disturbance, barrier effects to movement and collision risk arising from the construction and operation of the wind farm. In particular, these impacts could disrupt factors which maintain the favourable conditions for the species in the wider environment and in the network of SPA's in particular.

11.3 The appeal site is underlain by karstified limestone bedrock and within the same groundwater bodies as the network of designated wetland habitats within 15km of the site. I do not consider that the applicant has adequately demonstrated that the proposed development will not adversely impact on groundwater flowpaths within the karst landscape or indirectly therefore the groundwater regime of the designated wetland habitats in the vicinity of the site.

. . .

11.6 In summary, I consider that the proposed development should be refused for the two above substantive reasons set out above, impact on hydrology/hydrogeology of related designated wetland systems and impact on bird species of Special Conservation Interest occurring on the site and in the surrounding network of Special Protection Areas."

76. The Board, in the Phase 2 Decision, also expressly stated that it:

". . generally adopted the report of the Inspector except in relation to the following items (see section 11):-

(1) hydrology and groundwater quality and flow, and

(2) bird movements in the area,

for the reasons set out below."

77. For the reasons already set out, whilst the Board is entitled to rely upon an appropriate assessment conducted by its Inspector, and whilst it has generally adopted the Inspector's Report, the findings made and conclusions reached by the Inspector in relation to the matters identified as potentially affecting the integrity of the Natura 2000 sites concerned, are such that the appropriate assessment in the Inspector's Report could not support a determination that the proposed development would not adversely affect the European sites concerned, having regard to their conservation objectives when considered by the Court in accordance with established judicial review principles.

78. Again, the first paragraph of the Board's Decision relating to the appropriate assessment is no more than its determination or conclusion that the proposed development, either individually or in combination with other plans or projects, would not adversely affect the integrity of any European site in view of the conservation objectives.

79. In the first sentence of the second paragraph, the Board again simply disagrees with the Inspector's conclusions regarding the adverse effects of the proposed development on the bird species using the conservation sites. There is no evidence of any assessment conducted by the Board which includes complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the proposed development on the Natura 2000 sites concerned, having regard to their conservation objective of supporting the wintering wild fowl and waders identified.

80. In relation to the potential hydrological/hydrogeological impacts of the construction of the proposed development on Natura 2000 wetlands systems in the vicinity of the site, and in particular, certain turloughs, the Board has not conducted

any assessment which includes complete and precise findings and conclusions capable of removing all reasonable scientific doubt as to the effect of the works proposed on the habitat of the Natura 2000 sites in the light of its conservation objectives, having regard, in particular, to the potential indirect effects and *lacunae* in the information supplied identified by its own Inspector.

Conclusion on Phase 2 Decision

81. My conclusion is that on the evidence before the Court the Board has not lawfully conducted an appropriate assessment in accordance with Article 6(3) of the Habitat Directive capable of supporting its determination. It follows, for the reasons already set out, that by reason of its failure to do so, it did not have jurisdiction to grant permission for the proposed development and the applicant is entitled to an order of *certiorari* of the Phase 2 Decision.

82. I have also concluded that it failed to give reasons for its determination in the appropriate assessment in the Phase 2 Decision in accordance with the principles set out in this judgment.

Other Issues

83. By reason of the conclusions reached on the principal issues in dispute, it is unnecessary to consider the further issues raised by the applicant.

Relief

84. There will be orders of *certiorari* of each of the decisions of the Board set out in paragraph 1 of this judgment.

BARNADIVANE WIND FARM

Barna Wind Energy held a public information evening at the Riverside Hotel in Macroom on 12 November 2014 to announce the proposed changes to Barnadivane Wind Farm.

Proposed Development

Barna Wind Energy Ltd. intends to seek planning permission for six turbines, a permanent meteorological mast, borrow pits, access roads, electrical cabling and ancillary works at this site.

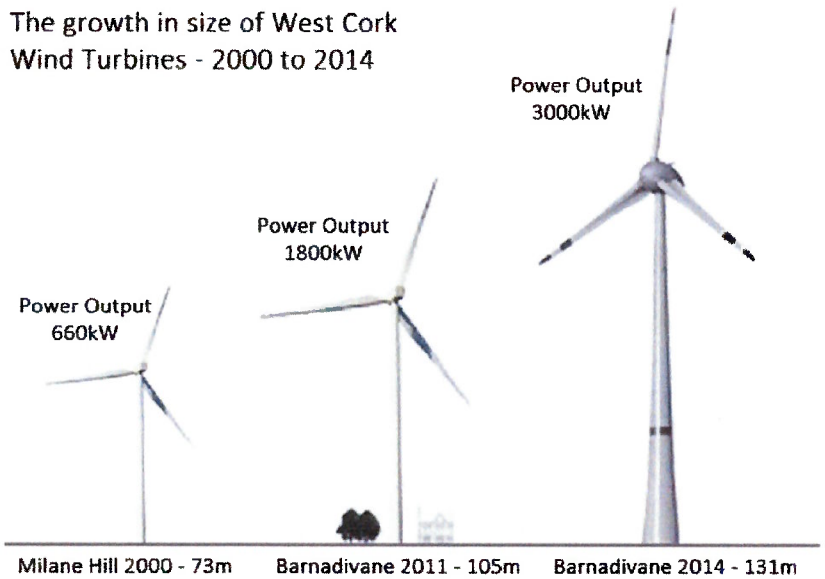
The proposed wind farm would, if consented, replace the 14 turbine development at the same site, which was granted planning by ABP in 2005 and which was granted an extension of planning by Cork County Council in 2011.

The wind farm will be capable of exporting a maximum of 18MW to the national grid. The proposed wind turbines will have a maximum tip height of 131m.

The permitted turbines have a maximum tip height of 105m, so the proposed turbines are 26m higher.

Location of Barnadivane Wind Farm

The growth in size of West Cork Wind Turbines - 2000 to 2014



Each wind turbine will be able to generate 3000kW of electrical power, or 65% more than the size of wind turbine that has existing planning consent.

The scale of the proposed turbines can be visualised by driving over to Ringaskiddy to look at the 3000kW wind turbines that have been installed there.

For further details, contact info@enercoenergy.ie

Noonan Linehan Carroll Coffey

SOLICITORS
54 North Main Street,
Cork,
Ireland
www.nlcc.ie
DX 2044 Cork

Telephone: 021 4270518
Fax: 021 4274347
jnoonan@nlcc.ie

Wind Submissions,
Planning Section,
Department of the Environment, Community and Local Government,
Custom House,
Dublin 1.

~ By Email - windsubmissions@environ.ie ~

21st February 2014
Our ref: JN/PW

Dear Sir/Madam,

Attached is our Submission to the Department's review of the 2006 Wind Energy Guidelines for your attention please.

Kindly acknowledge safe receipt.

Yours faithfully,

Joe Noonan
Joe Noonan,
NOONAN LINEHAN CARROLL COFFEY

Noonan Linehan Carroll Coffey Solicitors:
Submission on Proposed Revisions to Wind Energy Development Guidelines 2006
Targeted Review in relation to Noise, Proximity and Shadow Flicker

The proposed revisions to the wind energy development guidelines published by the Department in December are profoundly troubling.

Balance and Zoning

The Department claims (Section 5.6.1) that its approach *"seeks to achieve a balance between the protection of residential amenity of neighbouring communities in the vicinity of wind energy developments, and facilitating the meeting of national renewable energy targets."* The reality is the opposite of what is claimed. This is obvious to anyone familiar with the planning code.

The planning code is well used to balancing competing interests. The key tool used for this purpose is Zoning Policy. Incompatible uses are kept apart through appropriate zoning. Industrial activities are directed to areas zoned for industrial use. Homes are built in areas zoned for residential use. This is a sensible approach, well understood, and it works.

For reasons that have not been explained, that approach has been abandoned when it comes to industrial scale wind turbine siting policies. Instead, industrial scale wind turbines are given a unique status. In a reversal of the normal zoning policy, local authorities have been directed to identify areas which are *"strategically unsuitable"* for such wind turbines. Having done that constrained form of limitation exercise, the remainder of their functional areas is regarded as suitable in principle for this type of industrial development. This is an unprecedented departure from planning norms.

This is not a balanced approach seeking to respect the needs of competing interests. It is an approach which prioritises the interests of wind turbine developers over all others. The reasons for this lack of balance are unclear.

EU policy on protection from noise

National renewable energy policy is cited as one factor to be weighed in the balance. In reality it is being given undue weight. This is particularly inappropriate at a time when renewable energy policy at EU level is being re-examined. Also at EU level, realisation dawned over a decade ago on policymakers of the need to identify and protect people from unwanted noise for health and other reasons. Particular care is to be taken to preserve the character of certain defined quiet areas, of which Ireland is fortunate to have several. None of that is reflected in this review document however. The very first recital to the EU Environmental Noise Directive (2002/49/EC) says:

It is part of Community policy to achieve a high level of health and environmental protection, and one of the objectives to be pursued is protection against noise. In the

Green Paper on Future Noise Policy, the Commission addressed noise in the environment as one of the main environmental problems in Europe.

EPA Guidance

At national level the Environmental Protection Agency has done considerable work in devising noise guidelines for sites that require industrial pollution or waste licences from the Agency. Their 2012 guidance document on noise at licensed sites (EPA Guidance Document NG4) gives very clear guidance on how to approach the issue of noise pollution. The Agency specifically addresses the assessment and control of noise in areas having differing noise environments, including for example *'quiet areas'* as defined in the document. (These quiet areas include locations now being targeted for large scale wind turbine development).

Nothing of the Agency's measured approach to noise control in these areas is reflected in the proposed changes to the Department's guidelines. At first glance that might be thought to be reasonable, as the Agency Guidance Document only applies to licensed industrial or waste sites being policed by the EPA. That thought collapses immediately however: the noise condition now being proposed by the Department would permit far *more* noise than the EPA would regard as acceptable on certain licensed industrial or waste sites under its jurisdiction. This is because the proposed condition disregards entirely the nature of the existing noise environment in the locality in question. Quiet areas are thus to be treated no differently than noisy urban settlements or industrial sites. In the approach recommended by the Department consultants, one size fits all. The EPA sees things very differently. They require areas to be assessed by fixed parameters to see if they fall into the definition of a quiet area, or an area of low background noise. Depending on that assessment, carefully tailored noise conditions are then recommended.

The NG4 Guidance Document references one of the Agency's earlier publication *Environmental Quality Objectives – Noise in Quiet Areas* and this line from that publication is illustrative of the Agency approach:

The noise from anthropogenic sources should not be clearly audible at any point within Quiet Areas.

Quiet areas are by definition special, rare and in need of particular protection. Areas in County Kerry were recently in the news for achieving Dark Skies status. They have escaped the worst of urban light pollution and are being saluted internationally for still enjoying the advantages of having done so. Several areas in Ireland enjoy a rare and wonderful quietness particularly at night. Under the proposed guidelines all of that can be destroyed. Almost nowhere is safe from this threat. This is a revolutionary step. Yet the justification for taking it remains, at best, only vaguely expressed.

The Agency in 2011 issued a separate guidance document for limiting wind turbine noise on licensed sites: Guidance Document, NG3. Their later 2012 document NG4 reflects a more nuanced and calibrated approach, mindful of the need to treat differing areas differently. See in particular NG4 Table 1, page 20 on Recommended Noise Limit

Criteria. In a quiet area the EPA recommended noise criterion is that *"Noise from the licensed site to be at least 10dB* below *(our emphasis) the average background noise".*

The contrast with the proposed Departmental recommended noise limit could not be more stark. Instead of keeping new noise under careful control as NG4 does, the new limit would allow a quiet area to be subjected to noise levels that, by definition, would destroy its character as a quiet area. This is perverse. Other areas defined as having low background noise would also be exposed to significantly more noise at night time under the proposed condition than would be permitted by the EPA under NG4.

This cannot be described as balancing the residential amenity rights of communities in these areas with the needs of the renewable energy industry.

Mr Bowdler's submission

The noted expert Acoustician Mr Dick Bowdler in his submission to the Department of 17th January 2014 has said that what was promised as an evidence based review has provided no evidence as to how people are best protected against wind turbine noise in the context of the need for renewable energy. It has, in his view, instead resulted in draft guidelines that *"offer poor protection to people in rural areas, proposes noise limits that are higher than most other jurisdictions and fails to distinguish between major developments of national importance and small local developments."* We agree with Mr Bowdler's views in that regard. We hold a somewhat different view to Mr Bowdler on separation distances for reasons which we turn to next.

Separation distance

The proposed guidelines would remove the existing recommendation of a minimum 500m distance between large wind turbines and residential properties. The justification offered is that distance alone is not the sole predictor of nuisance from noise. That is certainly true. However this is not a reason to abandon the minimum separation distance concept. The very fact that topography plays such a role shows the need for effective separation distances.

Serious and credible complaints of noise nuisance have been made by residents in homes as far as 1250m away from large turbines. These people's direct evidence has been discounted by the authors of the revised guidelines, without any stated reasons being given for doing so.

Modelling is not the answer. Modelling has not predicted the complaints that have emerged; so clearly it has serious limitations. This is not surprising given the number of complex variables, including turbine height and size, power output, operating control systems, weather, topography, vegetation, building patterns locally, not to mention cumulative effects with other turbines in an area. The combination of faith in computer modelling (invariably carried out by developers' consultants) and abandonment of any

minimum separation distance is a recipe for serious trouble. Add to that combination the noise condition recommended by Marshall Day and the results are all too predictable - more nuisance and more avoidable conflict.

If there were a robust scientifically grounded regime in place that ensured proper baseline measurements, followed by rigorous independent project assessment, with well crafted noise conditions, all backed up by well resourced and speedy enforcement capabilities, one might consider moving away from minimum separation distances for the reasons Mr Bowdler mentions. Unfortunately at present in Ireland no one can credibly say that those four essential elements are in place. This is not likely to change in the near future.

Wind turbine industry representatives have claimed that only limited areas of the country would be available to them if significantly longer separation distances than 500m were recommended. That of course is not an argument with any merit if there are objective reasons for the separation distance in the first place. Developers have no right to claim precedence over people's property and family rights. However in any case, it would be open to developers to make arrangements with property owners and residents on a case by case basis if they wish to build inside a recommended distance. Both parties can strike a balance that meets their respective needs. The land is not sterilised by a policy which recites a recommended separation distance. All that happens is that the rights of those within that distance are respected and preserved rather than being disregarded.

Community impact assessment

The proposed revisions represent a missed opportunity to learn from the experience of communities around the country gained as this relatively novel large scale industrial development has taken off. Deep divisions have been created in places. Families have been disrupted. Some families have even been divided amongst themselves. This is all the more tragic for being unnecessary had good planning principles been followed. Any revision of the 2006 Guidelines should include a community impact assessment. Assessing community impact would be self-evidently within the remit of the Department of the Environment, Community and Local Government.

Huge and avoidable controversy follows inept and short-sighted planning decisions. Those bad decisions often accompany a speculative bubble. We had no shortage of them during the property bubble and we are seeing them again now.

Joe Noonan
Noonan Linehan Carroll Coffey
Solicitors
Cork.

www.nlcc.ie

PSC REF#:178200

BEFORE THE

PUBLIC SERVICE COMMISSION OF WISCONSIN

Application of Highland Wind Farm, LLC, for a Certificate of Public Convenience and Necessity To Construct a 102.5 Megawatt Wind Electric Generation Facility and Associated Electric Facilities, to be Located In the Towns of Forest and Cylon, St. Croix County, Wisconsin

Docket No. 2535-CE-100

Ex.-Clean Wisconsin-Hessler-6

Please enter the attached report titled "A Cooperative Measurement Survey and Analysis of Low Frequency and Infrasound at the Shirley Wind Farm in Brown County, Wisconsin" into the record as Ex.-Clean Wisconsin-Hessler-6.

Report Number 122412-1
Issued: December 24, 2012
Revised:

A Cooperative Measurement Survey and Analysis of Low Frequency and Infrasound at the Shirley Wind Farm in Brown County, Wisconsin

Prepared Cooperatively By:

Channel Islands Acoustics, Camarillo, CA
Principal: Dr. Bruce Walker

Hessler Associates, Inc., Haymarket, VA
Principals: George F. and David M. Hessler

Rand Acoustics, Brunswick, ME
Principal: Robert Rand

Schomer and Associates, Inc., Champaign, IL
Principal: Dr. Paul Schomer

1.0_Introduction

Clean Wisconsin is a nonprofit environmental advocacy organization that works to protect Wisconsin's air and water and to promote clean energy. As such, the organization is generally supportive of wind projects. Clean Wisconsin was retained by the Wisconsin Public Service Commission (PSC) to provide an independent review of a proposed wind farm called the Highlands Project to be located in St. Croix County, WI (WI PSC Docket 2535-CE-100). Clean Wisconsin in turn retained Hessler Associates, Inc. (HAI) to provide technical assistance.

During the course of the hearings, attorneys representing groups opposed to the Highlands project, presented witnesses that lived near or within the Shirley Wind project in Brown County, WI. The Shirley wind project is made up of eight Nordex100 wind turbines that is one of the turbine models being considered for the Highlands projects. These witnesses testified that they and their children have suffered severe adverse health effects to the point that they have abandoned their homes at Shirley. They attribute their problems to arrival of the wind turbines. David Hessler, while testifying for Clean Wisconsin, suggested a sound measurement survey be made at the Shirley project to investigate low frequency noise (LFN) and infrasound (0-20 Hz) in particular.

Partial funding was authorized by the PSC to conduct a survey at Shirley and permission for home entry was granted by the three homeowners. The proposed test plan called for the wind farm owner, Duke Energy, to cooperate fully in supplying operational data and by turning off the units for short intervals so the true ON/OFF impact of turbine emissions could be documented. Duke declined this request due to the cost burden of lost generation, and the homeowners withdrew their permission at the last moment because no invited experts on their behalf were available to attend the survey.

Clean Wisconsin, their consultants and attorneys for other groups all cooperated and persisted and the survey was rescheduled for December 4 thru 7, 2012. Four acoustical consulting firms would cooperate and jointly conduct and/or observe the survey. Channel Islands Acoustics (ChIA) has derived modest income while Hessler Associates has derived significant income from wind turbine development projects. Rand Acoustics is almost exclusively retained by opponents of wind projects. Schomer and Associates have worked about equally for both proponents and opponents of wind turbine projects. However, all of the firms are pro-wind if proper siting limits for noise are considered in the project design.

The measurement survey was conducted on schedule and this report is organized to include four Appendices A thru D where each firm submitted on their own letterhead a report summarizing their findings. Based on this body of work, a consensus is formed where possible to report or opine on the following:

- Measured LFN and infrasound documentation
- Observations of the five investigators on the perception of LFN and infrasound both outside and inside the three residences.
- Observations of the five investigators on any health effects suffered during and after the 3 to 4 day exposure.
- Recommendations for the existing Shirley project

2.0_Testing Objectives

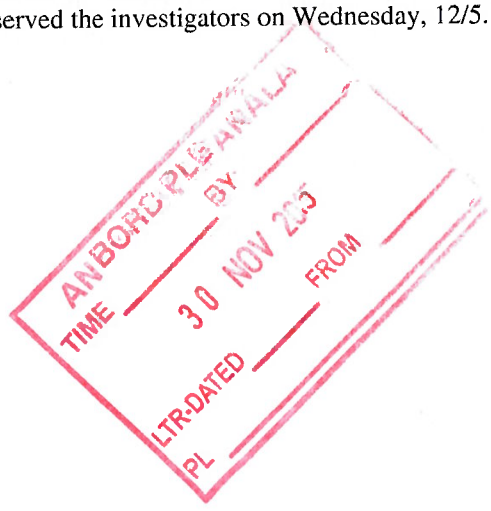
Bruce Walker employed a custom designed multi-channel data acquisition system to measure sound pressure in the time domain at a sampling rate of 24,000/second where all is collected under the same clock. The system is calibrated accurate from 0.1 Hz thru 10,000 Hz. At each residence, channels were cabled to an outside wind-speed anemometer and a microphone mounted on a ground plane covered with a 3 inch hemispherical wind screen that in turn was covered with an 18 inch diameter and 2 inch thick foam hemispherical dome (foam dome). Other channels inside each residence were in various rooms including basements, living or great rooms, office/study, kitchens and bedrooms. The objective of this set-up was to gather sufficient data for applying advanced signal processing techniques. See Appendix A for a Summary of this testing.

George and David Hessler employed four off-the-shelf type 1 precision sound level meter/frequency analyzers with a rated accuracy of +/- 1 dB from 5 Hz to 20,000 Hz. Two of the meters were used as continuous monitors to record statistical metrics for every 10 minute interval over the 3 day period. One location on property with permission was relatively close (200m) to a wind turbine but remote from the local road network to serve as an indicator of wind turbine load, ON/OFF times and a crude measure of high elevation wind speed. See the cover photo. This was to compensate for lack of Duke's cooperation. The other logging meter was employed at residence R2, the residence with the closest turbines. The other two meters were used to simultaneously measure outside and inside each residence for a late night and early morning period to assess the spectral data. See Appendix B for a Summary of this testing.

Robert Rand observed measurements and documented neighbor reports and unusual negative health effects including nausea, dizziness and headache. He used a highly accurate seismometer to detect infrasonic pressure modulations from wind turbine to residence. See Appendix C for Rob's Summary.

Paul Schomer used a frequency spectrum analyzer as an oscilloscope wired into Bruce's system to detect in real time any interesting occurrences. Paul mainly circulated around observing results and questioning and suggesting measurement points and techniques. See Appendix D for Paul's Summary.

Measurements were made at three unoccupied residences labeled R1, R2 and R3 on Figure 2.1. The figure shows only the five closest wind turbines and other measurement locations. All in all, the investigators worked very well together and there is no question or dispute whatsoever about measurement systems or technique and competencies of personnel. Of course, conclusions from the data could differ. Mr. M. Hankard, acoustical consultant for the Highland and Shirley projects, accompanied, assisted and observed the investigators on Wednesday, 12/5.



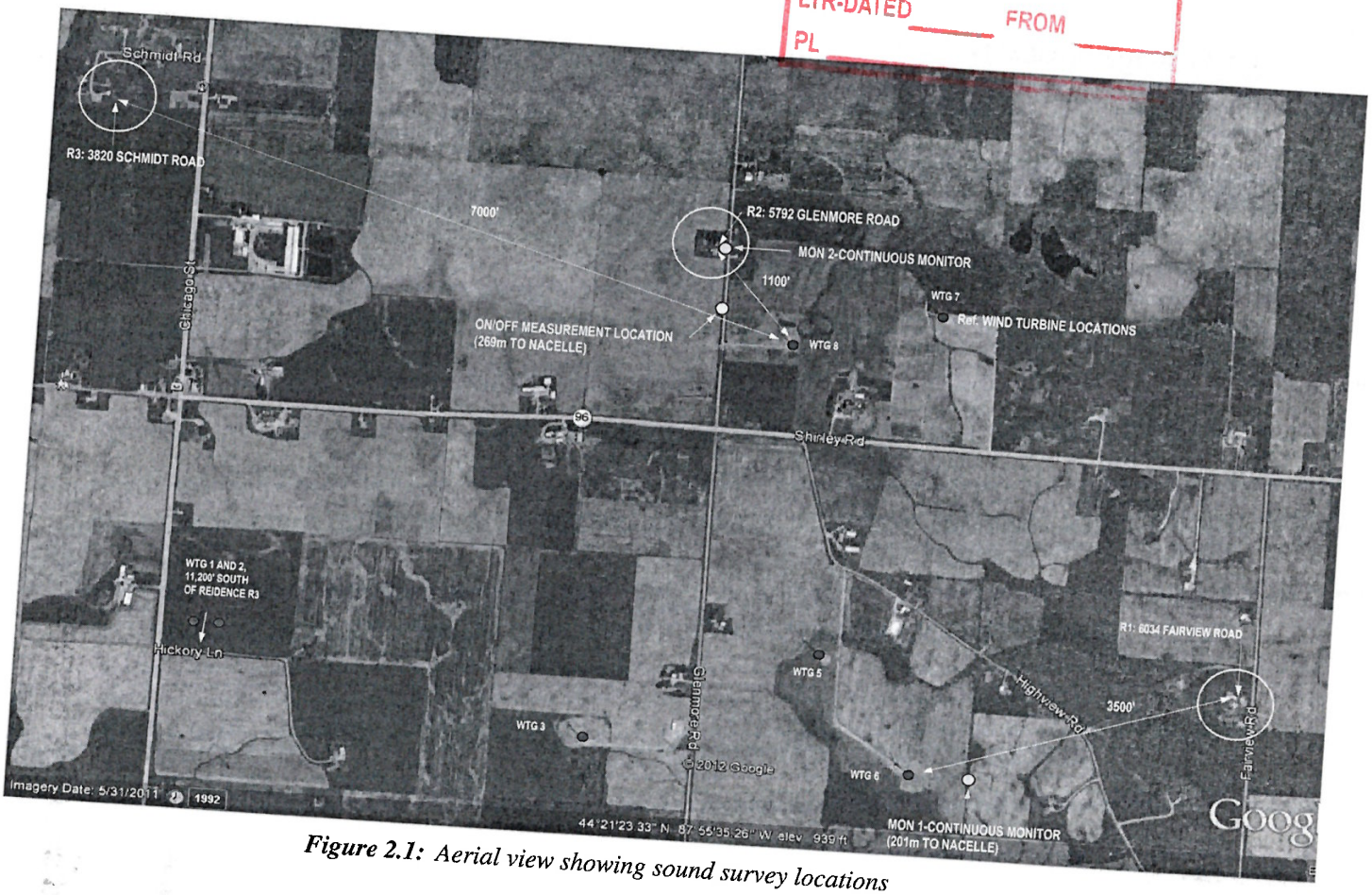


Figure 2.1: *Aerial view showing sound survey locations*

The four firms wish to thank and acknowledge the extraordinary cooperation given to us by the residence owners and various attorneys.

3.0_Investgator Observations

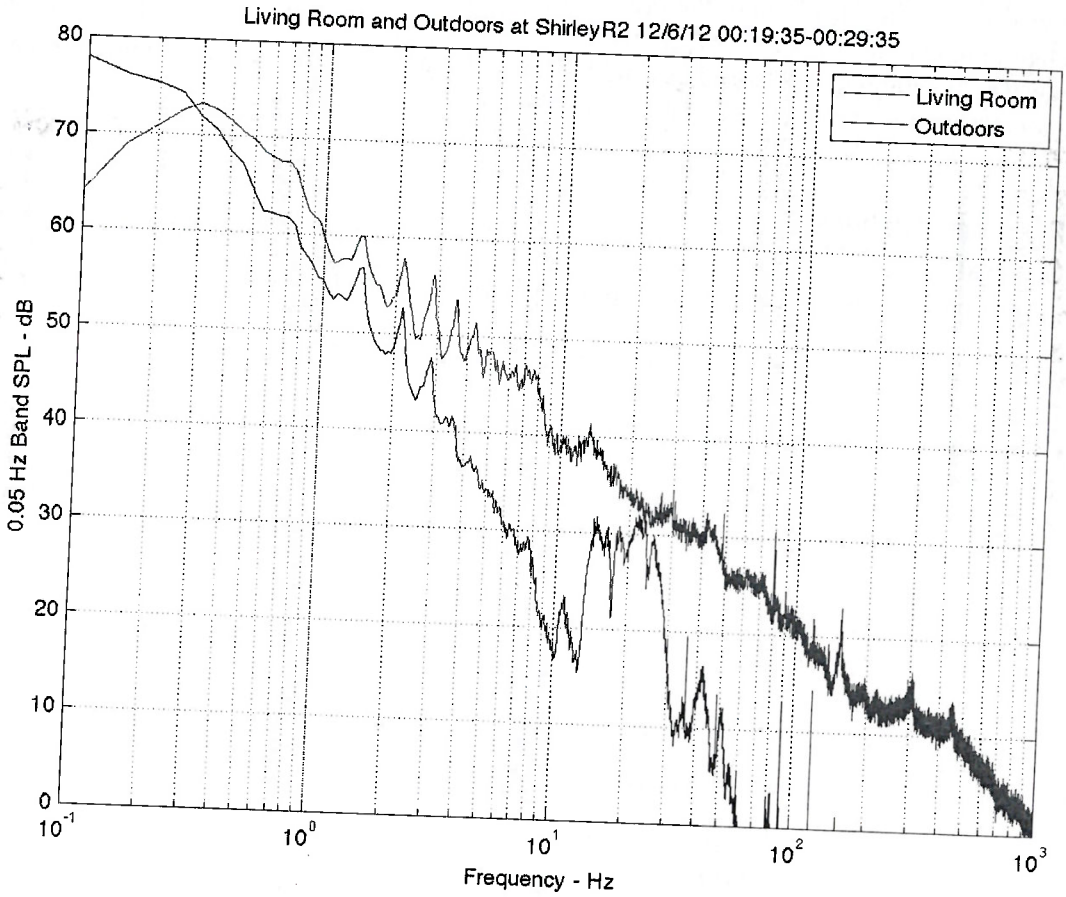
Observations from the five investigators are tabulated below: It should be noted the investigators had a relatively brief exposure compared to 24/7 occupation.

AUDIBILITY OUTSIDE RESIDENCES	*Observations*
BruceWalker	Could detect wind turbine noise at R1, easily at R2, but not at all at R3
George Hessler	Could detect wind turbine noise at R1, easily at R2, but not at all at R3
David Hessler	Could detect wind turbine noise at R1, easily at R2, but not at all at R3
Robert Rand	Could detect wind turbine noise at all residences
Paul Schomer	Not sure at R1 but could detect wind turbine noise at R2, not at all at R3
AUDIBILITY INSIDE RESIDENCES	*Observations*
BruceWalker	Could not detect wind turbine noise inside any home
George Hessler	Could not detect wind turbine noise inside any home
David Hessler	Could faintly detect wind turbine noise in residence R2
Robert Rand	Could detect wind turbine noise inside all three homes
Paul Schomer	Could not detect wind turbine noise inside any home
EXPERIENCED HEALTH EFFECTS	*Observations*
Bruce Walker	No effects during or after testing
Geoge Hessler	No effects during or after testing
David Hessler	No effects during or after testing
Robert Rand	Reported ill effects (headache and/or nausea while testing and severe effects for 3+ days after testing
PaulSchomer	No effects duringor after testing

4.0_Conclusions

This cooperative effort has made a good start in quantifying low frequency and infrasound from wind turbines.

Unequivocal measurements at the closest residence R2 are detailed herein showing that wind turbine noise is present outside and inside the residence. Any mechanical device has a unique frequency spectrum, and a wind turbine is simply a very very large fan and the blade passing frequency is easily calculated by RPM/60 x the number of blades, and for this case; 14 RPM/60 x 3 = 0.7 Hz. The next six harmonics are 1.4, 2.1, 2.8, 3.5, 4.2 & 4.9 Hz and are clearly evident on the attached graph below. Note also there is higher infrasound and LFN inside the residence in the range of 15 to 30 Hz that is attributable to the natural flexibility of typical home construction walls. This higher frequency reduces in the basement where the propagation path is through the walls plus floor construction but the tones do not reduce appreciably.



Measurements at the other residences R1 and R3 do not show this same result because the increased distance reduced periodic turbine noise closer to the background and/or turbine loads at the time of these measurements resulted in reduced acoustical emission. Future testing should be sufficiently extensive to cover overlapping turbine conditions to determine the decay rate with distance for this ultra low frequency range, or the magnitude of measurable wind turbine noise with distance.

The critical questions are what physical effects do these low frequencies have on residents and what LFN limits, if any, should be imposed on wind turbine projects. The reported response at residence R2 by the wife and their child was extremely adverse while the husband suffered no ill effects whatsoever, illustrating the complexity of the issue. The family moved far away for a solution.

A most interesting study in 1986 by the Navy reveals that physical vibration of pilots in flight simulators induced motion sickness when the vibration frequency was in the range of 0.05 to 0.9 Hz with the maximum (worst) effect being at about 0.2 Hz, not too far from the blade passing frequency of future large wind turbines. If one makes the leap from physical vibration of the body to physical vibration of the media the body is in, it suggests adverse response to wind turbines is an acceleration or vibration problem in the very low frequency region.

The four investigating firms are of the opinion that enough evidence and hypotheses have been given herein to classify LFN and infrasound as a serious issue, possibly affecting the future of the industry. It should be addressed beyond the present practice of showing that wind turbine levels are magnitudes below the threshold of hearing at low frequencies.

5.0_Recommendations

5.1_General

We recommend additional study on an urgent priority basis, specifically:

- A comprehensive literature search far beyond the search performed here under time constraints.
- A retest at Shirley to determine the decay rate of ultra low frequency wind turbine sound with distance with a more portable system for measuring nearly simultaneously at the three homes and at other locations.
- A Threshold of Perception test with participating and non-participating Shirley residents.

5.2_For the Shirley Project

The completed testing was extremely helpful and a good start to uncover the cause of any such severe adverse impact reported at this site. The issue is complex and relatively new. Such reported adverse response is sparse or non-existent in the peer-reviewed literature. At least one accepted paper at a technical conference[1] has been presented. There are also self-published reports on the internet along with much erroneous data based on outdated early wind turbine experience.

A serious literature search and review is needed and is strongly recommended. Paul Schomer, in the brief amount of time for this project analysis, has uncovered some research that *may* provide a probable cause or direction to study for the reported adverse health effects. We could be close to identifying a documented cause for the reported complaints but it involves much more serious impartial effort.

[1] Ambrose, S. E., Rand, R. W., Krogh, C. M., "Falmouth, Massachusetts wind turbine infrasound and low frequency noise measurements", Proceedings of Inter-Noise 2012, New York, NY, August 19-22.

An important finding on this survey was that the cooperation of the wind farm operator is absolutely essential. Wind turbines must be measured both ON and OFF on request to obtain data under nearly identical wind and power conditions to quantify the wind turbine impact which could not be done due to Duke Energy's lack of cooperation.

We strongly recommend additional testing at Shirley. The multi-channel simultaneous data acquisition system is normally deployed within a mini-van and can be used to measure immissions at the three residences under the identical or near identical wind and power conditions. In addition, seismic accelerometer and dedicated ear-simulating microphones can be easily accommodated. And, ON/OFF measurements require the cooperation of the operator.

Since the problem may be devoid of audible noise, we also recommend a test as described by Schomer in Appendix D to develop a "Threshold of Perception" for wind turbine emissions.

Bruce Walker

Bruce Walker

George F. Hessler Jr.

George F. Hessler Jr.

David M. Hessler

David M. Hessler

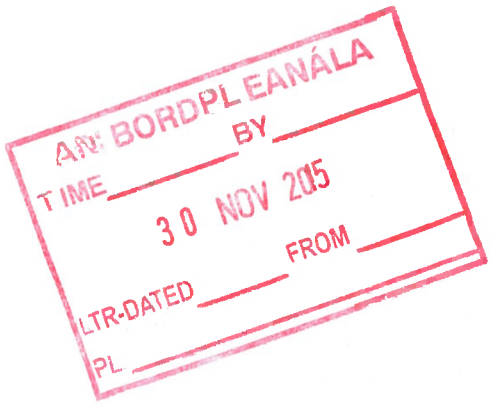
Robert Rand

Robert Rand

Paul Schomer

Paul Schomer

APPENDIX A
by
CHANNEL ISLANDS ACOUSTICS



Channel Islands Acoustics
676 West Highland Drive
Camarillo, CA 93010
805-484-8000 FAX 805-482-5075
bwalker@channelislandsacoustics.com

Low Frequency Acoustic Measurements at Shirley Wind Park

Bruce Walker, Ph.D., INCE Bd. Cert.

OVERVIEW

Bruce Walker of Channel Islands Acoustics (ChIA) was requested by Hessler Associates to assist in defining low and infrasonic frequency (approximately 0.5 – 100 Hz) sounds at abandoned residences in the environs of Shirley Wind Park near DePere, WI. ChIA has been developing a measurement system that combines extended range microphones and recording equipment with mixed time domain and frequency domain signal processing in an effort to quantify sound levels and waveform properties of very low frequency periodic signals radiated by large wind turbines[i].

The Shirley Wind park consists of eight Nordex turbines with 85 meter hub height and 100 meter rotor diameter. These turbines are distributed over an approximately six square mile area in Brown County, WI as shown in Figure 1. The turbines are of similar in size to those investigated in Ref. 1.

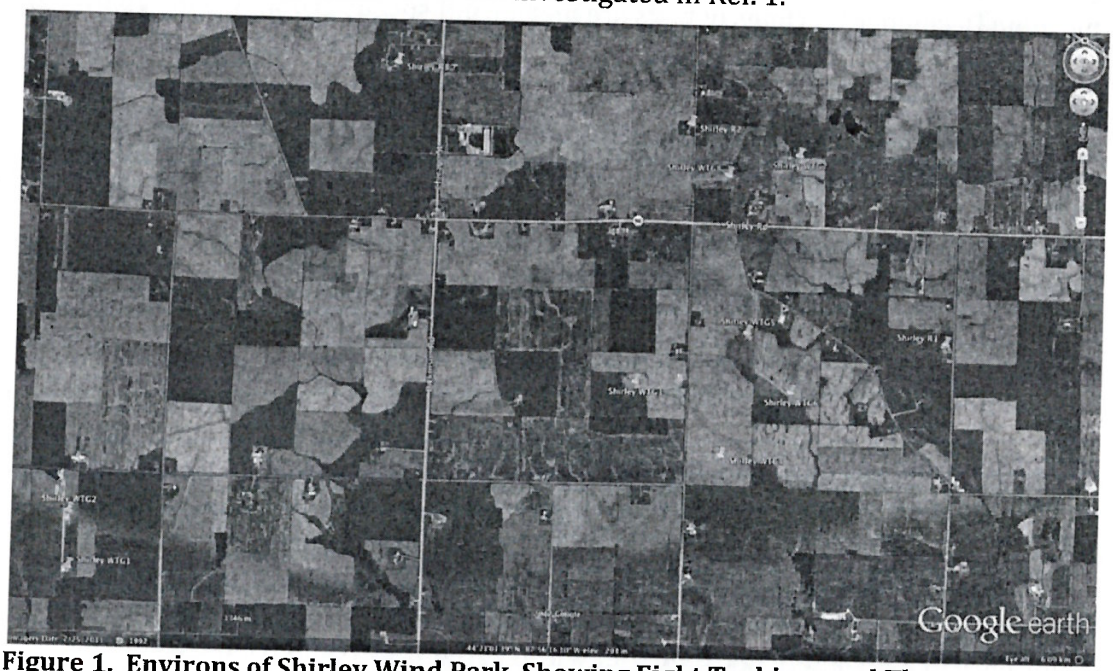


Figure 1. Environs of Shirley Wind Park, Showing Eight Turbines and Three Abandoned Residences Investigated in the Program

The tests included acoustic measurement at multiple locations inside and outside three abandoned residences, at nominal distances and bearings from the three turbines as shown in Table 1, and will be described in greater detail in a subsequent section. Test methodology and schedule were constrained to a testing period December 4-7 and inability to park the turbines to establish a reliable background noise baseline.

Table 1. Distances in feet and Bearing in degrees East of North from Turbines to Tested Residences

Receiver	R1		R2		R3	
Source	Distance	Bearing	Distance	Bearing	Distance	Beari ng
WTG1	18300	74	15400	53	12250	31
WTG2	18050	78	14800	57	11300	34
WTG3	6270	82	5290	11	8140	322
WTG4	5070	63	665 0	353	10330	3 19
WTG5	3990	93	4330	343	9020	307
WTG6	3303	72	5810	338	10470	309
WTG7	4870	141	2280	286	8360	282
WTG8	5540	127	1280	322	7110	288

ChIA measurements were conducted at residence R1 (Fairview) on the evening of December 4 and the early afternoon of December 5. Measurements were conducted at residence R2 (Glenmore) during late evening and late night December 5/early morning December 6 and mid-afternoon December 6. Measurements were conducted at residence R3 (Schmidt) during late afternoon December 6 and mid-morning December 7. Times of tests are mean wind speeds are shown in Table 3.

TERMINOLOGY

It is assumed the reader is familiar with commonly encountered acoustical terms and units such as decibel (dB), sound level, sound pressure level, sound power level, spectrum, frequency, hertz (Hz), etc. The following is a brief glossary of terms and units that lay-persons may not be familiar with, but which will be used to describe some of the data analyses in this program.

pascals (Pa) – the standard unit of pressure. The reference sound pressure is 20 microPa. Atmospheric pressure is just over 100,000 Pa. An acoustic signal of 1 Pa rms amplitude has a sound pressure level of 94 dB.

correlation function (CC(τ)) – a time-domain description of the commonality between two signals as a function of the time delay between them. The unit is Pa-squared. The correlation function for a signal and itself is the auto-correlation, and the rms amplitude of the signal is the square-root of the auto-correlation at zero delay. The correlation function between separate signals is the cross-correlation. The peak delay of the cross-correlation time the speed of propagation shows the difference in path len gth between the two signals ift heyresult from a common

source. The **correlation coefficient** is the cross-correlation function divided by the product of the square roots of the auto-correlation at zero delay.

power spectral density function (PSD) – the average of the squared-magnitude of the frequency spectrum of a time-varying signal, divided by the nominal bandwidth (BW in Hz) of the spectral analysis. The unit is Pa-squared per Hz. Narrow band sound pressure levels in this report are computed in dB as 10 log(PSD x BW) + 94.

cross-PSD – the frequency-by-frequency average of the products of the spectra from two signals.

coherence function - a frequency-domain description of the relative commonality between two signals. It is determined as the frequency-by-frequency ratio of the cross-PSD to the product of the square roots of the two PSD's. If a spectral component in two signals results from a common source, the coherence is unity (1) and if the spectral component results from two statistically independent sources, the coherence is zero.

spectrograph – a display of amplitude as color or brightness vs frequency and time.

MEASUREMENT SYSTEM and DATA ACQUISITION

A basic list of the components in the measurement system are shown in Table **2.** Serial numbers and calibration certifications are available on request.

Table 2. Basic Components of ChIA Low-Frequency Acoustic Data Acquisition System

Item	Type	Number
Portable Acoustic Analyzer	B&K 2250	2
Low Frequency Microphone	B&K 4193	6
Microphone Preamp	B&K 2639	4
Signal Conditioning Amp	B&K NEXUS 2690-OS4	1
24 Bit Simultaneous ADC	DT9826-16	1
Laptop Computer	Acer	1
Calibrator	B&K 4231	1
Anemometer	NRG Cup & Resolver	1

As deployed in this program, the 4193 microphones with low-frequency extensions, 2639 preamplifiers and NEXUS signal conditioner were placed in three or four rooms of the residences, while a fifth 4193 and a 2250 analyzer was placed in a standard 3-1/2 inch hemisphere wind ball under an 18 inch foam secondary wind screen on a ground board approximately 50 ft from the residence in the direction of wind turbines. The sixth 4193 and second 2250 were held in reserve and ultimately deployed at R3 on December 7. Full system throughput calibration was run for all channels each day and after each equipment relocation.

Measurement data was collected with simultaneous in 10-minute blocks at sampling rate 24 kHz as shown in the Test Log, Table **3.** The signal conditioning amplifiers were set for range 0.1 Hz to 10 kHz. Amplifier sensitivities were set to allow sound pressures up to 10 Pa (114 dB) to be accepted without system overload. The output of the NRG cup anemometer/resolver was recorded on a seventh channel of the

recording system. Acoustic signals, wind speed signals, set-up conditions and microphone location descriptions were stored in Matlab mat files and portions of the recorded signal were displayed for signal quality examination.

Table 3. Summary Test Log

Channel	1	2	3	4	5	6	7	Date	Start Time
Location R1	Study Desk	MBR Bedhead	Kitchen Counter	OutsideWall	Outside Ground Board	No Signal	Wind		
04T182504							2.3	12/4/12	20:25:04
04T184332							2.2	12/4/12	20:43:32
04T191533							3.2	12/4/12	21:15:33
04T192808							2.8	12/4/12	21:28:08
05T102032							1.2	12/5/12	12:20:32
05T110121							1.4	12/5/12	13:10:21
05T112110							1.5	12/5/12	13:21:10
Location R2	Living Room	Upstairs BR	Behind Kitchen	Basement	Outside Ground Board	No Signal	Wind		
05T204657								12/5/12	22:46:57
05T212420								12/5/12	23:24:20
05T213611							2.3	12/5/12	23:36:11
05T221935							3.0	12/6/12	0:19:35
05T231754							3.2	12/6/12	1:17:54
06T001413							3.3	12/6/12	2:14:13
06T120621							2.1	12/6/12	14:06:21
06T122547							1.7	12/6/12	14:25:47
Location R3	Family Room	Upstairs BR	Living Room	Basement	Outside Ground Board	No Signal	Wind		
06T135713							2.8	12/6/12	15:57:13
06T142857							2.4	12/6/12	16:28:57
Location R3	Family Room	Upstairs BR	Living Room	No Signal	Outside Ground Board	Isotron 86 on K Island	Wind		
07T092024							1.1	12/7/12	11:20:24
Location R3	Family Room	Upstairs BR	No Signal	Basement	Outside Ground Board	Living Room 2250	Wind		
07T094616							0.9	12/7/12	11:46:16
07T100232							1.1	12/7/12	12:02:32

NoteBlue = Chevy SUV Fron tSeat
NoteRed = Problem Data
NoteGray = Channel Not Used

DATA ANALYSIS

For each ten-minute data block, the following computed values were obtained and stored:

1. For each data channel, the time history of the signal, phaseless band pass filtered from 0.5 to 100 Hz, the time histories of Leq100ms for A, C, Z, G and 0.5-100 Hz bandpass filtering.
2. For each data channel, the 0.1 Hz narrow band and one-third octave frequency spectra covering the range 0.5 to 1,000 Hz, and the coherence function between the outdoor microphone and each indoor microphone.
3. For each data channel, the auto-correlation function and the cross correlation function from the outdoor microphone to each indoor microphone for the delay range -10 to +10 seconds.

It was observed in the time history plots that "high intensity" regions in the indoor and outdoor microphone channels were not necessarily aligned in time, possibly indicating that indoor noise sometimes resulted from sources other than those affecting the outdoor microphone. To study this in additional detail, each 10-minute data block was analyzed i n 20-second sub-blocks for narrow-band frequency spectrum, cross-spectrum with the outdoorm crophonean dcoherence with the outdoor microphone.

Following this, the spectrum with the most distinct representation of turbine blade passage pulsation was identified. From the Blade Passage harmonic series noted for this spectrum, waveforms were synthesized assuming two sets of phase relationships. In the first, the harmonics were arranged as sine waves with zero phase. In the second, they were arranged as cosine waves with zero phase. The former produces a composite wave with maximum wavefront slope while the latter produces a composite wave with maximum peak-to-rms ratio (crest factor).

RESULTS EXAMPLES

The test produced a large compendium of testing results, which, it is hoped, can be correlated with turbine operating conditions from data yet to be received. Mean local wind speeds for all blocks are shown (meters per second) in Table 3. Illustrative examples showing disparities among the three residences are shown in the following graphs. The full set of data is available for review.

Figure 2 shows a sample of raw data collected during windy conditions at Residence R2. Note that apparently wind-driven very low frequency pressure fluctuations are well synchronized and nearly equal in amplitude at four disparate locations within the home.

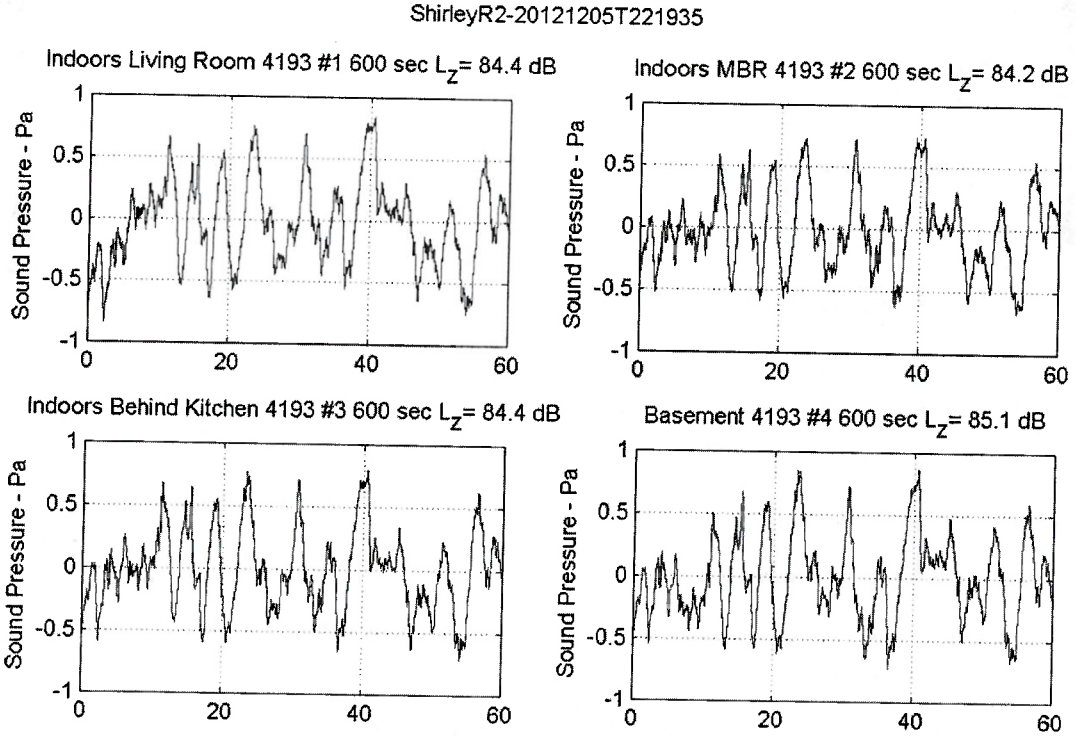


Figure 2. First Minute of Raw Data Collected at R2 On Dec 6 Starting 00:19:35. Note very low frequency fluctuations are nearly equal at four locations.

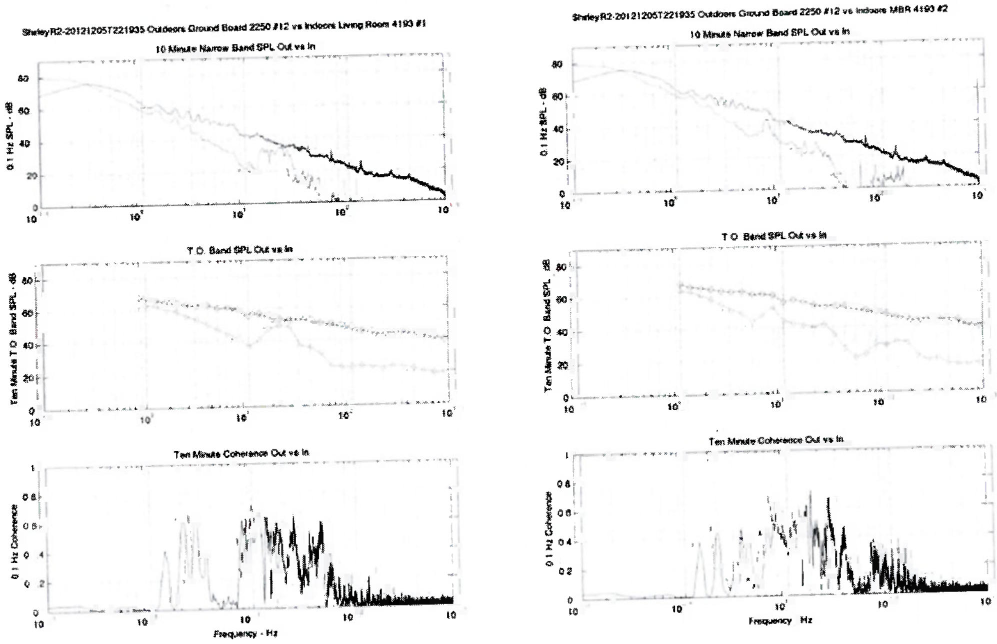


Figure 3. Low Frequency (0.1-1,000 Hz) Spectra and Coherence from Two Rooms in R2 measured 12/6/12 starting 00:19:35 showing differences in detail and well correlated low-order blade-pass harmonics. Red curve is measured outdoors between turbines and home.

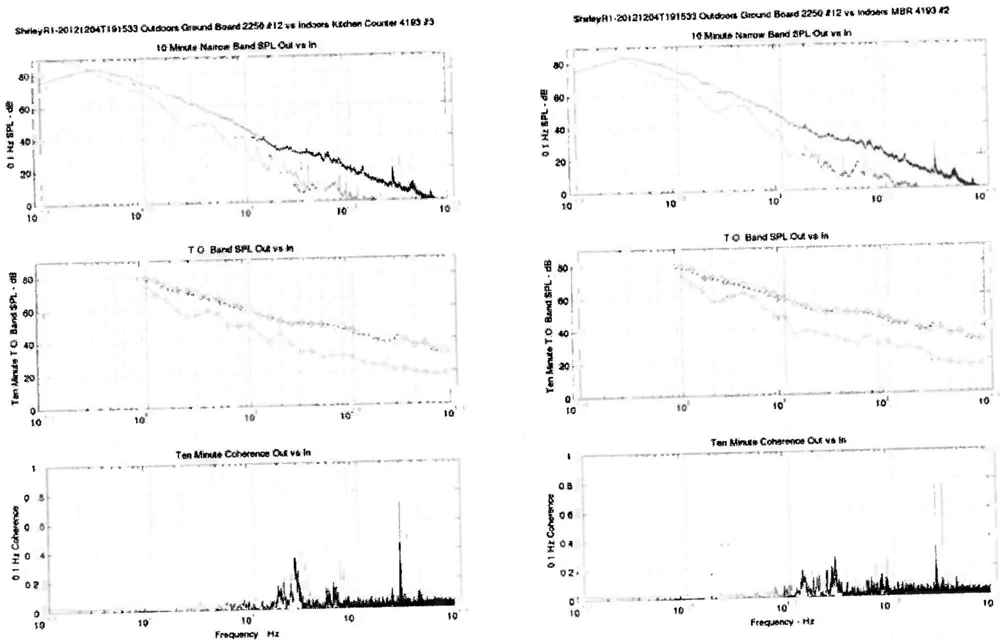


Figure 4. Low Frequency (0.1-1,000 Hz) Spectra and Coherence from Two Rooms in R1 measured 12/4/12 starting 21:15:33 showing differences in detail and poorly correlated low-order blade-pass harmonics. Red curve is measured outdoors between turbines and home.

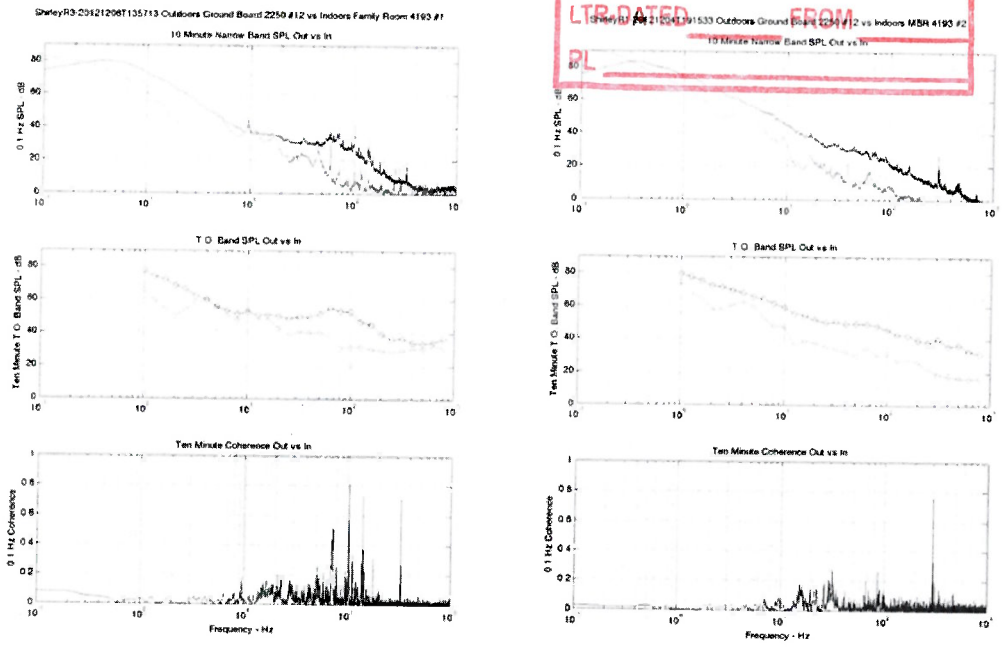


Figure 5. Low Frequency (0.1-1,000 Hz) Spectra and Coherence from Two Rooms in R3 measured 12/6/12 starting 15:57:13 showing differences in detail, poorly correlated low-order blade-pass harmonics and well correlated tones from passing vehicle exhausts. Red curve is measured outdoors between turbines and home.

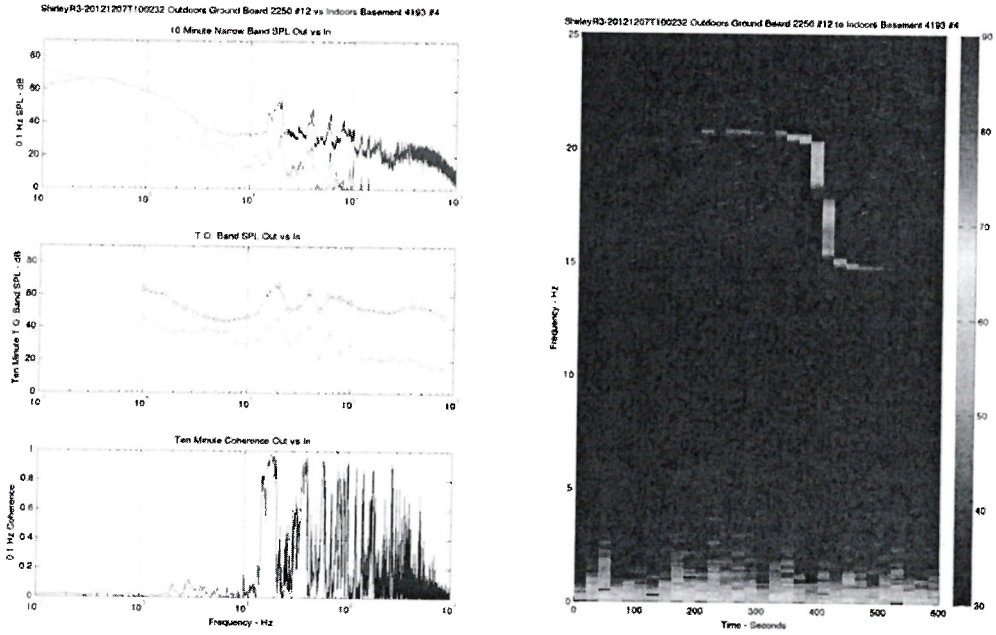


Figure 6. Low Frequency Spectra and Outdoor-Indoor Cross Spectrograph in Basement of R3 with Helicopter flyover. Note Doppler shift of rotor tone from 20.5 Hz on approach to 15 Hz receding. Also note high coherence of the helicopter rotor blade harmonics. Note very low coherence of turbine blade frequencies below 10 Hz, suggesting most of the infrasound is general atmospheric pressure fluctuation and wind force on the residence.

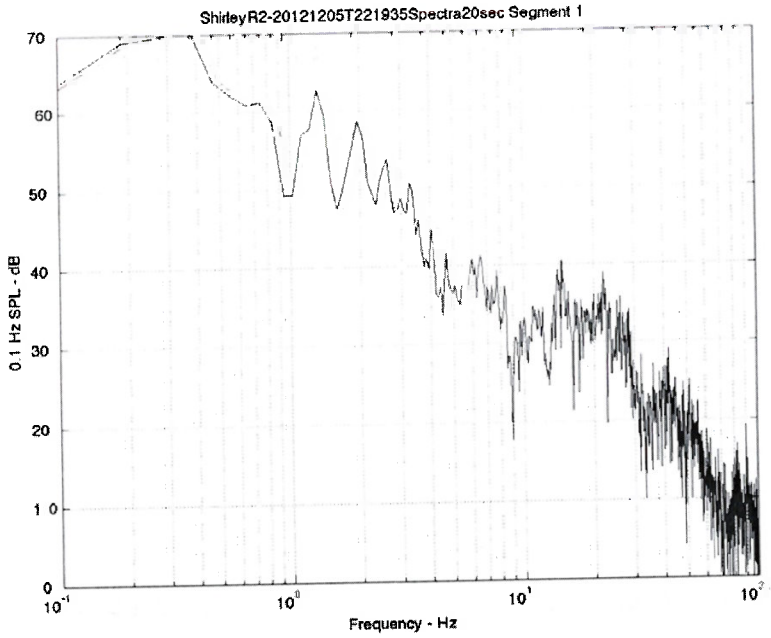


Figure 7. Short (20 sec) duration spectrum with best defined turbine blade harmonics, multiples of 0.7 Hz. Overall SPL of the Blade Pass Signal is 70 dB.

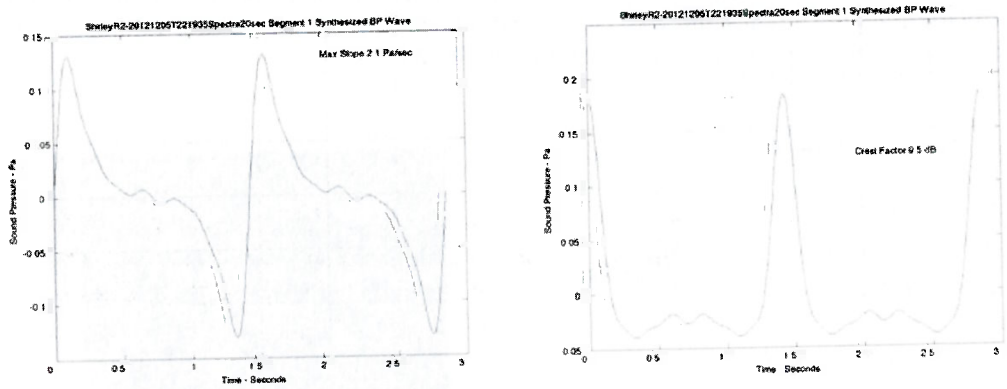


Figure 8. Turbine blade-pass waveforms synthesized from the harmonic series shown in Figure 7. Peak-to-peak SPL of the left-hand, more probable signal is about 82 dB.

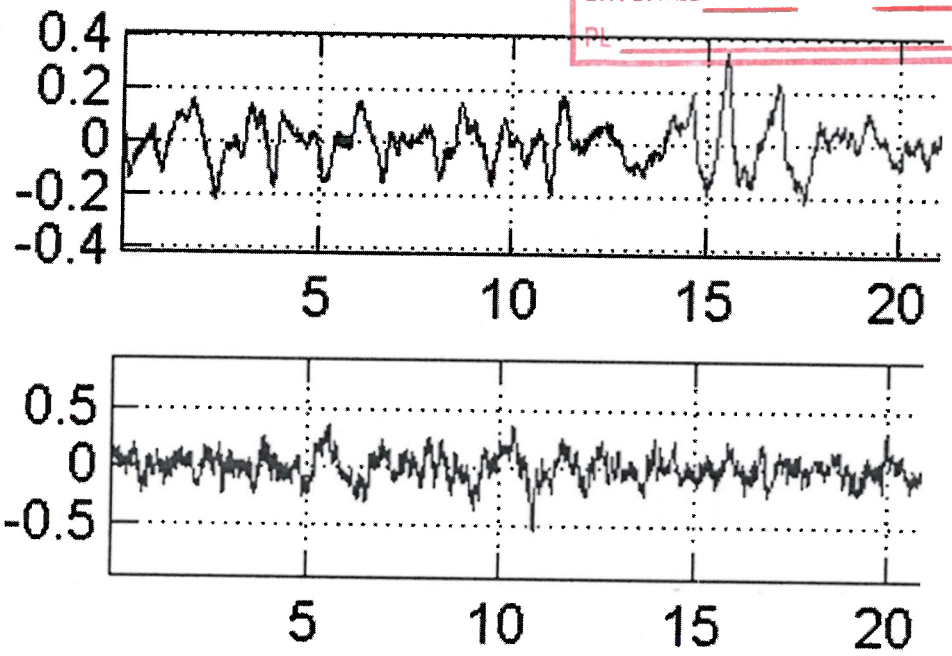
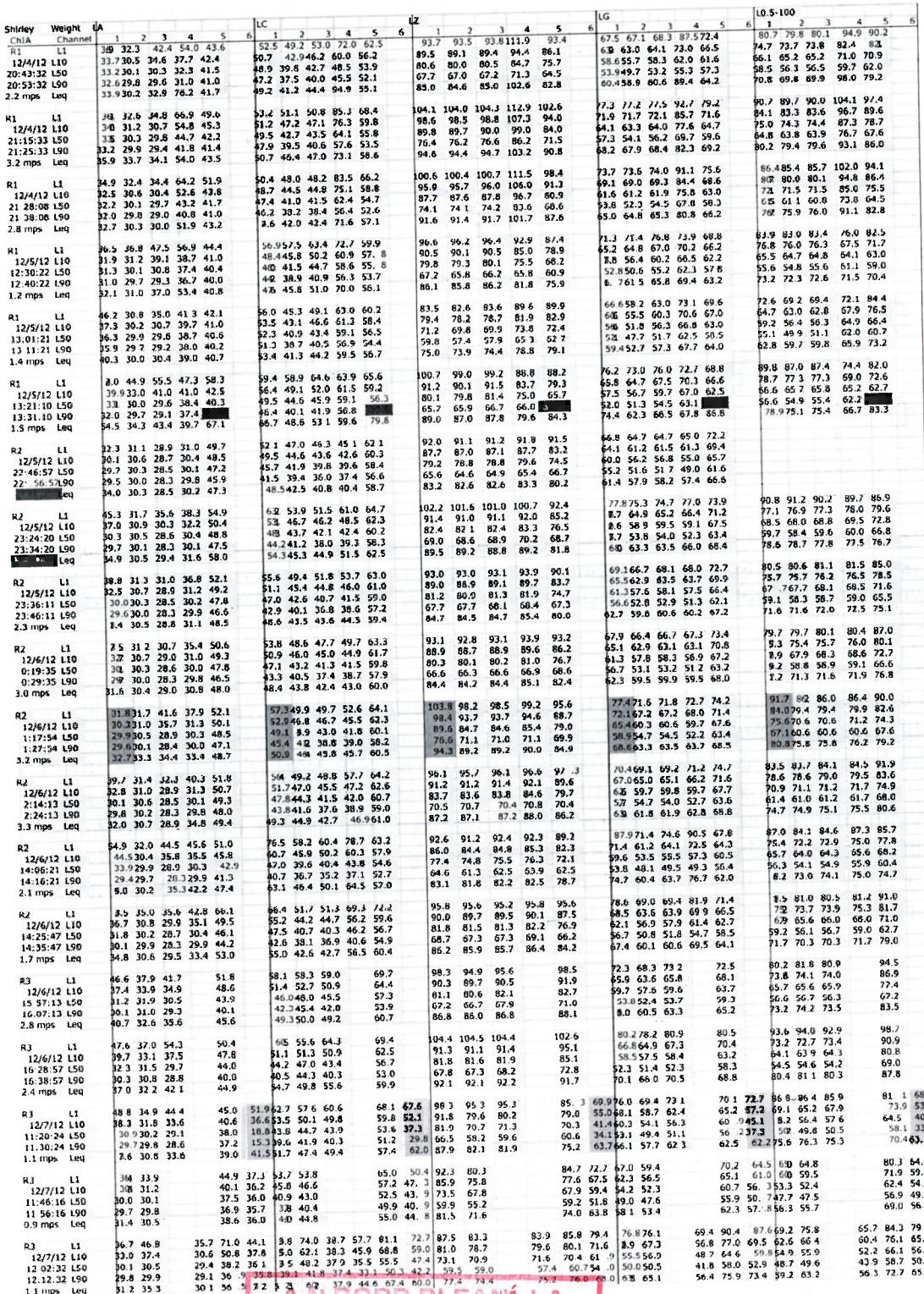


Figure 9. 0.5 Hz Phaseless High-Pass Filtered Waves Indoors (upper) and Outdoors at R2, Corresponding to Spectrum of Figure 7. Note repetitive waves indoors, similar to left-hand synthesized example. Note transient event indoors at 15.5 seconds unrelated to outside noise.

A summary of statistical sound levels for each test is shown in Table 4. Note that the high frequency noise floor of the low-frequency microphones used indoors limits the A-weighted results to 29-30 dB minimum. The cells marked in red were affected by system overload or other problems and should be discounted. The cells marked in gold are for a seismic accelerometer mounted on the Kitchen island of R3 and are not calibrated except that 94 dB is approximately 1 m/sec^2. The cells marked in teal are taken on the front seat of the Mini-SUV parked outside R2. All others are normal measurements as shown in the Log, Table 3.

Table 4. Statistical Sound Levels for All 10-minute Tests



CONCLUDING REMARKS

In an effort to determine acoustical conditions that could be linked to apparent intense reaction by some Shirley environs homeowners, simultaneous indoor and outdoor acoustic and local wind speed measurements were conducted sequentially at three disparate locations over a three-day period starting the evening of December 4, 2012. A very large compendium of raw and processed data was obtained, a small fraction of which is presented in this summary.

The apparent and tentative result indicates that at the second residence, located approximately 1,280 ft from the nearest turbine, blade-passage induced infrasound was correlated between outdoor and indoor locations and peak amplitudes of periodic waves composed of blade harmonics 0.7 to 5.6 Hz on the order 76 dB were detected both indoors and outdoors. Well correlated broadband low frequency noise at this nearest residence was also detected, with one-third octave band sound pressure levels approximately 50 dB in the frequency range 16-25 Hz. Both of these sounds are below normal hearing threshold; residents report being intensely affected without audibility.

At the other two residences, located approximately 3,300 and 7,100 ft from the nearest turbine, respectively, high levels of infrasound were detected indoors but the correlation with outdoor acoustic signals was not clear except at the 3,300 ft residence, where the broadband noise in the 20 Hz range was moderately correlated and produce one-third octave band level approximately 40 dB, which is well below normal hearing threshold. At the 7,100 ft residence, outdoor-to-indoor correlation was low except during motor vehicle passages or in particular a helicopter overflight. Again, residents report being intensely affected despite inaudibility and to be aware of turbine operation when the turbines are not visible.

The author is not qualified to make judgments regarding human response to normally subliminal sources of acoustic excitation. A detection test has been proposed by the consortium of investigators and put forth by Dr. Schomer. The author concurs that this is an important step in resolving a difficult issue.

An additional missing element in the program is ability to correlate acoustic test results with turbine operating conditions. Near-turbine acoustic monitors placed by HAI showed significant variability in near-field sound levels for turbines WTG6 and WTG8 over the course of the program, with an indication that turbine noise emissions may have decreased shortly before the team started and increased shortly after the team stopped measuring on some days. Review of turbine SCADA records will show turbine-height wind speeds and directions and turbine power output as well as times when turbine were parked for flicker suppression or other purposes. This will help determine the program for additional measurements and/or if scaling of measured levels would be appropriate.

---

[i] B. Walker, Time Domain Analysis of Low Frequency Wind Turbine Noise, Low Frequency Noise 2012, Stratford Upon Avon, UK

APPENDIX B
by
HESSLER ASSOCIATES, INC.

Hessler Associates, Inc.
Consultants in Engineering Acoustics
3862 Clifton Manor Place, Suite B
Haymarket, Virginia 20169 USA
Phone: 703-753-1602
Fax: 703-753-1522
Website: www.hesslernoise.com

Appendix B to Report Number 122412-1

1. Introduction

Hessler Associates concentrated on acquiring data to define the low frequency issue at the Shirley site using four Norsonics Model N-140 ANSI Type 1 precision instruments (NOR140). These systems with the standard microphone and preamp are rated at an accuracy of +/- 1 dB from 5 Hz to 20,000 Hz. Two of the systems were used as continuous data loggers and the other two for relevant attended measurements. The systems were also calibrated against the extended frequency range system brought by Channel Islands Acoustics (ChIA).

2. Calibration

Two NOR140 units were set-up in the living room of residence R2 adjacent to the high performance ChIA microphone, which is rated accurate from 0.1 Hz to 20,000 Hz. The results of a 10-minute run between the three systems, along with a photograph of the set-up, are shown below. It is clear from the test that the NOR140 off-the-shelf unit can be used with confidence down to about 2 Hz; significantly better than its 5 Hz rating.

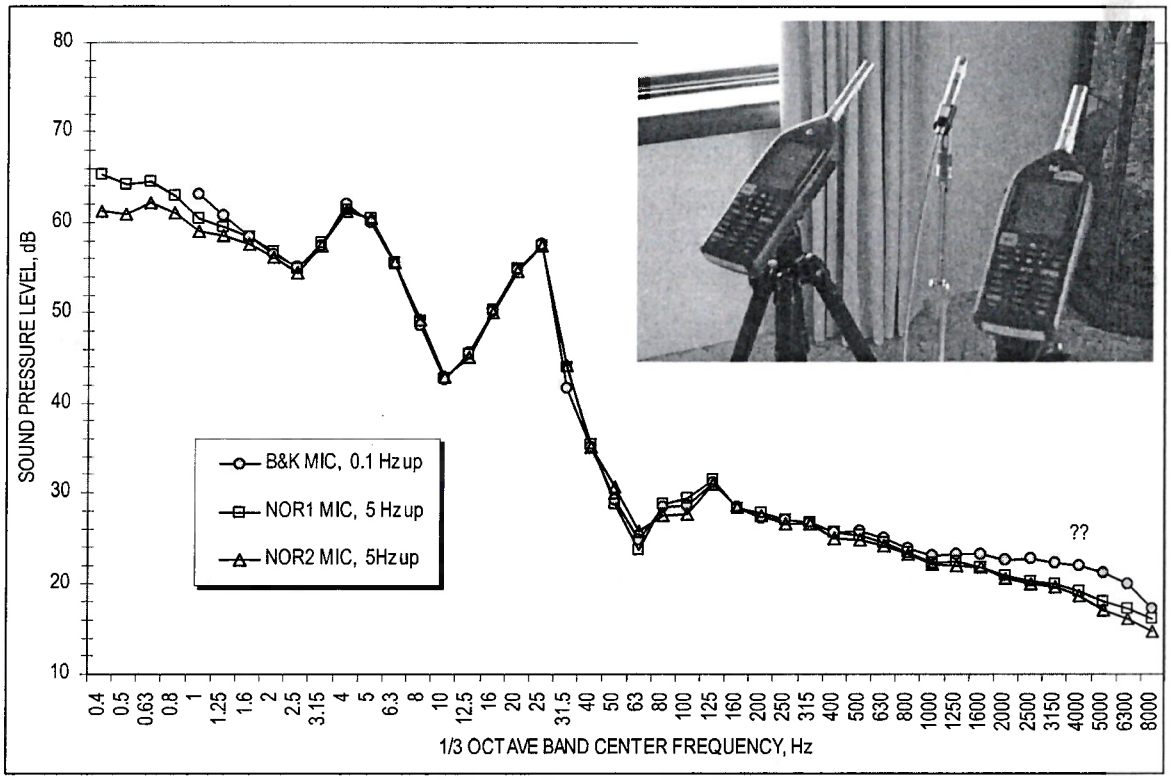


Figure 2.1 *Instrument Calibration Check Relative to High Performance ChIA System*

3. Data Logger

Because Duke Power would not participate in the test, it became necessary to install an automated sound level recorder near Turbine 6 to get a sense of what load that turbine, and presumably the remainder of the project, was operating at - and, indeed, whether the turbines were operating at all. The test position, designated as Monitor 1, is shown in Figure 2.1 in the cover report. A plot for each 10-minute interval in terms of the L50, L90 and Leq statistical metrics is given below.

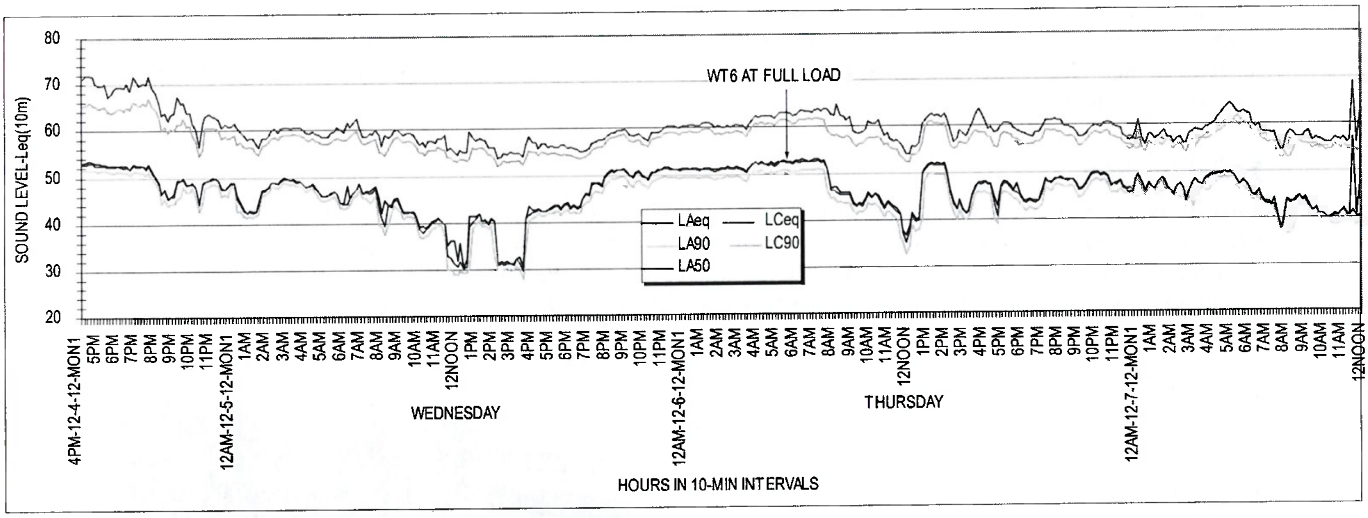


Figure 3.1 *Monitor 1 Results*

Calculations indicate that the turbine is at full power when the sound pressure at the monitor is approximately 53 dBA. In general, the plot shows when the unit was near or at full power and when it was off (e.g. around midday on Wednesday when the sound level dropped to about 31 dBA).

The second long-term logger, Monitor 2, which was located in front of the residence at R2, was not as useful because it was strongly influenced by extraneous, contaminating noise from traffic on Glenmore Road. Nevertheless, the results are given below in Figure 3.2.

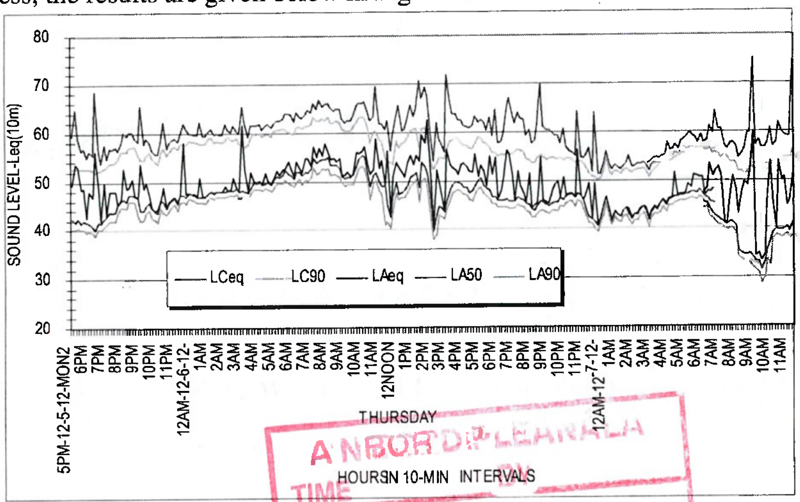
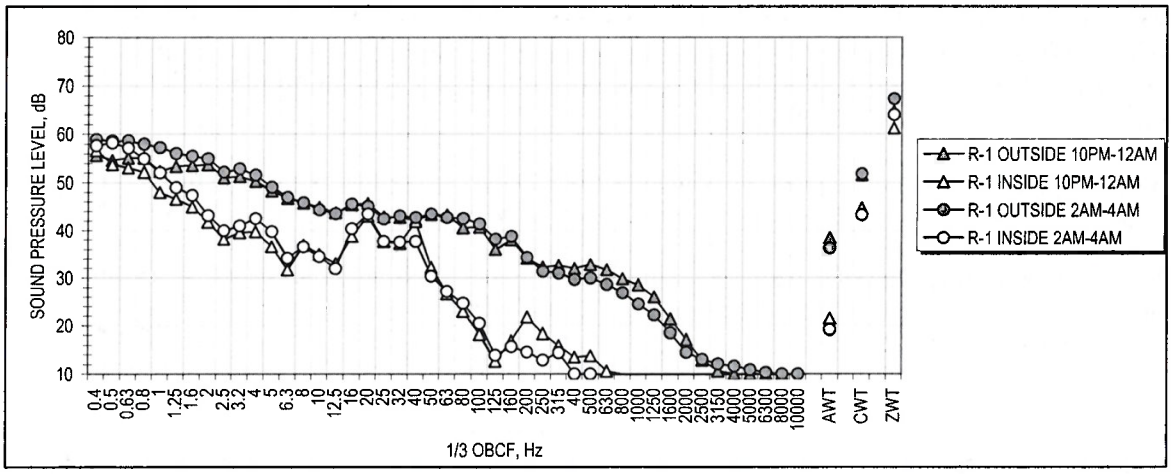
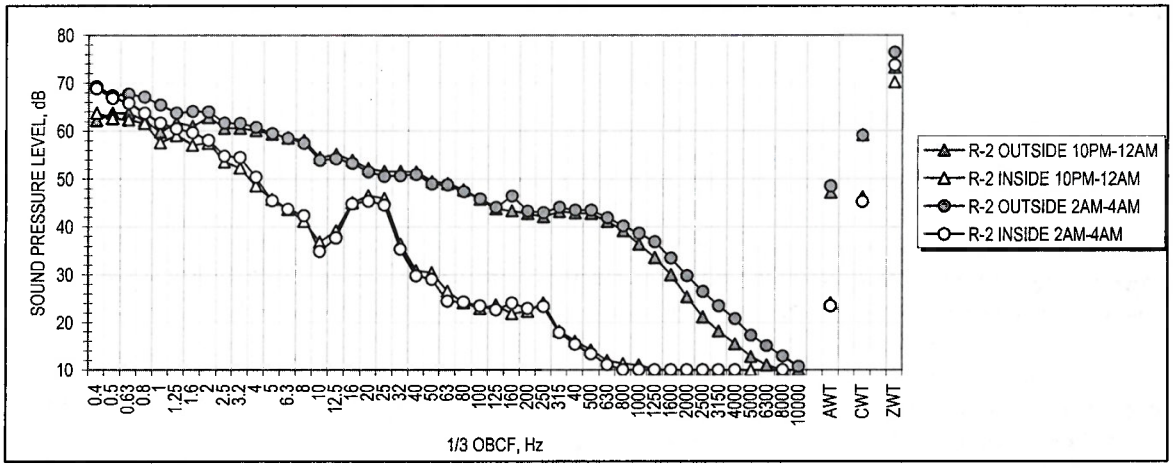


Figure 3.2 *Monitor 2 Results*

4. OUTDOOR/INDOOR Measurements

Measurements of the frequency spectra inside and outside of each of three residences on Wednesday night and early Thursday morning while the turbines were operating near full power are plotted below.





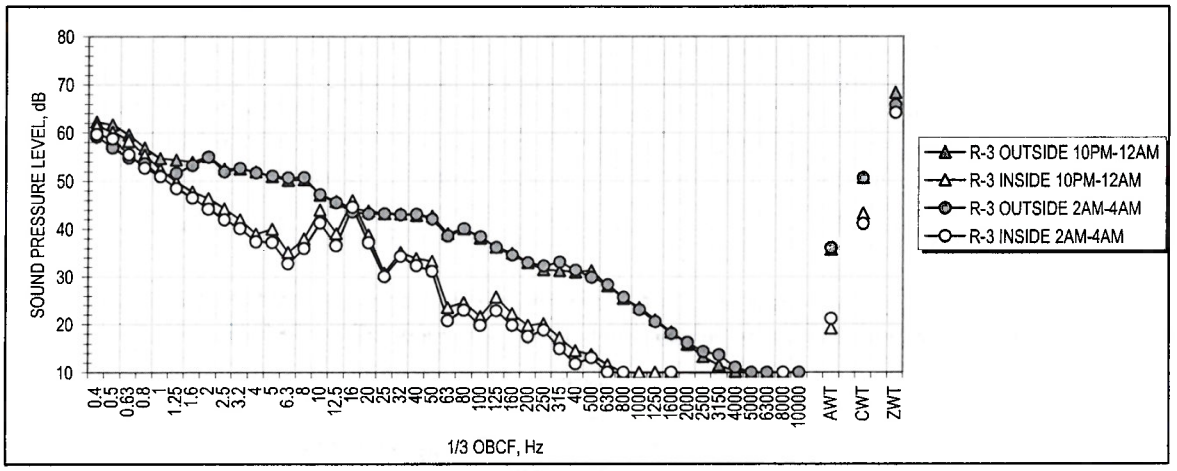


Figure 4.1 *Inside/Outside Sound Levels during Project Operation*

These figures are 10-minute L50 samples made simultaneously outside and inside of the three residences between 10 p.m. and midnight and between 2 and 4 a.m. The measured levels below 1 or 2 Hz may be pseudo noise, or false signal noise from the wind blowing over the microphone, even though the microphone was placed on a reflective ground board under a 7" hemispherical windscreen to minimize this effect. The plotted outdoor levels are the raw measurement results obtained on the reflective ground plane and should be reduced by 3 dB to reflect a standard measurement 1.5 meters above grade. Maximum levels occur at R-2 as one would expect, since it is closest to the turbines and the location where wind turbine noise was most readily audible.

What is significant about these plots is that there is a low frequency region from about 10 to 40 Hz where the noise reduction of each house structure appears to be weakest. This behavior is attributed to the frequency response of each structure, which is known to be in this frequency range. The small differences in the magnitude and frequency of the interior sound levels in this region of the spectrum are largely associated with differences in construction, design, openings, etc. The question is: what is the driving or excitation force in this range? It could be acoustic noise immissions from the wind turbines, normal environmental sources (mostly traffic), the natural response of each structure to varying wind pressure or some combination of these causes. The only sure way to discover the driving force is to turn off the wind turbines for a short period to see if the spectrum changes without the turbines in operation. This type of on/off testing was requested in the first test protocol and these rather inconclusive results make it clear that such an approach is essential to the task of identifying and quantifying the sound emissions specifically from the turbines inside of these homes.

5. ON/OFF Measurements

In the course of taking some supplemental outdoor measurements of the turbine closest to R-2 at least one on/off sample, although outdoors, was obtained through happenstance. After several measurements at a position 269 m WNW of WTG8, with the turbine in operation at some intermediate load in light winds from the north, the unit was unexpectedly shutdown by O&M personnel. Additional measurements were immediately obtained with all variables constant except for turbine operation. Prior to shutdown the rotor was turning at 11 rpm, which equates to a blade passing frequency of 0.55 Hz. The resulting on/off spectra are plotted below in Figure 5.1.

One could conclude that the wind turbine was not producing any low frequency noise since the spectra are essentially equal from 0 to 12.5 Hz; however, despite measuring on a hard surface using a hemispherical windscreen, the low end of both spectra appear to be pseudo, or false-signal noise based on some recent empirical tests of windscreen performance carried out in the Mohave Desert (in support of a new ANSI standard that is being developed for measuring in windy conditions). The objective of this testing was to evaluate measured low frequency sound levels in a moderately windy environment without any actual source of low frequency noise. The on/off measurements of WTG8 show that the levels below about 20 Hz coincide with the sound levels measured in the desert in the presence of a light 1 to 2 m/s wind. Consequently, all that can be concluded is that the low frequency emissions from the turbine were substantially lower in magnitude than the distortion effect produced from a nearly negligible amount of airflow through a 7" windscreen and across the ground-mounted microphone.

The overall reduction in audible sound of 8 dBA is attributable to eli minatingthe "whoosh" sound, which is clearly seen to occur in the higher frequencies; generally from about200 to 2000 Hz.

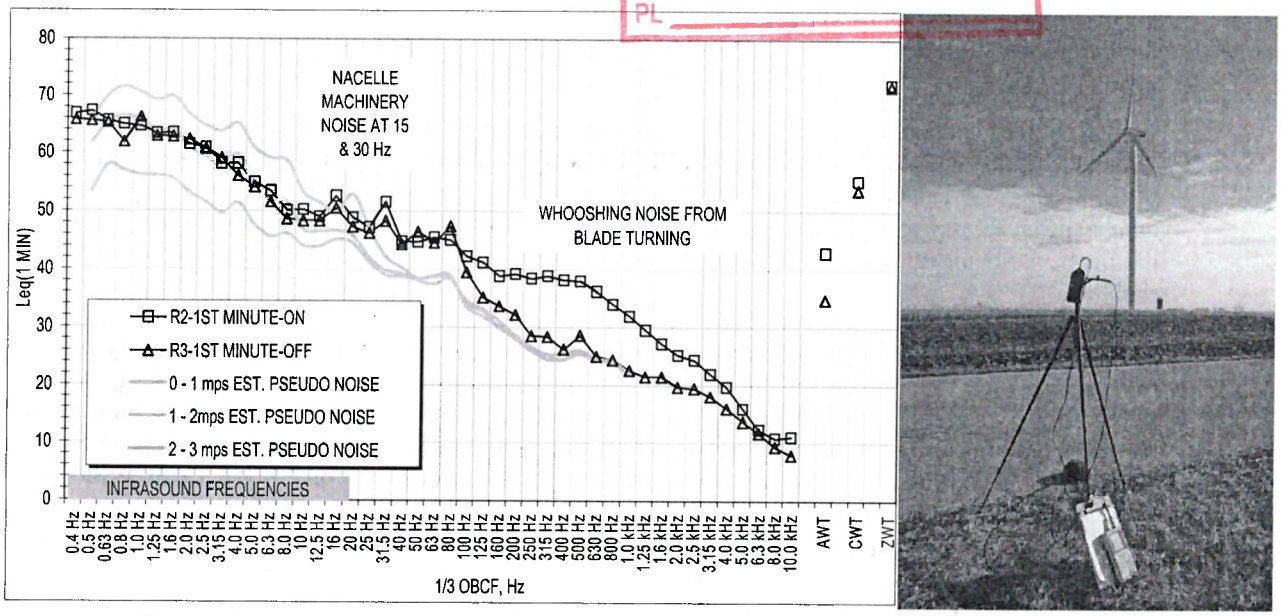


Figure 5.1 *On/Off Sound Levels Outdoors during Project Operation*

6. Proposed Method for Measuring Outdoor LFN in Wind

The experience above with on/off measurements outdoors can be combined with a finding made by Walker and Schomer that LFN inside a dwelling was quite uniform throughout all the rooms in the house, and not, as one might intuitively imagine, in the rooms facing the nearest turbine. This prompted them to measure the sound level inside of a vehicle, an SUV, and compare it to the levels measured inside the residence. It was found that the low frequency levels inside the car were similar to those inside the adjacent dwelling. Since an SUV is a closed, wind-free volume, it follows that the problem of obscuring pseudo could be eliminated with such measurements and accurate narrow band measurement of extreme low frequency sound could be measured inside of a car. The spectrum for a wind turbine shows up as a distinct pattern of peaks beginning at the blade passing frequency (about .5 to 1 Hz for modern wind turbines) with several following harmonic peaks that positively identify wind turbine low-frequency infrasound immissions. The beauty of the system sketched below in Figure 6.1 is that it is mobile and can be used at any public assess near or far from a wind farm.

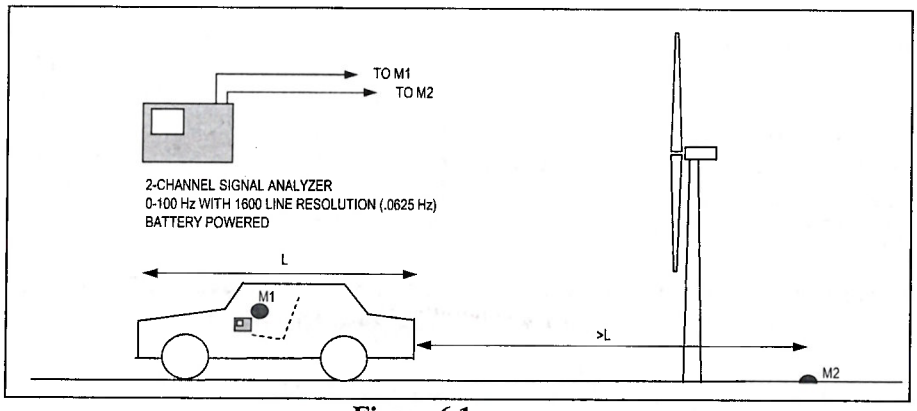


Figure 6.1
Schematic of Alternative, Mobile Measurement Technique for Low Frequency Sound Emissions from Wind Turbines

7. Conclusions

Walker showed unequivocally that low level infrasonic sound emissions from the wind turbines were detectable during near full load operation with specialized instrumentation inside of residence R2 as a series of peaks associated with harmonics of the blade passing frequency. The long-term response of the inhabitants at R2 has been severely adverse for the wife and child while the husband has experienced no ill effects, which illustrates the complexity of the issue. The family moved out of the area to solve the problem.

The industry response to claims of excessive low frequency noise from wind turbines has always been that the levels are so far below the threshold of hearing that they are insignificant. The figure below plots the exterior sound level measured around 2 a.m. on a night at R2 during full load operation compared to the threshold of hearing. In the region of spectrum where the blade passing frequency and its harmonics occur, from about 0.5 to 4 Hz, the levels are so extremely low, even neglecting the very real possibility that these levels are elevated due to self-generated pseudo noise, that one may deduce that these tones will never be audible. What apparently is needed is a new Threshold of Perception.

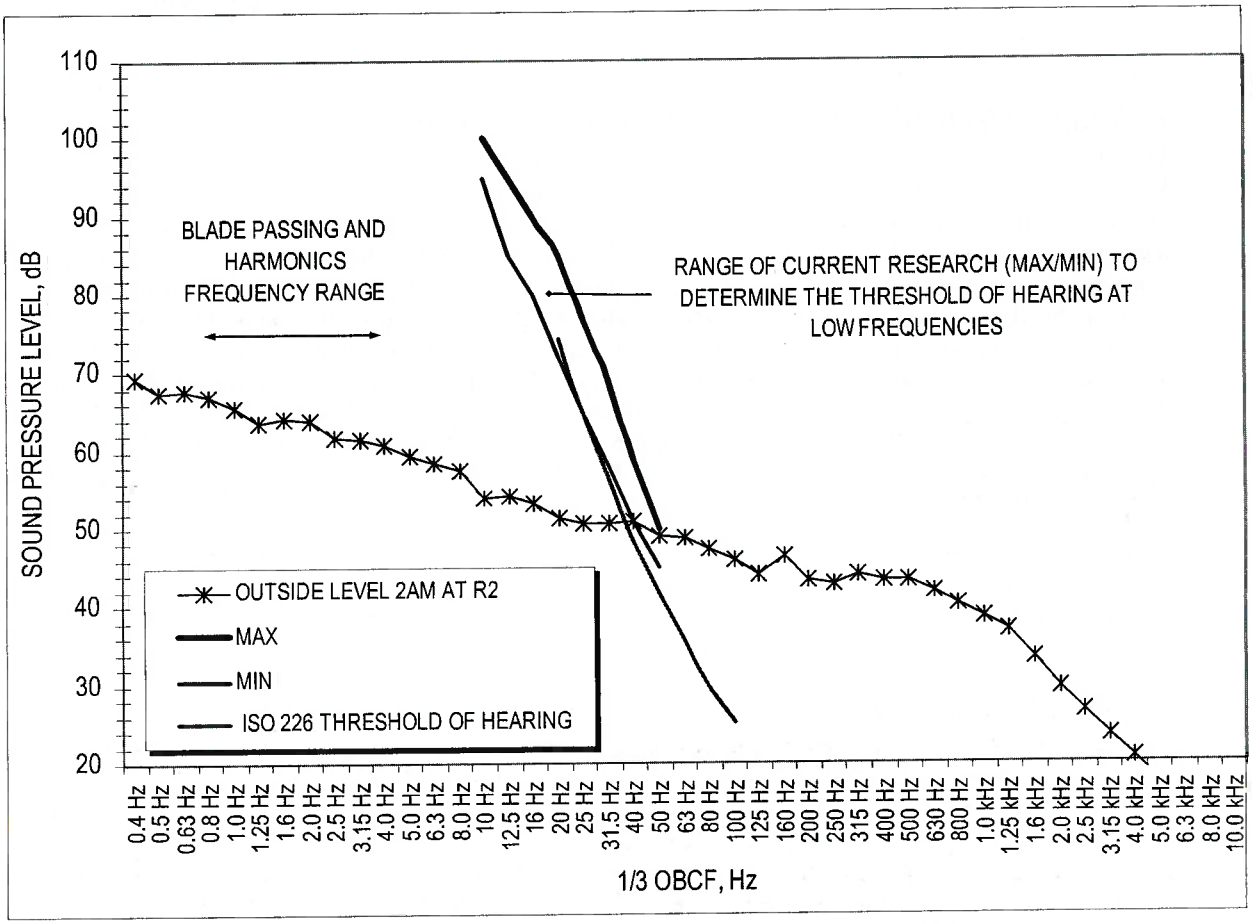


Figure 7.1 *Measured Project Sound Level Compared to Threshold of Hearing*

The study also showed that a wind turbine is indeed a unique source with ultra low frequency energy. The next figure plots the same R2 data above compared to a more commonly recognized low frequency noise source, an open cycle industrial gas turbine complex sited too close to homes. These two sources of electrical energy production, assuming the low end of the wind turbine measurement is actually due to the turbine rather than pseudo noise, have about the same A-weighted and Z-weighted overall sound levels.

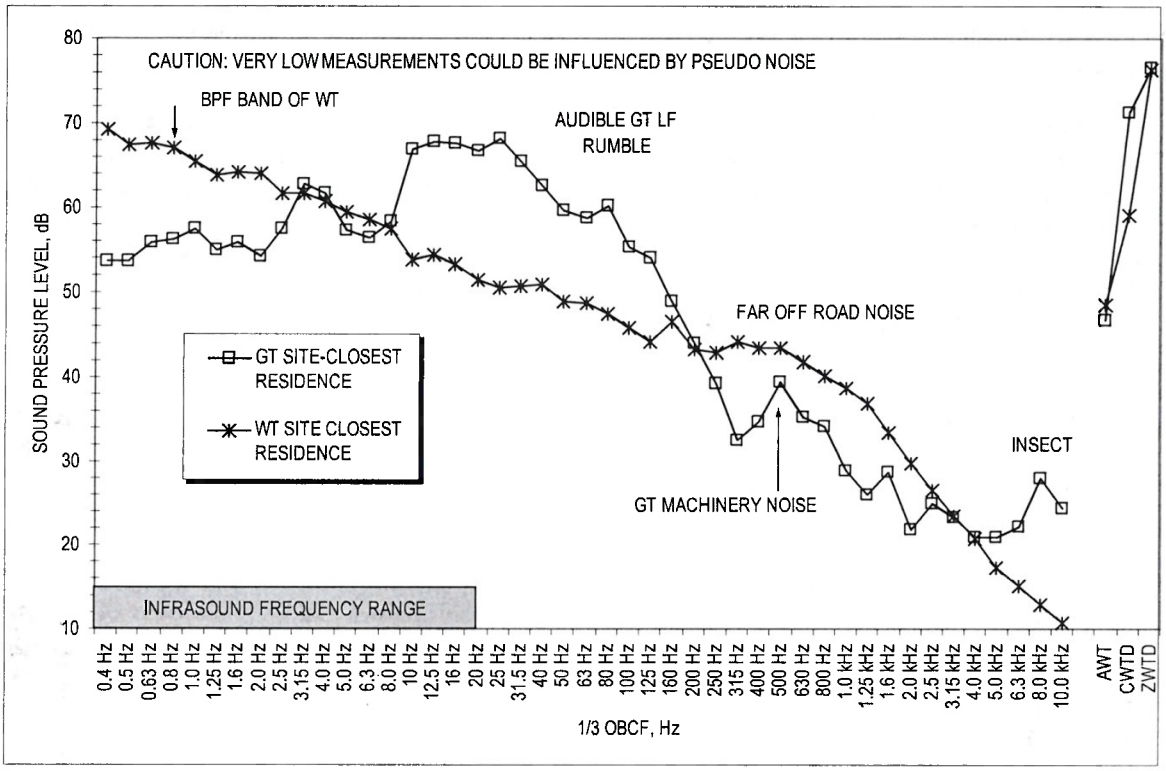


Figure 7.2 *As-Measured Wind Turbine Spectrum Compared to Gas Turbine Sound Level*

The C-weighted sound level is often used as a measure of low frequency noise; most commonly in gas turbine applications. If the C minus A level difference of a source is 15 to 20 dB, further investigation of the source is recommended by some test standards, since that apparent imbalance may be an indicator of excessive low frequency content in the sound. In this instance, the C-A level difference for the wind turbine is only 11 dB compared to 25 dB for the gas turbine, so this metric does not appear to work for wind turbines.

Schomer and Rand contend that the illness that is being reported may be a form of motion sickness associated with the body experiencing motion in approximately the same frequency range as wind turbine blade passing infrasound. However, this conjecture is based on a Navy study in which subjects were physically vibrated in flight simulators at amplitudes that may or may not be comparable to the situation at hand, whereas any such force from a distant wind turbine would need to be conducted through the air. One must make the leap that motion of the body in still air is the same as being still in air containing some level of infrasound. While potentially plausible this hypothesis needs to be verified.

Hessler and Walker have measured overall A-weighted sound levels and levels of infrasound at numerous wind farms that substantially exceed those measured here and to the best of their knowledge there are no reported adverse effects for noise or adverse health issues. It would be informative, in any further study, to survey the reactions of project participants and possibly other neighbors close to turbines, particularly with regard to health effects.

In general, enough was learned by these investigators, all with quite different past experiences, that it can be mutually agreed that infrasound from wind turbines is an important issue that needs to be resolved in a more conclusive manner by appropriate study, as recommended in the cover report.

End of Text

APPENDIX C
by
RAND ACOUSTICS

Robert W. Rand, INCE
RAND ACOUSTICS
65 Mere Point Road
Brunswick, Maine 04011

rrand@randacoustics.com
TEL 207.632.1215
FAX 206.339.3441

December 21, 2012

Investigations of infrasonic and low-frequency noise
Shirley Wind Facility, Wisconsin, December 4-7, 2012

1.0 Introduction

This report presents information on an investigation of infrasonic and low frequency noise performed at the Shirley Wind facility in Wisconsin December 4-7, 2012. The investigation was conducted by acousticians Dr. Bruce Walker, George Hessler, Dr. Paul Schomer, and Robert Rand under a Memorandum of Agreement developed for the investigation by Clean Wisconsin and Forest Voice. Mr. Hessler was accompanied by his son David Hessler. During the investigation, unexpectedly another consultant, Mr. Michael Hankard, visited the team and entered the homes under investigation during testing.

The investigation was conducted using instrumentation provided and employed by the acousticians. Three homes were investigated that had been abandoned by the owners due to negative health effects experienced since the Shirley Wind facility had started up. The health effects were reported to make life unbearable at the homes and had affected work and school performance. It was understood that once relocated far away from the facility, the owners and families recovered their health; yet revisiting the homes and roads near the facility provoked a resurfacing of the adverse health effects. The owners had documented their experiences in affidavits prior to the investigation.

This team functioned very well together with a common goal, and found collectively a new understanding of significant very low frequency wind turbine acoustic components that correlated with operating conditions associated with an intolerable condition for neighbors.

2.0 Methodology

It was generally understood that Dr. Walker would acquire simultaneous multi-channel, wide-bandwidth, high-precision recordings for later analysis. If successful and clear of contamination, those recordings would form the primary database for the investigation. George Hessler would acquire precision sound level meter measurements to correlate with wind turbine operations and for his project requirements. Paul Schomer and Rob Rand would serve as observers and, would also analyze and acquire measurements according to their investigative needs during the test. Measurements by acousticians would be catalogued and made available for later research and analysis. These general understandings were not detailed in the MOU due primarily to time constraints for the unusual, unprecedented collaboration brought together for this investigation.

Having investigated other wind turbine fa cilities anddirectly experienced the negative health

effects reported by others living near wind turbines [1,2], Mr. Rand focused on acquiring neighbor reports on health impacts during and prior to testing and correlated those to data being acquired. The working assumption borne out by experience is that the human being is the best reporting instrument.

Correlation: When investigating community noise complaints, value can be derived from measurements and analysis primarily when they are highly correlated to neighbor reports. In simple terms: if a recording or analysis is made when the turbines are turning, and the neighbors are present and report feeling intolerable, tolerable, or not a problem, and report such details as headache, nausea, vomiting, dizziness, vertigo, or cloudy thinking, or the absence of health effects, the correlation to the neighbor reports provides very useful information for assessing the utility of those data. Without the neighbor reports, it is difficult to determine the significance of acoustic data. From details given in neighbor reports, the investigators can look for unusual or distinctive acoustic characteristics or differences to clarify what acoustical conditions correspond to the degree of health effects being reported.

Self-reports taken as valid: The team agreed prior to testing that neighbor reports would be useful. They also agreed that neighbor reports are sincere and truthful, not "claims" as often alleged by the wind industry. Neighbors considered and agreed to requests to be available during testing. Mr. Rand also agreed to note his condition during the testing, since unlike the other acousticians he is prone to seasickness and has also proved vulnerable to negative health effects when near large wind turbines.

Due to schedule constraints, Mr. Rand was unable to attend a preliminary meeting with the owners of the three homes during the midday on Tuesday, December 4. However he met with the owners during the evening of December 4 shortly after arriving, and observed and acquired owner health reports and noted his own health over the next three days.

2.1 Equipment

Equipment used by Mr. Rand included:

- Gras 40AN microphone
- Larson Davis Type 902 Preamplifier
- Larson Davis Type 824 Sound Level Meter
- M-Audio MicroTrackII 24-bit line-level audio recorder
- Bruel & Kjaer Type 4230 Acoustic Calibrator
- SoundDevices USBPre audio interface
- Infiltec Model INFRA-20 seismometer (acoustic pressure, 0.1 to 20 Hz)
- SpectraPlus 5.0 acoustic analysis software
- Amaseis helicorder datalogger software

---

1 Robert W. Rand, Stephen E. Ambrose, Carmen M. E. Krogh, "Occupational Health and Industrial Wind Turbines: A Case Study", Bulletin of Science Technology Society October 2011 vol. 31 no. 5 359-362.
2 Ambrose, S. E., Rand, R. W., Krogh, C. M., "Falmouth, Massachusetts wind turbine infrasound and low frequency noise measurements", Proceedings of Inter-Noise 2012, New York, NY, August 19-22.

2.2 Protocol

Measurements would be obtained during higher-wind conditions as possible to derive a contrast from low- or no-wind conditions at the three homes under investigation. A "control" home in a quiet location far away from the Shirley Wind facility would be measured to provide background acoustic levels and signatures with no wind turbines nearby. Walker measurements would be observed and discussed and independent analysis performed by the observers as possible during the testing. The first primary goal was to obtain clean precision audio recordings for later analysis. The second primary goal was to obtain neighbor reports and discern acoustic contrast during the field investigations for immediate reporting of significant noise components to concerned parties. Mr. Rand would remain attentive to and report his health state during the testing.

At times during the testing Mr. Rand moved to other locations independently of the Walker system because of easier instrumentation mobility and to reduce noise contamination from activity by the other investigators.

3.0 Data collected

Mr. Rand took notes on health reports during the investigations, conveyed his state to the team during the testing, and compiled notes for later analysis, provided in Table 1. Neighbors were interviewed and they assembled reports for the team's use, listed in Table 2.

Mr. Rand referred primarily to Dr. Walker's acoustic recordings and analysis during testing and analysis. He acquired recordings and infrasonic acoustic pressure data separately for backup and reference.

Weather data were obtained from Wunderground as shown in Table 3.

Note: Although requested prior to the survey and again while at the site, Mr. Hessler made a decision not to acquire acoustic data with the Walker system at a control home far away from the Shirley Wind facility, citing "too many variables."

4.0 Analysis

Analysis focused on health state and, the levels and time-varying waveforms during higher-wind conditions when neighbors reported conditions as intolerable or difficult, versus quieter conditions which neighbors reported as tolerable.

5.0 Results

Results are preliminary. Nausea was experienced and nauseogenicity is indicated.

5.1 *Neighbors report either tolerable or intolerable conditions, with little rating scale in*

between. They said if the turbines are operating, it's intolerable. Mr. Rand observed neighbors unable to stay at the homes at times even under moderate wind conditions during the testing.

5.2 *Neighbors do not always hear the turbines. The neighbors indicated there is no real difference in wind compass direction on the negative health effects.* The house could be upwind, downwind or crosswind to the turbine; no difference.

5.3 *Neighbors retreated to the basement and gained partial relief from symptoms. Tested sound levels are the same everywhere in the home except less in the basement.* Lower sound levels in the basement matches the neighbor reports to Mr. Rand to the effect that, when the turbines are operating, it's about the same level of difficulty everywhere in the house, except the basement, where they would retreat to gain partial relief, until they either left or abandoned the home to get substantial relief. The neighbors reported that they felt a need to get outside when conditions were intolerable. Their reports are supported by and correlate to the ubiquitous presence of the acoustic energy inside in all locations, except in the basement where it is slightly less. The neighbors take to the basement or if that is not sufficient to gain relief, they leave the home.

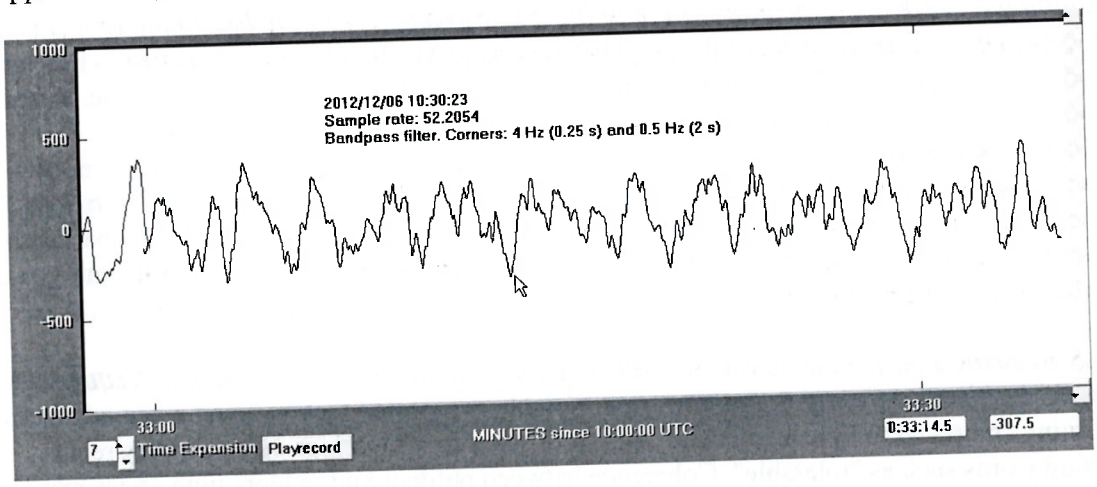
5.5 *Acoustic energy outside was strongly coupled into the home at infrasonic frequencies when turbines operating in design range.* Neighbors reported feeling worst when turbines are turning compared to light-wind conditions with some or all turbines off when they report using words such as "tolerable". Coherence between outdoor and indoors time-series was high at infrasonic frequencies below 8 Hz when wind turbines operating compared to when wind turbines off or turning slowly in light winds.

5.6 *Neighbors reported being highly annoyed by the interior sound. Elevated acoustic energy was observed inside all three homes in the range of 10 to 40 Hz.* Room, house, wall and floor acoustic modes (resonant frequencies) are found in the 10 to 40 Hz range. The Nordex N100 has in-flow turbulence noise at a peak frequency of 9 to 14 Hz depending on rotational speed, which might be involved in exciting resonant frequencies in walls and floors. More analysis and/or survey work appears needed to determine the extent of the problem. Mr. Rand was able to discern panel excitation in R3 where the owner reported feeling pressure on his ears as he moved toward the southerly wall of the sitting area in the open-area. Two wind turbines operating at a distance were faintly audible in R3 and detectable with ear to wall. Dr. Walker and Mr. Rand discussed the sensation, examined the walls, and made measurements of the home room dimensions for a future check of room modes against acoustic recordings.

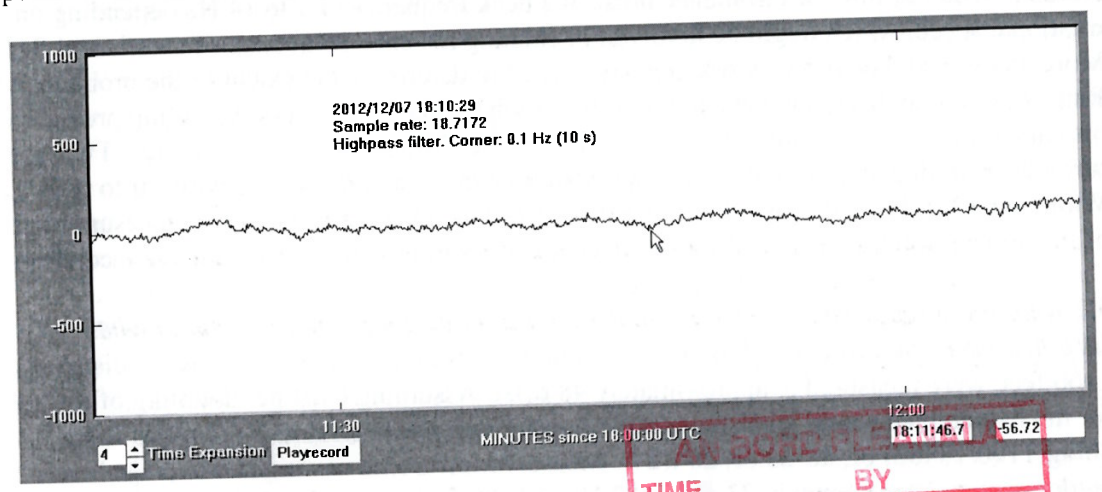
5.7 *Neighbors reported that at a distance of 3-1/2 miles, they could find relief when turbines were operating.* Outdoor average sound levels at the nearest home R2, a distance of 1100 feet, were measured at approximately 48 dBA. Assuming 6 dB per doubling of distance for the A-weighted sound level, a probable A-weighted sound level at 3-1/2 miles is 48-20log(1100/18480) or, 48-23 or, 25 dBA. Measured infrasonic unweighted average levels outdoors were approximately 73 dB at 0.3 Hz at 1100 feet. Assuming 3 dB per doubling of

distance (cylindrical spreading) [2][3] for infrasonic propagation, a probable average infrasonic level at 3-1/2 miles is 73-10log(1100/18480) or, 73-12 or, 61 dB. More work is needed to establish what infrasonic levels are consistent with relief for the neighbors.

The sample seismometer graph below shows the time varying waveform inside R2, the closest home at 121206 3:33 am with several turbines turning. Signal is filtered to pass the blade pass frequency and first four harmonics. Peak levels were 0.2 to 0.3 Pa (living room; scale shown approximately in milliPa), about 80 to 83 dB peak.



At R3 on 121207 110pm winds were light and the neighbors described the conditions as "tolerable" with no real problems. The sample seismometer graph below shows the time varying waveform for that period inside R3, the farthest home away in the testing. Peak levels were roughly 0.05 Pa (living room; scale shown approximately in milliPa), or about 50 dB peak. These results are preliminary and roughly similar to Dr. Walker's infrasonic data.



3 H. Møller and C. S. Pedersen: Low-frequency wind -turbine nóse from lar ge wind turbines.J. Aco ust.Soc. Am. 129 (6), June 2011.

5.7 *Negative health effects were experienced.* During testing Mr. Rand experienced again [4] some of the adverse health effects reported by the neighbors. In effect, Mr. Rand "peer-reviewed" the neighbors by staying in two of the homes for extended periods of time overnight to experience what they are reporting. Mr. Rand slept in R1 the night of December 4th to assess the effects on sleep, and worked at R2 much of the second night (to 5:30 am) to assess audibility and effects while awake. Wind turbine sound levels were faintly detectable with interior sound levels in the range of 18-20 dBA. Note: Although he had arrived the previous night feeling good, on awakening on December 5 Mr. Rand felt nauseous (very unusual). To summarize, Mr. Rand encountered unusual negative health effects during the testing period when near the operating wind turbines, including, at various times:

- Nausea
- Headache
- Dizziness

Symptoms persisted after the testing for about a week, relieved by rest away from the site. The other investigators do not get seasick and did not report the same negative health effects.

Implications

A nauseogenic factor is present. Naval, aviation and other research has established human sensitivity to motion producing nausea. While mechanism for motion sickness is not well understood, "theories all describe the cause of motion sickness via the same proposition: that the vestibular apparatus within the inner ear provides the brain with information about self motion that does not match the sensations of motion generated by visual or kinesthetic (proprioceptive) systems, or what is expected from previous experience". The range of motion nauseogenicity has been measured at 0.1 to 0.7 Hz and with a maximum nauseogenic potential at 0.2 Hz [5][6] (see Figure 1). The Nordex N100 has a rotational rate of 0.16 to 0.25 Hz and a nominal blade passage rate of 0.5 to 0.7 Hz (three times the rotational rate). A hypothesis is suggested based on the limited, preliminary research correlating acceleration and nauseogenicity: *Nauseogenicity is present at Shirley due to acceleration on inner ear from modulated, impulsive acoustic pressure at rotation and/or blade passage rates.*

Note: Wind turbines produce periodic acoustic pressure modulations at the rotation rate (per blade) and blade passage rate (per turbine), due to changes in wind speed and turbulence as blades are rotated top to bottom, and as they pass the tower where a pressure blow zone changes local wind speed. Pressure modulations at BPF with strong rates of change were documented by Dr. Walker (see Dr. Walkers report and the main report, conclusions).

---

4 Nausea/dizziness/headache (very unusual) experienced at three other wind turbine sites including Falmouth, MA, April 2011 (Vestas V82); Hardscrabble, NY, August, 2012 (Gamesa G90-2MW); Vader Piet, Aruba, October, 2012 (Vestas V90-3MW).
5 Samson C. Stevens and Michael G. Parsons, Effects of Motion at Sea on Crew Performance: A Survey. Marine Technology, Vol. 39, No. 1, January 2002, pp. 29–47.
6 Golding JF, Mueller AG, Gresty MA., A motion sickness maximum around the 0.2 Hz frequency range of horizontal translational oscillation. Aviat Space Environ Med. 2001 Mar;72(3):188-92.

Investigations of infrasonic and low-frequency noise
Shirley Wind Facility, Wisconsin, December 4-7, 2012

Note: Wind turbines encounter stronger winds at the top of rotation compared to the bottom. As each blade rotates through a full turn (one revolution) the blade is forced, bent, or flexed back by stronger wind load at the top of rotation and then returns to a lesser amount of bending at the bottom of rotation (the bending moment). Flexing occurs at the rotation rate. It's hypothesized that the blade displaces or disturbs a volume of air proportional to bending moment, translating motion into sound pressure at the flexing frequency, just as a loudspeaker moves air by displacement. Blade flexing may also impart a forcing function into the tower then transmitted into the ground, traveling to the house which responds, yielding two paths for acceleration on the inner ear.

Figure 2 shows rotational rates in Hz for various wind turbine models, for the total frequency span of 0.1 to 1 Hz associated with nauseogenicity. As wind turbine MW ratings have increased, the blades have become longer and less stiff with larger bending moments, and the rotational rate has decreased. The operating rpm for the Nordex N100 is 0.16 to 0.25 Hz with blade pass rates at 0.5 to 0.7 Hz.

Under the hypothesis of nausea produced by a periodic forcing acceleration on the inner ear either at rotation or blade pass rates, the Nordex N100 operates in or near the documented range of highest potential for nauseogenicity. Earlier turbine models studied for annoyance (primarily the stall- regulated models shown) have shorter, stiffer blades with smaller bending moments and do not have rotation rates near the peak potential nauseogenic frequencies. Consistent with the hypothesis, a limited review of a previous wind turbine noise study on community effects near smaller wind turbines [3] did not find nausea.

The only range of frequencies capable of creating an identical level throughout an enclosed structure are frequencies with wavelengths significantly larger than the size of the enclosed volume (the house). This points to the lower infrasonic frequency range below 10 Hz. This is consistent with the nauseogenic hypothesis for a driving force near 0.2 Hz and, the highest sound levels which were measured in the range of 0.2-0.4 Hz (see main report) with the wind turbines turning at 9 to 14 rpm (0.16 to 0.25 Hz) with blade pass rates of 0.5 to 0.7 Hz. While the highest sound levels indoors were down near 0.2 Hz, the most strongly coupled acoustic frequencies were the first several multiples of 0.7 Hz.

Shirley neighbors reported sleep interference in affidavits. Sleep deprivation magnifies the occurrence of motion sickness because it interferes with the vestibular system habituation process [4]. Further, many people suffer the misery of motion sickness without vomiting [4].

Conclusions

Nauseogenicity is a factor at Shirley. Acceleration of the inner ear is suggested due to extremely low-frequency pulsations at the rotation and blade pass rates that occur in or near the frequencies of highest potential for nauseogenicity and, are coupled strongly into the homes now abandoned. More research at Shirley is recommended to understand nauseogenicity from wind turbine operations, to properly design and site large industrial wind turbines (over 1 MW) near residential areas to prevent the severe health effects. More work is needed to establish what infrasonic levels are consistent with relief for the neighbors.

Medical research and measurement is urgently needed to be field coordinated along with infrasonic acoustic and vibration testing. The correlations to nauseogenicity at the 2.5MW power rating and size suggest worsening effects as larger, slower-rotating wind turbines are sited near people.

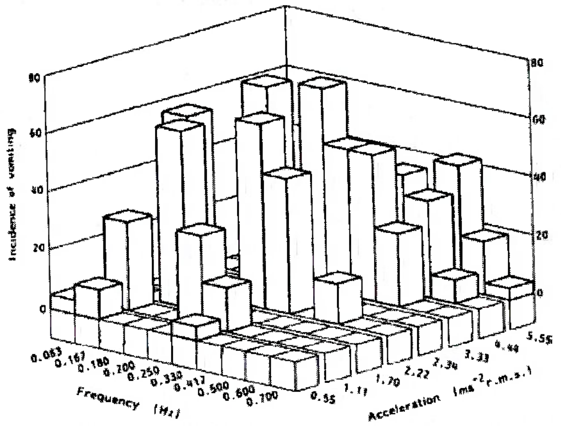


Fig. 5 Incidence of vomiting associated with exposure to various magnitudes and frequencies of vertical oscillation according to McCauley et al (1976)

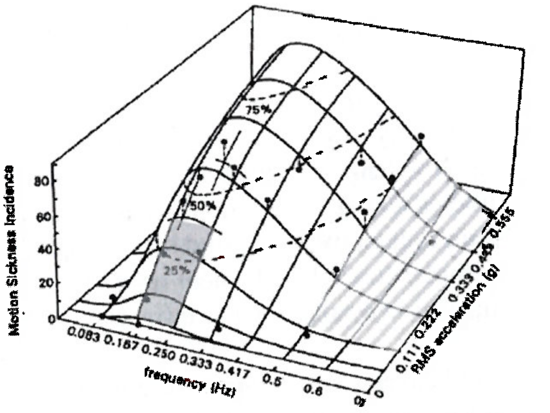


Fig. 6 The model of McCauley et al (1976), describing incidence of motion sickness with subjects inside a ship motion simulator moving sinusoidally in the vertical direction. Incidence of motion sickness was measured in terms of the percentage of subjects vomiting within 2 hours of exposure (Wertheim 1996a, Bos & Bles 2000)

Figure 1. From Stevens et al (2002) Figure 5 showing incidence of vomiting associated with vertical oscillation according to McCauley et al (1976) and modeled. Colored patches postulate association between rotational rate (solid), BPF(striped) and response at Shirley (nausea, did not vomit); acceleration level was not measured.

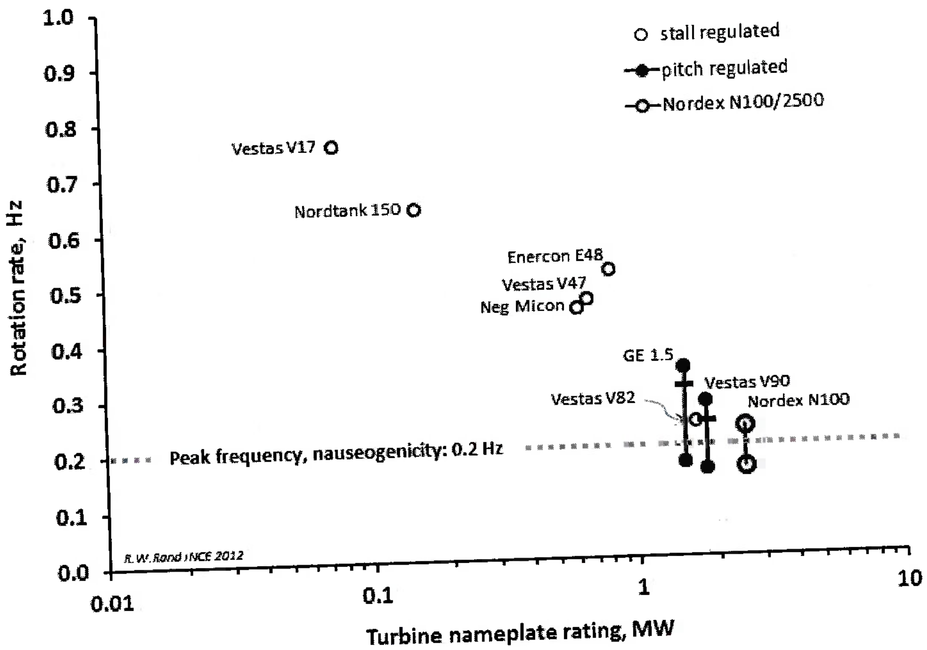
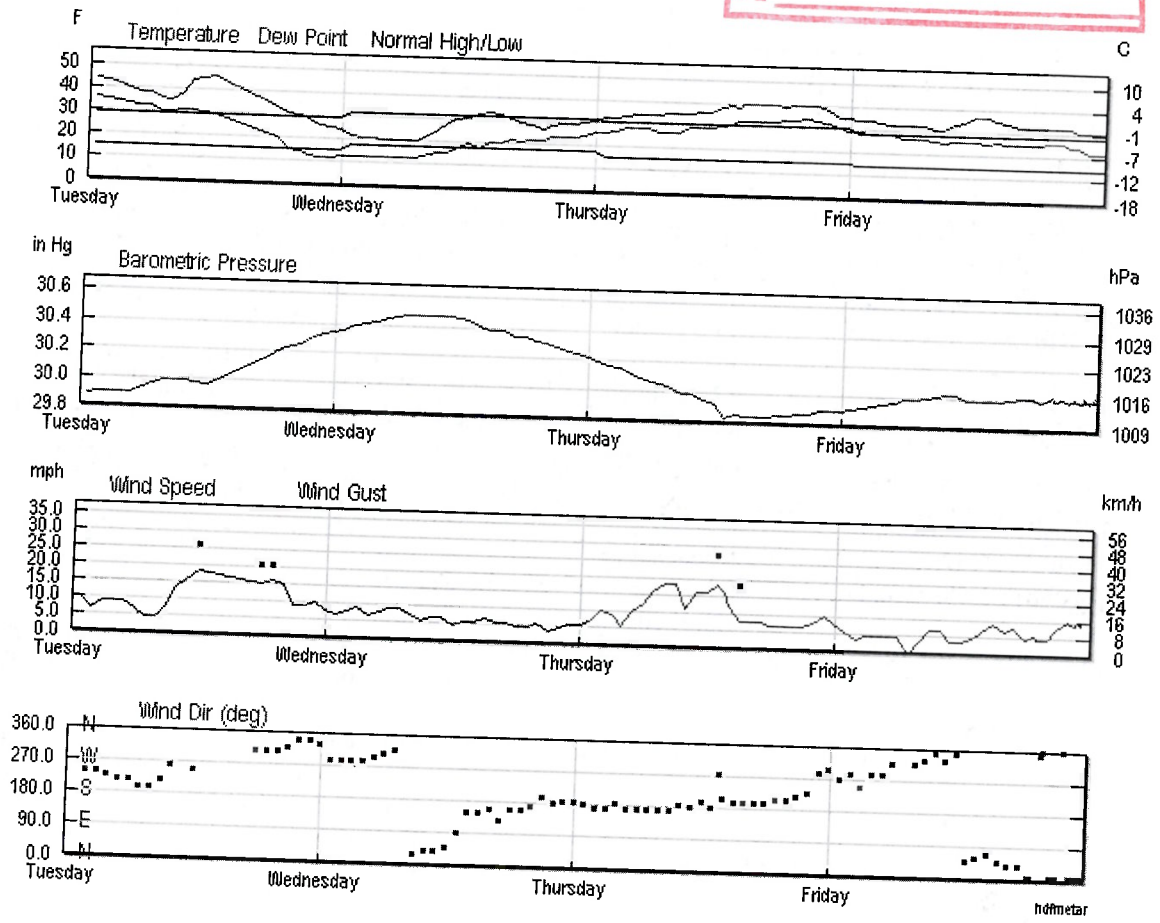


Figure 2. Chart of wind turbine rotation rates (Hz) for various wind turbine models includng the Nordex N100. Note nauseogenicity range is 0. 1to 1 Hz with peak potential noted at0.2 Hz. Note bars on GE 1.5 and Vestas V90 models i ndicate nominal rotation rate.

Figure 3. Weather conditions during investigations, December 4-7, 2012.



Weather source: KGRB Green Bay, WI. December 4-7, 2012
http://www.wunderground.com/history/airport/KGRB/2012/12/4/CustomHistory.html?dayend=7&monthend=12&yearend=2012&req_city=NA&req_state=NA&req_statename=NA&MR=1

Investigations of infrasonic and low-frequency noise
Shirley Wind Facility, Wisconsin, December 4-7, 2012

Table 1. Symptom reports logged during investigations.

Date	Time	Location	Condition	Report By
12/4/2012	before 8:15 pm	R1 - Enz	Intolerable (left the home).	Mrs. Enz
12/4/2012	after 8:15 pm	R1 - Enz	Lessened. (sound levels dropped)	Rand Schomer, Rand
12/4/2012	9:30 pm	R2 – Cappelle	Dizzy, tight chest. (No sensation)	Mrs. Cappelle (Mr. Cappelle)
12/5/2012	7 am	R1 – Enz	Slept at R1. Nauseous on awakening (very unusual).	Rand
12/5/2012	11:45 am	R1 – Enz	Feel okay. WTs stopped.	Rand
12/5/2012	12::45 pm	R3 – Ashley	Feel all right. Light winds, only 2 of 8 WTs turning	Rand
12/5/2012	8:38 pm	R2 - Cappelle	Headache, left ear full.	Rand
12/5/2012	9 pm	R1 – Enz Kitchen area	Chest pain (both parties) Left ear pain "Pain of wall echoing off head."	D. Enz, D.Ashley D. Enz D. Ashley
12/5/2012	9:10 pm	R1- Enz Kitchen area	Both ears feel blocked.	Rand
12/5/2012	9:23 pm	R1 – Enz Blue bedroom	Feeling okay. Not comfortable.	Rand D. Enz, D. Ashley
12/5/2012	10:45–11:15 pm	R2 – Cappelle	Felt ill 10:45 pm, felt better around 11:15 pm. Symptoms explained-not WTs.	P .Schomer, Bruce Walker
12/5/2012	11:45 pm	R2 – Cappelle	Feeling okay except pressure in left back of head (very unusual). Stayed listening, judging condition, and observing seismometer until 12/6/12 5:30 am.	Rand
12/6/2012	1:08 pm	R2 – Cappelle	Headache onset, intensified all day (very unusual).	Rand
12/6/2012	2:06 pm	R2 – Cappelle	Pressure in back of head (very unusual, felt only at other wind turbine sites).	Rand
12/6/2012	2:55 pm	R2 – Cappelle	Very dizzy on stairs, almost fell, had to steady with hand, pressure in back of head, strong headache (very unusual).	Rand
12/7/2012	12:02 pm	R3 – Ashley	"very tolerable"; right ear popping and cracking.	D. Ashley
12/9-15/12	after testing	Maine	Dizziness, nausea persist. Eye fatigue. PC work reduced.	Rand

Investigations of infrasonic and low-frequency noise
Shirley Wind Facility, Wisconsin, December 4-7, 2012

Table 2. Neighbor field notes.

Name:		Darren Ashley	Location:	Enz and Ashley Homes
Date	Time	What you were feeling	Wind direction	# turbines on
4-Dec	12-1 pm	Tight chest, slight starting ear pain/pressure	west	4-6
4-Dec	2:30-3:30	Ears burning, more burning as on more turbine starts up	west	4-6
4-Dec	8:45 PM	Ears burning, especially strong sensation as I approached west window in Enz house	west/northwest	6 I think
5-Dec	am	Traveled from Denmark home to Schmidt home, mild ear pain in and outside of home, and while traveling	southeast	on and off
5-Dec	3-4:30 pm	At Schmidt home, in basement, fixing furnace, mild ear pain, very anxious all day into evening.	southeast	6 of 8
5-Dec	9-9:45 pm	pain in middle of my chest at Enz house, could not sit in kitchen against north wall because of head pain/pressure, no strong sensation as I would approach window west windows	south/southeast	6 of 8
6-Dec	12-12:45 am	felt strong presence in cozy room at Schmidt house, better outside not nearly as anxious all day	south/southeast	8
6-Dec	12-12:45 am	I had a tight neck while sitting on couch at Schmidt house, waiting for test	south/southeast	8
6-Dec	11:30 AM	drove thru wind farm, no issues, no pain, no headache	south	ZERO
6-Dec	12:40-12:50 pm	Driving home from Schmidt home thru wind farm I had a splitting headache, which lessoned as got further away.	south	7
6-Dec	4:15 PM	Stood on Glenmore road, close to Shirley road, felt sicker and sicker through my body the longer I stayed	south/southwest	6?
6-Dec	4:25 PM	could feel pressure in cozy room at Schmidt house, not as strong as night before, but still detectable	Southwest	5
6-Dec	4:35 PM	While testing I stepped outside, two turbines at School rd were off, I could immediately feel pressure in my right ear as the two turbines started up, reported this to Rand. At Schmidt home	Southwest	2at School rd and 3 others

Table 2 (continued). Neighbor field notes.

				Enz and Ashley
Name:		Dave Enz	Location:	Homes
4-Dec	8:30 AM	Headache, tight chest, unstable at Enz home	west	4
4-Dec	3:00 PM	blurred vision, tight chest, head pressure at Enz Home	West	4-5
5-Dec	am	head and ear pressure, felt upstairs in Schmidt house from turbines dir	S-SE	1-3
5-Dec	9-10 pm	At Enz home, felt chest pain mostly on left side-it moved toward the center. It felt like my forehead was being pushed into my head, ear pressure, pain queasy stomach.	SE I think	8?
5-Dec	Midnight	At Schmidt house, head pain and ear pressure, both downstairs along east side of house where it was the worst, eyes blurry, upset stomach and unstable	SE	
6-Dec	1:00 AM	we stopped on Highview RD and videoed turbines, loud whooshing and thumping sounds varied a lot as the turbines meshed with each other.	SE	
6-Dec	1:45 AM	while laying in bed, my chest started to quiver, I checked my pulse, it seemed OK. It lasted a few minutes. Eyes are blurry and I am very unstable, I don't feel well yet.	In Denmark away from turbines	
6-Dec	8:00 AM	At Denmark House, away from turbines. Working on computer difficult due to blurry vision/eye strain. Still unstable and nauseated. I don't feel well, hope it will pass soon. Ears are still burning and sore. I don't think I will go among turbines today. I am not sure being a lab rat. Left eye seems out of touch with right eye.	In Denmark away from turbines	

			Location:	Enz Home
Name:		Rose Enz		
Date	Time	What you were feeling	Wind direction	# turbines on
4-Dec	8:30 AM	My ears started hurting as we retrieved some items out of the house before testing	tails to the house	
4-Dec	8:45 PM	My ears started hurting and then I started side stepping as not walking in a straight line. I had a hard time not tripping over all the wires. I sat down in my rocker chair, kitchen corner for a short time, felt sick to my head and stomach.	tails to the house	

APPENDIX D
by
SCHOMER AND ASSOCIATES, INC.

SCHOMER AND ASSOCIATES, INC.

Consultants in Acoustics and Noise Control

Paul D. Schomer, Ph. D., P.E.
Member; Board Certified
Institute of Noise Control Engineering

2117 ROBERT DRIVE
CHAMPAIGN, ILLINOIS 61821
PHONE (217) 359-6602
FAX (217) 359-3303

December 21, 2012

I) Observations from discussions with residents:

Four of the five researchers; George Hessler, David Hessler, Bruce Walker, and Paul Schomer met with affected residents of Shirley and discussed the problems they had that were precipitated by the wind turbines. This discussion produced several notable points not previously known by this researcher.

1. At most locations where these health problems occurred, the wind turbines were generally not audible. That is, these health problems are devoid of noise problems and concomitant noise annoyance issues. The wind turbines could only be heard distinctly a one of the 3 residences examined, and they could not even be heard indoors at this one residence during high wind conditions.

2. The residents could sense when the turbines turned on and off; this was independent of hearing the turbines.

3. The residents reported "bad spots" in their homes but pointed out that these locations were as likely to be "bad" because of the time they spent at those locations, as because of the "acoustic" (inaudible) environment. The residents certainly did not report large changes from one part of their residences to another.

4. The residents reported little or no change to the effects based on any directional factors. Effects were unchanged by the orientation of the rotor with respect to the house; the house could be upwind, downwind, or crosswind of the source.

5. Residents of the nearest house reported that their baby son, now 2 years old, would wake up 4 times a night screaming. This totally stopped upon their leaving the vicinity of the wind turbines, and he now sleeps 8 hours and awakens happy.

I) Implications of these observations:

1. The fact that these residents largely report wind turbines as inaudible, and the reported effects on a baby seem to rule out the illness being caused by extreme annoyance as some have suggested.

2. The lack of change with orientation of the turbine with respect to the house and the lack of change with position in the house suggest that we are dealing with very low frequencies; frequencies where the wind turbine size is a fraction of the wavelength--about 3 Hz or lower.

II) Observations from results of measurements:

1. These observations are based upon the coherence plots and coherence graphs produced by Bruce Walker. He produced both amplitude, frequency and coherence plots and 10 minute coherence charts showing only amplitude and frequency. While both show the same thing, this analysis concentrates on the latter because the former have only a 30 dB dynamic range. Figures 1 and 2 show the coherence between the outdoor ground plane microphone and 4 indoor spaces at Residence 2: the living room, the master bedroom, behind the kitchen, and in the basement. Figure 3 shows the single valid example of basement measurements at Residence 3. The data from Residence 2 are for optimum wind conditions in terms of the turbine operation. Whereas the data at Residence 3 are for low wind conditions and not necessarily indicative of what would be found were the wind turbines operating at normal power.

2. In Implications (I), it is inferred from the resident observations that the important effects result from very low frequency infrasound, about 3 Hz or lower. We can test the asse rtion withthe data collected at the three residences at Shirley. Only Resi dence 2 was tested during opt imum wind conditions, so that is the primary source of data used h erein Figur es 1 and 2 show thecoher ence

between the outdoor ground plane microphone and the four indoor spaces listed above. First, we examine Figure 1. All of the four spaces exhibit coherence at 0.7 Hz, 1.4 Hz, 2.1 Hz, 2.8 Hz and 3.5 Hz, and in this range there is no coherence indicated except for these five frequencies. The basement continues, with coherence exhibited at 4.2 Hz, 4.9 Hz. 5.6 Hz, 6.3 Hz and 7 Hz. The coherence in the basement drops low from 10-18 Hz and is more or less random and low after 18 Hz. Figure 1b shows the coherence just for the frequency range from 10 Hz to 35 Hz, and essentially this figure exhibits random patterns with no correlation from one room to the next. For example, coherence with the microphone behind the kitchen is high from 10-14 Hz and the master bedroom is high from 12-14 Hz while the other two spaces exhibit low coherence, and again the master bedroom is high 28-35 Hz with the others being low, and the living room is high from 50-58 Hz with the other spaces low; no pattern. In contrast all four spaces are lock step together in their coherence with the outdoor microphone below about 4 Hz. Figure 2, another sample from Residence 2 shows much the same pattern. In this case, 0 .7 Hz, 1.4 Hz, 2.1 Hz clearly are evident for all four spaces. For some reason 2.8 Hz is much reduced for the living room but 3.5 Hz is evident for all four spaces. In terms of the basement a number of other peaks are evident up to about 8 Hz where the basement then falls low until about 18 Hz and is random thereafter. As with Figure 1, there is no pattern to the coherence function above about 8 Hz.

3. Residence 2, and indeed all three residences, exhibit classic wall resonances in about the 10-35 Hz range which are different for each room and exposure, so it is reasonable to suppose that the randomness in the 10-35 Hz region in the above ground rooms is the result of wall resonances. The basement, which has no common wall with the outside, exhibits generally the lowest coherence in the 10-35Hz region. Thus, I conclude that the only wind turbine related data evident in the measurements at Residence 2 are the very low frequencies ranging from the blade passage frequency of 0.7 Hz to up to about 7 Hz. This conclusion is consonant with the residents' reports that the effects were similar from one space to another but a little to somewhat improved in the basement, the effects were independent of the direction of the rotor and generally not related to audible sound.

4. Figure 4 shows the coherence as functions of both time and frequency, and it is clear that the basement shows the greatest coherence below 8Hz of the four spaces and the least coherence above 8Hz. This result further supports the conclusion that it is the very low frequencies that are important.

5. Figure 3 is for Residence 3 which was 7000 feet from the nearest turbine, in contrast to Residence 2 which was only 1100 feet from the nearest turbine. Even here with much reduced amplitude there seems to be several frequencies where the four spaces have peaks together beginning at 0.8 Hz. However, unlike Residence 2, the coherence functions for all four of the space move together from about 15 Hz to 70 Hz. The sound pressure level at the outdoor microphone and at each of the four indoor spaces shows every harmonic from what appears to be the first harmonic at 20 Hz through 200 Hz. To my thinking this was clearly a loud outdoor source with a fundamental frequency of just under 20 Hz. And indeed it was. I called Bruce and he told me it was a helicopter. (I was not present the last day)

6. Figure 5 shows the sound pressure level for first minute of the 10 minutes represented by Figure 1, above. This figure, which is sensitive to the lowest frequencies shows that at these very low frequencies the sound pressure level in all four spaces is quite similar. The small changes from different positions in the house also suggests that the house is small compared to the wavelength so that the insides of the house are acting like a closed cavity with uniform pressure throughout being driven by very low-frequency infrasound.

II) Implications of the measurements:

1. The measurements support the hypothesis developed in (I)that the primary frequencies are very low, in the range of several tenths of a Hertz up to several Hertz. The coherence analysis shows that only the very low frequencies appear throughout the house and are clearly related to the blade

passage frequency of the turbine. As Figure 5 shows, the house is acting like a cavity and indeed at 5 Hz and below, where the wavelength is 200 Ft or greater, the house is small compared to the wavelength.

III) Observations from related literature:

1. We consider a 1987 paper entitled: Motion Sickness Symptoms and Postural Changes Following Flights in Motion-Based Flight Trainers .

This paper was motivated by Navy pilots becoming ill from using flight simulators. The problems encountered by the Navy pilots appear to be somewhat similar to those reported by the Shirley residents. This 1987 paper focused on whether the accelerations in a simulator might cause symptoms similar to those caused by motion sickness or seasickness. Figure 6 (Figure 1 from the reference) shows the advent of motion sickness in relation to frequency, acceleration level and duration of exposure. To develop these data, subjects were exposed to various frequencies, acceleration levels and exposure durations, and the Motion Sickness Incidence (MSI) was developed as the percentage of subjects who vomited. Figure 6 show two delineated regions. The lower region is for an MSI of 10%. The top end of this region is for an exposure duration of 30 minutes and the bottom end is for eight hours of exposure. The upper delineated region has the same duration limits but is for an MSI of 50%. The acceleration levels indicated for the SH3 Sea King Simulator show that the accelerations in the y and z direction went well into the nauseogenic region as defined by the Navy, whereas the P3-C Orion simulator had comparable accelerations in the x direction and lower accelerations in the y and z direction. Not surprisingly pilots' reports of sickness increased dramatically after exposure to the SH3 simulator while exposure to the P3 -C simulator had virtually no effect on reports of sickness.

2. What is important here is the range encompassed by the delineated regions of Figure 6. Essentially, this nauseogenic condition occurs below 1 Hz; above 1Hz it appears that accelerations of 1G would be required for the nauseogenic condition to manifest itself. While the Navy criteria are for acceleration, in Shirley we are dealing with pressures in a closed cavity, the house. Acceleration of the fluid filled semi-circular canal in the ear will manifest itself as force on the canal. The similarity between force on the canal from acceleration and pressure on the canal from being in a closed cavity suggest that the mechanisms and frequencies governing the nauseogenic region are very similar for both pressure and acceleration.

3. As the generated electric power of a wind turbine doubles the sound power doubles and the blade passage frequency decreases by about 1/3 of an octave. The wind turbines at Shirley have a blade passage frequency of about 0.7 Hz. This suggests that a wind turbine producing 1 MW would have a blade passage frequency of about 0.9 Hz, and on Figure 6, a change from 0.7 Hz to 0.9 Hz requires a doubling of the acceleration for the same level of response. Thus, it is very possible that this nauseogenic condition has not appeared frequently heretofore because older wind farms were built with smaller wind turbines. However, the 2 MW, 0.7Hz wind turbines clearly have moved well into the nauseogenic frequency range.

III) Implications from the Navy's Nauseogenic Criteria:

1. This analysis suggests that similar problems to the problems in Shirley can be expected for other wind turbines that have the same or lower fundamental frequency. The Navy criteria suggests that to maintain the same level of health-related effects as have occurred heretofore, the levels of a 2 MW,0.7 Hz wind turbine as experienced in the community must be 6 dB lower than those for 1 MW, 0.9 Hz wind turbine. Moreover, Figure 6 does not bode well for future larger wind turbines if they go even lower in frequency.

IV) Descriptors for Wind Turbine Emissions

1. Currently the wind turbine industry presents only A-weighted octave band data downto 31 Hz. They have stated that the wind turbines do not pr oduce low frequency soundenergies. The

measurements at Shirley have clearly shown that low frequency infrasound is clearly present and relevant. A-weighting is totally inadequate and inappropriate for description of this infrasound. In point of fact, the A-weighting, and also the C and Z-weightings for a Type 1 sound level meter have a lower tolerance limit of -4.5 dB in the 16 Hz one-third-octave band, a tolerance of minus infinity in the 12.5 Hz and 10 Hz one-third- octave bands, and are totally undefined below the 10 Hz one-third-octave band. Thus, the International Electro-technical Commission (IEC) standard needs to include both infrasonic measurements and a standard for the instrument by which they are measured.

V) The Tests We Should Perform

1. That the wind turbines make people sick is difficult to prove or disprove. However, the sensing of the turbines turning on or off is testable. Consider the two houses where there is no audible sound. Residents would arrive at the house with the wind turbines running for something like a 2-hour test. Sometime during the first hour, the wind turbines might or might not be turned off. If turned off, it would be the residents task to sense this "turn off" within some reasonable time--say 1 hour. Correct responses (hits) would be sensing a "turn off" when the turbines were turned off, or sensing no change if they were not turned off. Incorrect responses (misses) would be failure to sense a turn off when the turbines were turned off, or "sensing" a turn off when the turbines were not turned off. Similar tests could be done starting with the turbines initially off.

2. It would be necessary to prevent the subjects from seeing the turbines or being influenced by one another. If everyone marked a silent response on their board or into their laptop at the same time; say every 5 minutes, then no one would be able to know another person's responses. Pure chance is 50/50, so a hit rate statistically significantly greater than 50/50, and/or a miss rate statistically significantly less than 50/50 would indicate that the residents were able to sense the wind turbines without the use of sight or sound.

3. Testing would take about 3 to 5 good days; days when the wind was such that the wind turbines were operating at a substantial fraction of full power. Up to 3 tests per day could be done, with 3-4 subjects in each of the two, or possibly 3, houses. Physical measurements would be made of the before and after conditions at each house simultaneously to correlate with the sensing tests. Each subject would be tested up to 5 times. Note: Testing multiple times per day presupposing that the subjects could tolerate such a rigorous testing schedule.

4. The testing would require at least 1 researcher at each house to take the physical measurements and one researcher to supervise the sensing test with one test "proctor" per test room. It would be necessary for the proctor to help the researcher performing the physical measurements during non-test hours with activities like calibration.

5. Conduct of this test clearly requires the assistance and cooperation of Duke Energy. This test can only be done if Duke Energy turns on and off the turbines from full power, as requested and for the length of time requested.

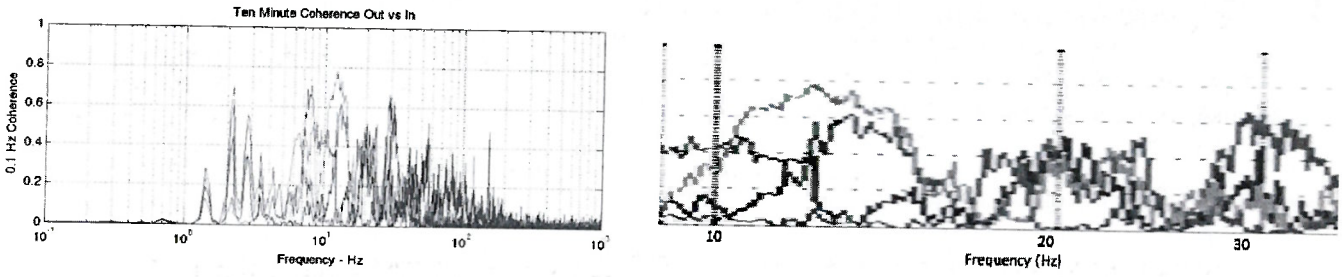


Figure 1a, b: R2-5T212420--coherence with outdoor-ground plane microphone; Living Room-Blue, Master Bed Room- Red, Behind Kitchen- Green, Basement-Purple, b is an expanded view from 9` Hz to 35 Hz

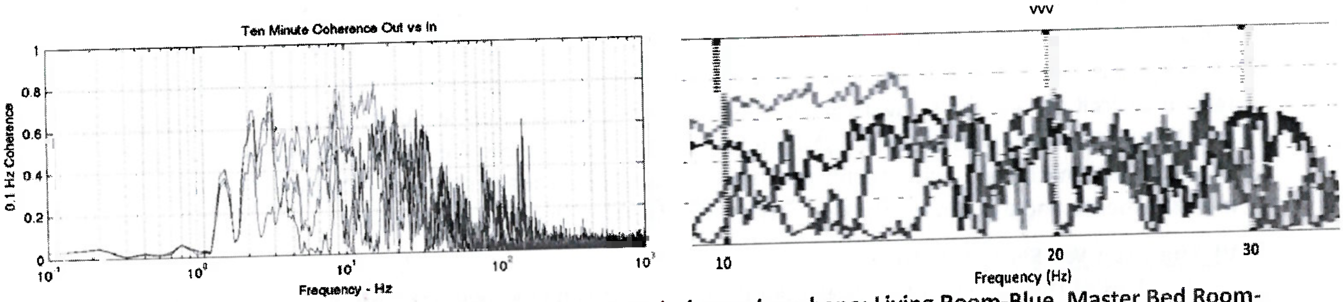


Figure 2a, b: R2-5T204657--coherence with outdoor, ground-plane microphone; Living Room-Blue, Master Bed Room-Red, Behind Kitchen- Green, Basement-Purple, b is an expanded view from 9 Hz to 35 Hz

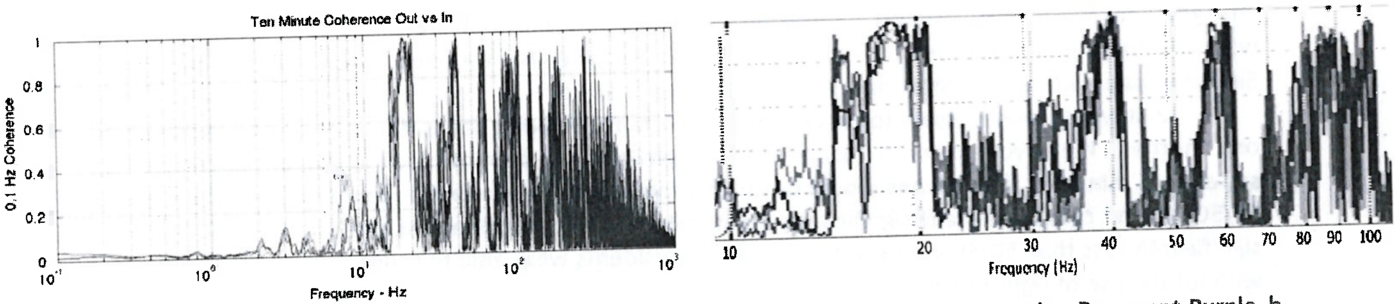
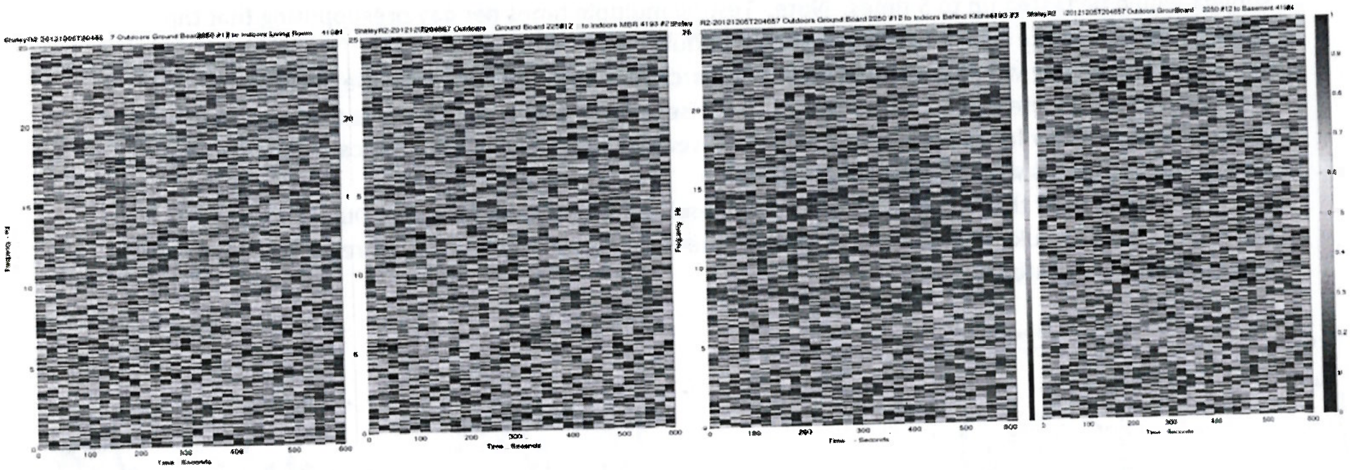


Figure 3a, b: R2-5T204657; Living Room-Blue, Upstairs Bed Room- Orange, Family Room- Turquoise, Basement-Purple, b is an expanded view from 10 Hz to 100 Hz. Note the strong coherence from 20 through at least 80 Hz that resulted from a nearby Helicopter.



4a- Living Room | 4b- Master Bed Room | 4c- Behind Kitchen | 4d- Basement

Figure 4a,b,c,d- Coherence with the outside ground microphone and the four inside microphones in the locations indicated. Note the Basement (4d) which does not have walls coincident with outside shows high coherence at the wind turbine blade passage frequency for several harmonics and almost no coherence above about 8 Hz where the at or above ground walls are resonant.

ShirleyR2-20121205T212420

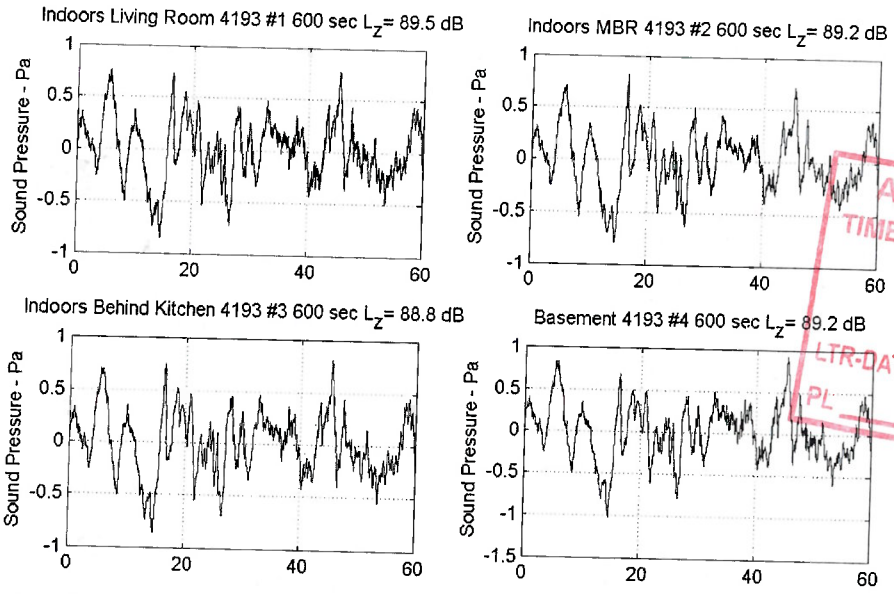


Figure 5- First of the ten minute period of 5T212420. Note that the SPL is very similar for all indoor locations.

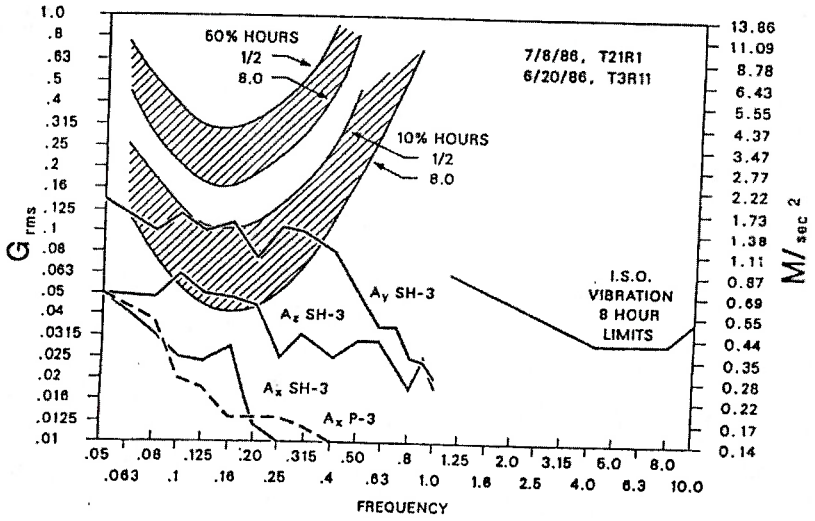


Figure 6. SH3 Sea King Nominal Run vs P-S Orion Nominal A_x

Figure 1 from "Motion Sickness Symptoms and Postural Changes Following Flights in Motion-Based Flight Trainers"

R.S. Kennedy, G.O. Allgood, B.W. Van Hoy, M.G. Lilienthal, **(1987).** " Motion Sickness Symptoms and Postural Changes Following Flights in Motion-Based Flight Trainers," Journal of Low Frequency Noise and Vibration, **6** (4), 147-154.

KEANE
MAHONY
SMITH
KMS
AUCTIONEERS ESTATE AGENTS
VALUERS LAND AGENTS

35 Grand Parade,
Cork,
Ireland.

tel: 021 427 0311
fax: 021 427 1296
email: keanemahonysmith@gmail.com
www.k-m-s.com

Mr Joe Noonan,
Noonan Linehan Carroll Coffey,
Solicitors,
54 South Mall,
Cork.

2nd February 2015

Re: Proposed Wind farm Development by Barna Wind Energy at Gurranreigh, Lissarda and Barnavidane, Teralton for 6no 131 meter high turbines.
Planning reference: 14/1760

Dear Sirs,

We write to confirm that we have carried out inspections of the following properties and have made other appropriate enquiries in order to provide you with our opinion of the Current Market Value.

(1) Ashmore House, Hornhill, Lissarda - Ms Geraldine Hanley
(2) Gurranreight, Lissarda - Jerome & Nickie Cohalan
(3) Gurranreight, Lissarda - Dan & Tessie Galvin
(4) Moneygave, Coppeen, Enniskeane - Paddy & Noelle Sheehan

We have prepared Certificates of Current Market Value for each of the properties on the basis that clean marketable Titles are in place.

At this stage we are not in a position to comment on what effort the proposed Wind Farm will have on the market value of the aforementioned properties, suffice to say that the erection of a wind turbine creates apprehension in the general public which makes the property less desirable and therefore diminishes the prices of all neighbouring properties.

Studies have shown that fear of wind farms can negatively affect purchase prices and there is continuing scientific uncertainty over the advance health consequences and only seems to perpetuate the debilitating effect of wind turbines on property prices.

The proposed wind farm if developed will have a significant negative factor in the marketability, attractiveness and ultimately the achievable sale price of the property.

KEANE
MAHONY
SMITH
KMS
AUCTIONEERS ESTATE AGENTS
VALUERS LAND AGENTS

35 Grand Parade,
Cork,
Ireland.

tel: 021 427 0311
fax: 021 427 1296
email: keanemahonysmith@gmail.com
www.k-m-s.com

Property Address: Gurranreigh, Lissarda, Co Cork.

Owners Name: Jerome and Nickie Cohalan

Brief Description: New part three storey detached residence

Accommodation: Hall, sitting room, kitchen/dining room, spare bedroom, study/ library, guest cloakroom, utility room, 4 bedrooms, 3 bathrooms. Top Floor: bedroom and work station.

When Built: 2012

Floor Area: c3,700sq.ft.

Site Area: C.1.2 Acre

Services: Septic Tank/Mains - Septic Tank
Private Well/Mains Water - Private Well
Heating - Oil fuel central heating and solar panels

Distance from Proposed Wind Farm: 1050 metres

Additional Comments:

Current Market Value: €400,000.00 (Four Hundred Thousand Euro).

Signed: _____
Anthony O'Regan

Date: 2/2/2015

We trust this is the information you require for now, and if we can be of any further assistance, please do not hesitate to contact us.

Yours faithfully,
For Keane Mahony Smith

Anthony O'Regan

Proceedings of the National Academy of Sciences
www.pnas.org
(/) > Current Issue (/content/111/42.toc) > vol. 111 no. 42
> Paul. M. Cryan, 15126–15131, doi: 10.1073/pnas.1406672111

Behavior of bats at wind turbines

Paul. M. Cryan (/search?author1=Paul.+M.+Cryan&sortspec=date&submit=Submit)[a,1],
P. Marcos Gorresen (/search?author1=P.+Marcos+Gorresen&sortspec=date&submit=Submit)[b],
Cris D. Hein (/search?author1=Cris+D.+Hein&sortspec=date&submit=Submit)[c],
Michael R. Schirmacher (/search?author1=Michael+R.+Schirmacher&sortspec=date&submit=Submit)[c],
Robert H. Diehl (/search?author1=Robert+H.+Diehl&sortspec=date&submit=Submit)[d],
Manuela M. Huso (/search?author1=Manuela+M.+Huso&sortspec=date&submit=Submit)[e],
David T. S. Hayman (/search?author1=David+T.+S.+Hayman&sortspec=date&submit=Submit)[f,g],
Paul D. Fricker (/search?author1=Paul+D.+Fricker&sortspec=date&submit=Submit)[h],
Frank J. Bonaccorso (/search?author1=Frank+J.+Bonaccorso&sortspec=date&submit=Submit)[i],
Douglas H. Johnson (/search?author1=Douglas+H.+Johnson&sortspec=date&submit=Submit)[j],
Kevin Heist (/search?author1=Kevin+Heist&sortspec=date&submit=Submit)[k], and
David C. Dalton (/search?author1=David+C.+Dalton&sortspec=date&submit=Submit)[l]

Author Affiliations

Edited by James H. Brown, University of New Mexico, Albuquerque, NM, and approved September 3, 2014 (received for review April 11, 2014)

Abstract (/content/111/42/15126.abstract) Full Text Authors & Info
Figures (/content/111/42/15126.figures-only) SI (/content/111/42/15126/suppl/DCSupplemental)
Metrics Related Content (/content/111/42/15126.full/?tab=related)
PDF (/content/111/42/15126.full.pdf+html)
PDF + SI (/content/111/42/15126.full.pdf+html?with-ds=yes)

Significance

Bats are dying in unprecedented numbers at wind turbines, but causes of their susceptibility are unknown. Fatalities peak during low-wind conditions in late summer and autumn and primarily involve species that evolved to roost in trees. Common behaviors of "tree bats" might put them at risk, yet the difficulty of observing high-flying nocturnal animals has limited our understanding of their behaviors around tall structures. We used thermal surveillance cameras for, to our knowledge, the first time to observe behaviors of bats at experimentally manipulated wind turbines over several months. We discovered previously undescribed patterns in the ways bats approach and interact with turbines, suggesting behaviors that evolved at tall trees might be the reason why many bats die at wind turbines.

Abstract

Wind turbines are causing unprecedented numbers of bat fatalities. Many fatalities involve tree-roosting bats, but reasons for this higher susceptibility remain unknown. To better understand behaviors associated with risk, we monitored bats at three experimentally manipulated wind turbines in Indiana, United States, from July 29 to October 1, 2012, using thermal cameras and other methods. We observed bats on 993 occasions and saw many behaviors, including close approaches, flight loops and dives, hovering, and chases. Most bats altered course toward turbines during observation. Based on these new observations, we tested the hypotheses that wind speed and blade rotation speed influenced the way that bats interacted with turbines. We found that bats were detected more frequently at lower wind speeds and typically approached turbines on the leeward (downwind) side. The proportion of leeward approaches increased with wind speed when blades were prevented from turning, yet decreased when blades could turn. Bats were observed more frequently at turbines on moonlit nights. Taken together, these observations suggest that bats may orient toward turbines by sensing air currents and using vision, and that air turbulence caused by fast-moving blades creates conditions that are less attractive to bats passing in close proximity. Tree bats may respond to streams of air flowing downwind from trees at night while searching for roosts, conspecifics, and nocturnal insect prey that could accumulate in such flows. Fatalities of tree bats at turbines may be the consequence of behaviors that evolved to provide selective advantages when elicited by tall trees, but are now maladaptive when elicited by wind turbines.

This Issue


(/content/111/42.toc)
October 21, 2014
vol. 111 no. 42
Masthead (PDF)
(/content/111/42/local/masthead.pdf)
Table of Contents
(/content/111/42.toc)

PREV ARTICLE (/CONTENT/111/42/15132.SHORT) NEXT ARTICLE (/CONTENT/111/42/15132.SHORT)

View this article with *LENS beta* (/lens/pnas/111/42/15126)

Don't Miss

Thinking of submitting your next paper to PNAS? Learn tips in our tutorial videos (/site/authors/submit-how.xhtml).

Navigate This Article

- Top
- Abstract
- Results
- Discussion
- Methods
- Acknowledgments
- Footnotes
- References

Article Tools

- Article Alerts
- Export Citation
- Save for Later
- © Request Permission (/site/aboutpnas/rightperm.xhtml)

Share

f (/external-ref?tag_url=http://www.pnas.org/cgi/content/sh
-+Cryan%20et%20al.%20111%20%2842%29
+PNAS&doi=10.1073/pnas.1406672111&link

(/external-ref?tag_url=http://www.pnas.org/cgi/content/lc
-+Cryan%20et%20al.%20111%20%2842%29

8+1

(/external-ref?tag_url=http://www.pnas.org/cgi/content/lc
-+Cryan%20et%20al.%20111%20%2842%29
+PNAS&doi=10.1073/pnas.1406672111&link

video surveillance (/search?fulltext=video+surveillance&sortspec=date&submit=Submit&andorexactfulltext=phrase)
wildlife (/search?fulltext=wildlife&sortspec=date&submit=Submit&andorexactfulltext=phrase)
wind energy (/search?fulltext=wind+energy&sortspec=date&submit=Submit&andorexactfulltext=phrase)

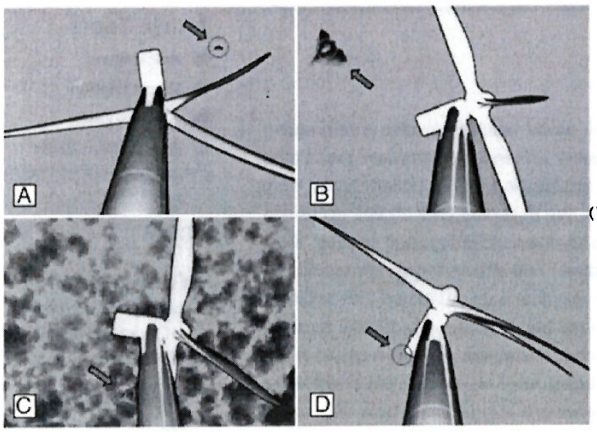
Bats are long-lived mammals with low reproductive potential and require high adult survivorship to maintain populations (1, 2). The recent phenomenon of widespread fatalities of bats at utility scale wind turbines represents a new hazard with the potential to detrimentally affect entire populations (3, 4). Bat fatalities have been found at wind turbines on several continents (3⇓⇓–6), with hypothesized estimates of fatalities in some regions ranging into the tens to hundreds of thousands of bats per year (4, 6). Before recent observations of dead bats beneath wind turbines, fatal collisions of bats with tall structures had been rarely recorded (7). Most fatalities reported from turbines in the United States, Canada, and Europe are of species that evolved to roost primarily in trees during much of the year ("tree bats"), some of which migrate long distances in spring and late summer to autumn (8). In North America, tree bats compose more than three-quarters of the reported bat fatalities found at wind-energy sites (6, 9), although there is a paucity of information from the southwestern United States and Mexico. Similar patterns occur in Europe (4). Another prominent pattern in bat fatality data from northern temperate zones is that most fatalities are found during late summer and autumn, sometimes with a much smaller peak of fatality in spring (4, 6). Concurrent involvement of species with shared behaviors suggests that behavior plays a key role in the susceptibility of bats to wind turbines, and that tree bats might somehow be attracted to wind turbines (8).

The causes of bat collisions with wind turbines are unknown, and many explanations for this phenomenon remain unexplored (8). Proposed causes of susceptibility range from bats randomly being struck by turbine blades while migrating past in large numbers to bats being attracted to wind turbines while searching for important resources, such as food, shelter, and social opportunities (8). Although causes of susceptibility remain unknown, altering turbine operations under certain conditions during periods of high risk can reduce bat deaths. Fatalities during late summer and autumn tend to occur when average wind speeds are lower than about 5–6 m/s (4, 9, 10), and studies in Canada (11), the United States (12), and Germany (4) demonstrated that bat deaths can be substantially reduced by preventing turbine blades from turning until winds reach such speeds. Such operational modifications at wind facilities bring logistical and financial costs but may prove to be effective at reducing bat fatalities in many areas (11, 12). Discovering the underlying reasons why bats are susceptible to wind turbines could help improve the efficiency of existing strategies and potentially uncover new ways of further reducing fatalities while maximizing power production.

In late summer and autumn of 2012, we observed the behaviors of bats at a wind facility in northwest Indiana using thermal video-surveillance cameras, supplemented with near-infrared video, acoustic detectors, and radar. Our aim was to better understand how wind and turbine blade movement influence behaviors of bats around turbines, and thus fatality risk. Turbine operation was manipulated so that we could observe if bat behaviors and activity patterns differed around rotating versus stationary blades, and how bats interact with turbines under various operating and environmental conditions. Specifically, we tested the hypotheses that wind and blade rotation speed influenced the way that bats approached turbines.

Results

We recorded bat activity in the rotor-swept zones of three turbines on 163 camera-nights (one camera deployed for one night at a turbine) during July 29 to October 1, 2012, for a total of 1,304 h of thermal imagery. Video detections of bats were treated as the same event when detected within 1 min or less of other bat observations (Fig. 1). Bats were detected at turbines throughout the study period (Fig. S1 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=SF1)) and throughout the night without any apparent trend toward later or earlier activity over the study period (Fig. S1 (/lookup/suppl/doi:10.1073/pnas 1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=SF1)).



(15126/ F1.expansion.html)

In a new window (15126/F1.expansion.html) | Download PPT (/powerpoint/111/42/15126/F1)

Fig. 1.

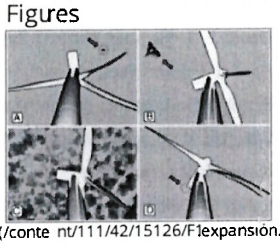
Still images of night-flying bats (green arrows) at wind turbines that were detected in thermal-infrared video footage. Cameras were positioned 12 m from the base of the turbine, looking up the 80-m monopole toward the nacelle (rectangular machinery enclosure) and rotor, to which three 40-m blades

Published online before print September 29, 2014, doi: 10.1073/pnas.1406672111
PNAS (Proceedings of the National Academy of Sciences) **October 21, 2014** vol. 111 no. 42 **15126-15131**

Classifications

Biological Sciences
Ecology (/search?tocsectionid=Ecology&sortspec=date&submit=Subi

Figures



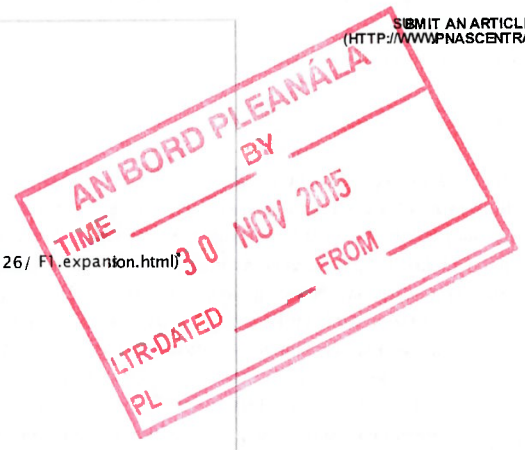
(/conte nt/111/42/15126/F1expansion.html)
Fig. 1. Browse All Figures (/content/111/42/15126.figures-only)

Videos

Movie S1. Browse All Videos

Other Articles

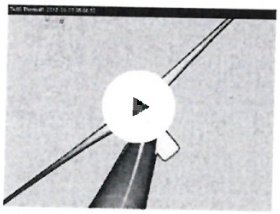
Citing This Article
Google Scholar
PubMed
Similar to This Article



their presence in nightly (~10 h) video recordings. A variety of detection conditions are illustrated, including a bat approaching fast-rotating (14 rpm) turbine blades at about midtower height (*A*), a bat flying low (<10 m) above the camera (*B*), a bat approaching the leeward side of a turbine monopole in cloudy conditions (*C*), and a bat flying at about nacelle height in the leeward airspace on the far side of a turbine with blades rotating at full speed (*D*).

Approximately 3–4 million animals were detected by radar flying through the monitored portions of the wind facility at or below about 200 m above ground level during this study (*SI Results* (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=STXT)). Of this number, about a quarter were vertebrates occurring within the range of heights swept by turbine blades (≤200 m) (*SI Results* (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=STXT)). Among a total of 1,261 video detections of flying animals, a large proportion were identified as bats (79%), with fewer detections of bat-like targets (15%), birds (2%), likely insects (3%), and unidentified objects (1%); only the bat detections (n = 993) were included in this analysis. Adjusting for the number of thermal cameras operating per night, the average number of animal detections on video per turbine-night was 7.8 (min: 0; first quartile: 2; third quartile: 12; max: 31) and the average number of bat detections per turbine-night was 6.2 (min: 0; first quartile: 1; third quartile: 12; max: 26).

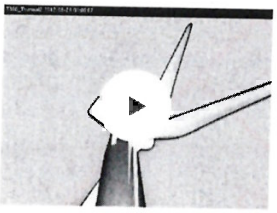
Most (88%) video detections of bats involved flight trajectories indicating the individual was moving toward the turbine, hereafter referred to as "focal" behavior. We observed multiple focal behaviors of bats at turbines, several of which have not been previously reported (Table S1 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=ST1) and Movies S1–S9 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental)) (13). Behaviors included close approaches to the monopole and nacelle (enclosure of machinery on top of monopole to which rotor and blades are attached), close approaches to slowly moving blades, flight loops and dives centered on the turbine, distant hovering, and chasing other bats toward or near the turbines. Focal behaviors often involved bats closely (<2 m) approaching the turbine monopole (13%), nacelle (30%), and occasionally blades (6%;) (Table S1 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=ST1)). Most bats exhibiting focal behavior made single approaches and then moved away (72%), but many (27%) approached turbines multiple times during a detection (Table S1 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=ST1)) and such interactions at times lasted several minutes. Bat detections within a night at a turbine were found to be significantly clustered in time for 23 of the 163 camera-nights (14%), as measured by an index (14) applied to bat counts in sequential 10-min periods. Bats were more frequently detected during periods when the moon phase was more than half full and visible above the horizon (Kolmogorov–Smirnov test, D = 0.0822, P < 0.0001) (Fig. S2 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=SF2)). Because the thermal cameras do not rely on reflected light, we assume this relationship with moonlight was attributable to biological causes rather than detection bias.



Movie S1.

Bat making a single directed approach toward a turbine before changing course and flying away at ~0530 hours on September 9, 2012. Blade rotation 14 rpm, wind out of the southwest (225°) at 4.4 m/s, and 44% moon illumination.

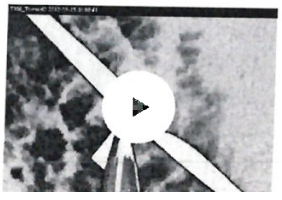
1406672111/video-1)
f0a41af8cf5f551d064/pnas.1406672111.sm01.avi)



Movie S2.

Bat making repeated looping approaches to leeward side of wind turbine at ~0109 hours on August 29, 2012. Blade rotation <1 rpm, wind out of the east-northeast (58°) at 5.4 m/s, and 93% moon illumination.

1406672111/video-2)
f0a41af8cf5f551d064/pnas.1406672111.sm02.avi)



Movie S3.

A hoary bat (Lasiurus cinereus; identified acoustically) air-brakes, hovers, and then makes repeated approaches after flying downwind past a wind turbine with curtailed blades at ~0100 hours on August 25, 2012. Blade rotation <1 rpm, wind out of the southeast (131°) at 7.2 m/s, and no moon

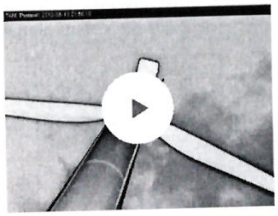
illumination.

406672111/video-3)
0a41af8cf5f551d064/pnas.1406672111.sm03.avi)

Movie S4.

Near-infrared, close-up video of a bat closely approaching and investigating the upper parts of a turbine at ~0430 hours on September 19, 2013. Blade rotation <1 rpm, wind out of the west-southwest (257°) at 2.7 m/s, and no moon illumination.

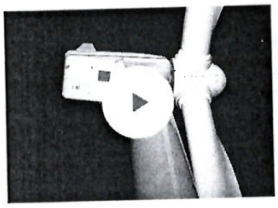
1406672111/video-4)
f0a41af8cf5f551d064/pnas.1406672111.sm04.avi)



Movie S5.

Bat making repeated close approaches to a turbine monopole at ~2150 hours on August 19, 2012. No blade rotation, wind out of the north-northwest (330°) at 0.4 m/s, and no moon illumination.

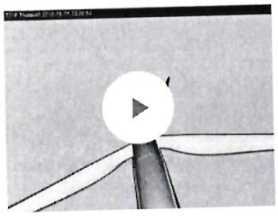
1406672111/video-5)
f0a41af8cf5f551d064/pnas.1406672111.sm05.avi)



Movie S6.

Near-infrared, close-up video of a bat closely following a slow moving turbine blade (shadowed on far side of monopole) at ~0240 hours on July 19, 2013 (before monitoring with thermal cameras began). Blade rotation <1 rpm, wind out of the east-northeast (70°) at 7.5 m/s, and no moon illumination.

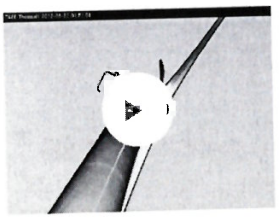
1406672111/video-6)
f0a41af8cf5f551d064/pnas.1406672111.sm06.avi)



Movie S7.

Two bats chasing each other near wind turbine at ~2320 hours on August 5, 2012. No blade rotation, wind out of the north-northwest (321°) at 4.6 m/s, and no moon illumination.

1406672111/video-7)
f0a41af8cf5f551d064/pnas.1406672111.sm07.avi)



Movie S8.

Bat repeatedly returning to turbine after close encounters with spinning blades at ~0150 hours on August 22, 2012. Blade rotation 14 rpm, wind out of the east (93°) at 8.0 m/s, and no moon illumination.

1406672111/video-8)
f0a41af8cf5f551d064/pnas.1406672111.sm08.avi)

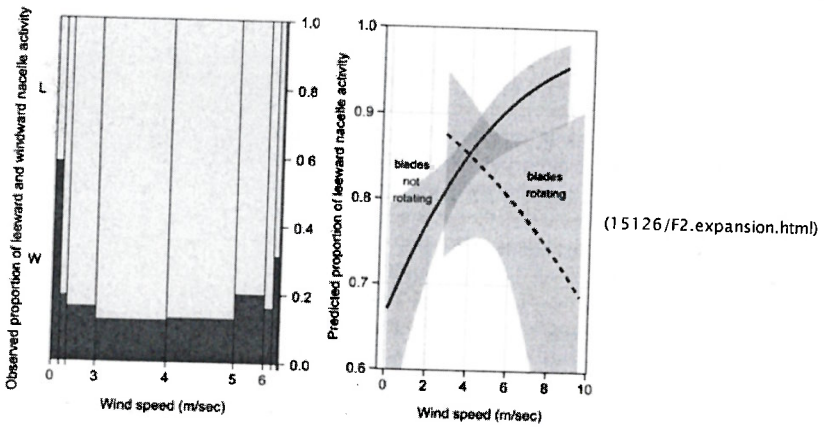
Movie S9.

Bat exhibiting serpentine flight in lee of wind turbine monopole and blades at ~0500 hours on September 29, 2012. No blade rotation, wind out of the northeast (315°) at 5.8 m/s, and 96% moon illumination.

1406672111/video-9)
f0a41af8cf5f551d064/pnas.1406672111.sm09.avi)

Twelve fresh bat fatalities were found under turbines after nights when video imagery was recorded (*SI Results* (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=STXT)). Possible strikes or bats being moved by air around turbine blades were observed on video during two of the nights after which fatalities were found, and during only 18 of the 993 bat video detections (2%). Because of this low frequency of video-observed strikes and other rarely observed interactions and behaviors (<1% prevalence in Table S1 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=ST1)), we were unable to adequately test the effects of wind and turbine blade speed on these phenomena. Based on the species composition of fatalities and acoustic calls recorded on the turbines (*SI Results* (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=STXT)), it is likely that most of our video detections involved tree bats.

Bats were detected more frequently at lower relative to higher wind speeds, and this pattern was evident regardless of whether the turbine blades were spinning (Kolmogorov–Smirnov test, $D = 0.2365$, $P < 0.0001$) or not ($D = 0.1937$, $P < 0.0001$) (Fig. S3 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=SF3)). When the wind was blowing > 1 m/s (96% of the time), bats exhibiting focal behaviors were observed significantly more often (~80% of detections) on the leeward (downwind) compared with the windward side of the turbine (χ^2 test = 329.3, df = 1, $P < 0.0001$), regardless of turbine nacelle orientation. When the wind was blowing ≤1 m/s, observed activity between leeward and windward areas (gauged relative to nacelle orientation) was approximately equal and the strong prevalence of leeward bat activity was not evident (Fig. 2*A*). However, the propensity for leeward activity at higher wind speeds was also influenced by the rotation of turbine blades. Similar to the general trend observed in video detections, logistic regression revealed a significant interaction between wind speed and blade rotation that resulted in opposite patterns of leeward activity ($P = 0.0196$). For example, when turbine blades were prevented from rotating, the observed frequency of leeward approaches to the nacelle increased from 65% to >90% as wind speeds increased from 0 to >8 m/s, whereas the proportion of leeward activity declined from >85% to <70% with a similar increase in wind speed when the turbine blades were spinning (Fig. 2*B*).



(15126/F2.expansion.html)

In a new window (15126/F2.expansion.html) | Download PPT (/powerpoint/111/42/15126/F2)

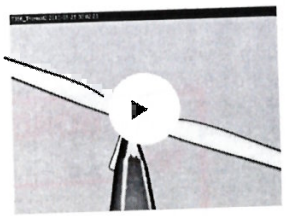
Fig. 2.

Spineplot (*Left*) depicts the proportion of observed bat activity as a function of wind speed (m/s) in leeward (L; light gray) and windward (W; dark gray) areas near the turbine nacelle. Spineplot bar widths are proportional to the number of observations within each wind-speed interval, with wider bars representing more observations ($n = 208$ in the 3–4 m/s category) and narrower bars representing fewer observations ($n = 6$ in the >8 m/s category). Predicted proportion of leeward activity (mean and 95% confidence interval) derived from logistic regression (*Right*) illustrates the significant interaction of wind speed and blade rotation (where curtailment prevented turbine blades from rotating on some nights).

Focal bat behaviors, including close approaches to the monopole, blades, and nacelle, were observed across a range of wind speeds (0–9.6 m/s), but were detected more frequently at low blade-rotation speeds and less frequently at intermediate and high speeds (classed as 0 to <1 rpm, 1–10 rpm, >10 rpm). For example, of the 55 detections that involved apparent investigations of turbine blades, 31% occurred when the blades were stationary, 69% occurred when blades were spinning very slowly (<1 rpm, a speed typical of near-windless conditions or when the blade edges were pointed into the wind), and none were detected when blades were spinning at ≥1 rpm (χ^2 test = 27.5, df = 2, $P < 0.0001$). Similarly, about 41% of the 110 monopole approaches occurred when the blades were stationary, 51% occurred when blades were spinning

very slowly, and only 8% of detections were noted at higher rotation speeds (χ^2 test = 31.6, df = 2, $P <$ 0.0001). Nacelle approaches demonstrated a similar pattern, with 42%, 40%, and 18% of the 258 detections in the stationary, very slow, and higher rotation-speed categories, respectively (χ^2 test = 28.6, df = 2, $P <$ 0.0001). These findings are all consistent with the hypotheses that wind speed and blade rotation speed influenced the way that bats approached turbines.

Most video detections of bats involved single individuals, although a small proportion (3%; n = 29) included pairs of bats. Bats were seen chasing or following each other during 48% (n = 14) of the observations involving pairs. On a few occasions, bats chasing each other near turbines appear to touch in flight. One video event revealed two hoary bats (*Lasiurus cinereus*; identified from concurrent acoustic recordings) hovering next to each other in the airspace near the turbine nacelle for over 10 s after a prior sequence in which they interacted in the lee of the turbine tower (Movie S10 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.1406672111.sm10.avi)).



Movie S10.

Two hoary bats (Lasiurus cinereus) interacting in midair on the leeward side of a wind turbine at ~0200 hours on August 25, 2012. The species identification was made from concurrent acoustic calls recorded from the turbine nacelle, in which navigation and social calls characteristic of this species were heard during the close midair approaches. No blade rotation, wind out of the south-southeast (157°) at 8.3 m/s, and no moon illumination.

406672111/video-10)
f0a41af8cf5f551d064/pnas.1406672111.sm10.avi)

Discussion

Our video observations indicate that many bats passing close (<50 m) to wind turbines with stationary or slow-moving blades during late summer and autumn are attracted to and actively approach them using minimally turbulent air currents, vision, and to some degree echolocation for orientation. In contrast, radar observations indicate that nocturnally migrating vertebrates, presumed to be mostly birds, likely far outnumbered bats in the airspace, yet their near absence from video observations suggests that birds did not interact with turbines in the same way as bats, possibly avoiding them. Furthermore, acoustic detectors pointing upward from the tops of the turbine nacelles regularly detected the calls of bats not observed by video cameras, indicating that some bats passed high in the airspace above the turbines without closely approaching. It remains to be determined what proportion of passing bats approach turbines and whether they might respond to the presence of turbines over greater distances than those we observed with video cameras.

Bats likely can sense and respond to air currents. We saw no preference in the directions from which they approached turbines when the wind was not blowing or was blowing very gently, but bats consistently approached from leeward at wind speeds >1 m/s. The downwind direction of activity only when air was moving suggests that bats know which way the wind blows and approach tall structures in a patterned way that is independent of cardinal direction. As do many animals that move through air (15), bats orient by sensing and responding to flows through which they fly. Bats sometimes commute and forage on the leeward sides of windbreaks, such as tree rows and cliffs, with the postulated benefits of leeward activity including lower risk of predation, favorable conditions for energy-efficient flight, and greater availability of insect prey, particularly during high winds (16, 17). Being able to follow flows can provide substantial selective advantages to animals, particularly when other sensory cues are limited and when important resources can be predictably found within flows (15). It was once believed that bats made their way through darkness with the help of highly sensitive touch receptors in their wings and ears (18), but this concept of landscape orientation received little subsequent attention after the discovery of echolocation (19). Highly evolved hair-cell receptors on the skin surfaces of bat wings recently have been studied in detail; hair receptors in bat wings are now known to play an important role in flight control by sensing minute changes in airflow across the wing surfaces (20). Whether wing receptors help bats to sense subtle patterns of airflow at larger spatial scales is unclear, but Brazilian free-tailed bats (*Tadarida brasiliensis*) show evidence of orienting through wind currents and exploiting migrating insects concentrated in airflows in the absence of other visual or acoustic cues at high altitudes [up to 3,000 m above ground level (21, 22)]. In light of previous general observations of bat activity in the lee of windbreaks and our observations of consistent leeward bat activity at turbines, we suspect that bats are well adapted for sensing and orienting by airflows at landscape scales and that going with the flow, or against in the case of bats at turbines, may be an underappreciated sensory modality that evolved in these night-flying mammals.

Our thermal video cameras detected bats at turbines more often during periods of night with b right moon illumination and less often during periods with lower levels of moonlight, suggesting that vision pla ys a role in bats perceiving and approaching wind turbines. Bats rely on vision for long-distance orientation (23⇓–25), are known or suspected to orient through landscapes using light cues, such as stars and po stsunset glow (26, 27), and use visual cues to help them find roosts in trees (28). The effects of moonlight on bat activity and fatality at turbines are not well understood, but a study in Alberta, Canada, reported higher fata lity rates of silver-haired bats (*Lasionycteris noctivagans*) at wind turbines on nights when the moon was fully illuminated (29). There is no evidence that tree bat activity in the absence of, or distant from, turbines varies with lunar cycles or illumination (30). Acoustic data gathered on the turbines we monitored, which inclu ded many calls from bats passing higher in the airspace than our cameras could image, did not show a t rend toward proportionally more activity under moonlit conditions (*SI Results*

(/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=STXT)), further indicating general activity levels are not influenced by moonlight. The patterns we observed on video could be attributable to the visual conspicuousness of the wind turbines waxing and waning with the moon, affecting the probability of passing bats seeing and moving closer to them to investigate.

Despite our observations that suggest bats orient toward wind turbines using flow and visual cues, the reasons why they do so remain unknown. Although we could not determine why bats behaved the way they did around turbines, we suspect that such behaviors evolved in association with trees. At a fundamental level, tree bats may not be able to discriminate wind turbines from trees (3). Both trees and turbines have tall and cylindrical "trunks" (monopoles), visually conspicuous "crowns" (nacelles), and radially extending "limbs" (blades). Bats are rarely reported interacting or colliding with other tall structures (7), as might be expected if the behaviors we observed were a general response to structural stimuli. However, a recent study revealed higher activity of tree bats during late summer and autumn at tall communication towers compared with surrounding habitats (31). Bats may not have the cognitive ability to differentiate wind turbines or other tree-like structures from real trees either at a distance or at close range, particularly if visual cues, such as similar silhouettes against the night sky, are accompanied, reinforced, or overwhelmed by other perceptual cues, such as similar downwind airflow patterns. For example, the predatory beetle (*Rhizophagus grandis*) responds to disturbance of airflow around a simulated tree more than the tree's visual silhouette (32).We do not know if the patterns of behavior we observed apply to cave-roosting species of bats that die at wind turbines [e.g., genera *Myotis* and *Tadarida* (6)], but even cave-roosting bats may occasionally visit trees for the reasons discussed below.

Key findings of our study were that wind speed and blade rotation speed influenced the way that bats approached turbines. Bats approached turbines less frequently when their blades were spinning fast and the prevalence of leeward approaches to the nacelle increased with wind speed at turbines with slow-moving or stationary blades. A plausible explanation for these patterns (see *SI Discussion* (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=STXT) for others) is that airflow profiles around tall trees and turbines with stationary blades may be very similar to each other (e.g., oscillating swirling patterns, called a Kármán vortex street), whereas the spinning blades of turbines cause chaotic downwind turbulence (33) that is unlikely to resemble any natural airflow patterns that bats might associate with trees. If tree bats find and orient toward trees by sensing and moving into upstream airflows, turbines may resemble trees only when the blades are moving slowly or are stationary. In other words, airflow paths that bats potentially follow may not be present downwind of turbines with fast-spinning blades. Nighttime flight behaviors of bats around tall trees during late summer and autumn have not been reported, but finding and observing such behaviors if they exist might help explain why tree bats are susceptible to wind turbines.

Compounding the potential for bats to mistake wind turbines for trees is the possibility that they expect important resources when they arrive at the "trees." Such possible expectations may not apply to concurrently migrating birds, which radar detected in apparently high abundance in the surrounding airspace yet were infrequently observed on video near turbines. Bats may exploit streams of air flowing downwind from trees, turbines, and perhaps other tree-like structures [e.g., communication towers (31)] at night while searching for roosts, conspecifics, and possibly feeding on nocturnal insects that could accumulate in such flows. Many of the hypothesized causes of tree bat susceptibility to turbines involve attraction (8). Our observations are consistent with the possibility that bats are attracted at close distances (<50 m) to turbines with stationary or slow-moving blades, but the potential source of attraction remains unknown. We did not see evidence of close-scale attraction based solely on physical phenomena, such as heat, electromagnetic fields, or sounds generated by specific parts of the turbines, because focal behaviors were dispersed across many different parts of the turbine structure, often involving motionless blades and inert monopoles. A prior study also reported bats focusing attention on monopoles, nacelles, and blades of wind turbines, but no part stood out as attracting disproportionately more bats than others (13). The variety of turbine parts toward which bats focus their attention suggests a general close-range attraction, but the strong leeward component to these varied focal behaviors may offer clues as to what bats might be trying to find.

Resource-based hypotheses of attraction include bats seeking shelter, social opportunities, or food at turbines (3, 8, 9, 13), all of which may occur more often on the leeward sides of tall, tree-like structures. The simplest explanation for bats closely approaching turbines may be that they are seeking places to roost in what they perceive as trees while migrating. We regularly observed hoary bats and eastern red bats (*Lasiurus borealis*) flying in under the bottom of the leeward nacelle and making close approaches to the recessed exhaust port (Movie S4 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.1406672111.sm04.avi)). Although we did not see clear evidence of bats consistently trying to land on turbines, we frequently observed bats approaching the monopoles very closely, as previously reported (4, 13, 34). The high proportions of close approaches focused on nacelles and monopoles (Table S1 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=ST1)) are consistent with bats trying to find places to land. After not finding suitable places to alight upon (e.g., close investigations reveal turbine surfaces too smooth), bats may simply move on.

Bats might also closely approach turbines while looking for social opportunities. Similarities in the social behaviors of tree bats in North America and Europe led to speculation that bats might use the tallest trees in landscapes as flocking or gathering places (35). Tree bats tend to begin mating during the time when most mortality is documented at turbines (36), and bats seeking mates at trees may be drawn toward turbines (37) and other tall structures (31). We observed pairs of bats in 3% of our observations, and in about half of those cases they appeared to be following or chasing each other. In one case we observed two hoary bats in the lee and recorded social calls (Movie S10 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.1406672111.sm10.avi)), but did not see evidence of larger social aggregations that

were hypothesized for this species (37). Many species of tree bats in Europe exhibit mating flight displays centered on trees during late summer and autumn, but such flight behaviors have not been reported for any temperate North American bats (37). We speculate that some of the sustained leeward focal behaviors that we observed at turbines in our study, such as repeated looping returns and dives (Movie S2 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.1406672111.sm02.avi)), might be associated with mating displays that could occur at trees. The "upstream orientation" we frequently observed is common in other types of flying and swimming organisms during foraging and mate-searching movements (15).

Bats may be drawn in by insects whose distribution is concentrated around wind turbines. Empirical data demonstrating the consistent presence and aggregation of insects at turbines during the night are lacking, but insects are known to foul turbine blades (38), be attracted to certain turbine paint colors (39), and migrate in large numbers during periods of bat fatality at turbines (40). In addition, bats have been observed foraging near turbines (4, 34) or found dead beneath them with full stomachs (41, 42), highlighting the plausibility of the feeding hypothesis. Although we regularly observed insects in the video imagery, we did not observe the frequent presence of insects with bat detections or record any unambiguous feeding calls of bats at turbines (*SI Results* (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=STXT)), nor did we regularly observe what we would consider typical foraging behaviors of bats during our study. However, this observed lack of insects and typical foraging patterns does not preclude the possibility that bats expected to find insects at the turbines they approached.

There are several general patterns of insect behavior and distribution that give us reason to suspect the leeward behaviors we observed at turbines might be associated with bats expecting insects at the structures as they approached, irrespective of the actual presence of insects. Insects often accumulate on the leeward sides of artificial and natural structures, and behind windbreaks insects tend to increase in number and density with wind speed (43, 44). Many diurnal and crepuscular insects swarm above prominent high points in landscapes during calm conditions and such aggregations often blow leeward in windy conditions (45, 46). Certain nocturnal insects, such as gypsy (*Lymantria dispar*) and spruce-budworm (*Choristoneura* spp.) moths, lay eggs in and disperse from the tops of tall trees during late summer and autumn (47, 48). Bats sometimes feed on insects dispersing from trees. For example, Lloyd et al. (49) reported bats feeding on emerging spruce-budworm moths, and Lewis (50) reported eastern red bats feeding on moths in the airflows leeward of human-made structures: "When a moderate, steady wind is blowing over a moth-infested [corn] crib I have seen bats strung out in a narrow belt to a distance of 200 yards or more, catching moths that were carried by the wind." Given the likelihood of insects accumulating at night above and in the lee of tall trees in natural environments, the leeward focus of bat behaviors at tree-like structures may not be coincidental.

Resource-based attraction hypotheses involving shelter, social opportunities, and food all seem plausible in the light of our results, but gathering direct evidence of such resource use by bats may not be possible at wind turbines or other anthropogenic structures. The roosts, conspecifics, and insect prey that bats might expect at turbines or other tree-like artificial structures would not necessarily have to occur there to draw them in and put them at risk. Bats may be acting upon the expectation of resources rather than the actual presence of resources. Fatalities of bats at turbines may be the consequence of behaviors that evolved to provide selective advantages when elicited by tall trees, but are now maladaptive when elicited by wind turbines. Paradoxically, direct evidence of the causes of tree bat susceptibility to wind turbines may not be observable at wind turbines, but instead at the trees and their associated resources where potentially causal behaviors evolved.

Our observations have practical implications. Although our scope of inference is limited to certain tree bats (*L. borealis*, *L. cinereus*, and *L. noctivagans*), areas of turbines from the rotor-swept zone around the nacelle to near the ground (different behaviors may occur higher in the airspace), and are based on observations from just three turbines in midwestern North America, efforts to monitor bat activity near turbines (e.g., acoustic detectors and video cameras), or deter bats from turbines [e.g., devices producing startling sounds (51)] may benefit by aiming instruments from the back of the nacelle into the leeward airspace, an area where we consistently observed higher bat activity regardless of changing wind directions. Strategies for minimizing fatalities of bats at turbines currently focus on preventing blades from spinning during low wind periods (4, 11, 12). Our observations that tree bats show a tendency to closely investigate inert turbines and sometimes linger for minutes to perhaps hours (in the cases of clustered observations) highlight the plausibility of a scenario in which bats are drawn toward turbines in low winds, but sometimes remain long enough to be put at risk when wind picks up and blades reach higher speeds. Therefore, the frequency of intermittent, blade-spinning wind gusts within such low-wind periods might be an important predictor of fatality risk; fatalities may occur more often when turbine blades are transitioning from potentially attractive (stationary or slow) to lethal (fast) speeds. Efforts to minimize bat fatalities at wind facilities might benefit by averaging wind-speed curtailment thresholds over longer periods of time (e.g., >10 min) to prevent gu sts from intermittently pushing blades to lethal speed during low-wind periods. Finally, fatalities may be reducible by altering the appearance of turbines. Fewer fatalities of eastern red bats were found under turbines wh flashing red aviation lights at a large wind facility in Texas (52), hinting at the possibi lity that supplemental lighting of turbines might make some bats less likely to mistake them for trees.

Methods

Study Area and Experimental Design. We conducted this study at a wind turbine facility (Fowler Ridge Wind Farm, BP Alternative Energy, Oakland, CA and Dominion Resources Inc., Richmond, VA) i n Benton County, IN, which consisted of 355 wind turbines with a total nameplate capacity of 600 megawatts (MW). The 20,234-ha site is dominated by agricultural lands (mostly soybean and corn fields) with build ings and forested areas composing <5% of the total area. The topography is mostly flat with elevations ranging from about 210–225 m. The three turbines monitored (Model V82, Vestas Wind Systems) each had a nameplate

capacity of 1.65 MW, 82 m rotor diameter, and 80-m-high monopole.

To observe bat interactions with turbines across a range of weather and operating conditions, turbines were run under three different scenarios: (*i*) blades never rotating, (*ii*) blades not rotating (curtailed) until wind speeds reached 6.5 m/s, and (*iii*) blades rotating under normal operating conditions (begin rotating at about 2 m/s wind speed). We randomly assigned operation treatments each night so that on any given night, one of the three turbines was randomly assigned to be never rotating, curtailed, or fully operational.

Recording Video Imagery. We monitored the three turbines using video surveillance cameras with sensors that operate in the "thermal" spectrum of infrared light (~9,000–14,000 nm; Model Q1921-E with a 19-mm lens, Axis Communications) and which require no supplemental illumination. The effective sensor-array size of the cameras was 384 × 288 pixels, and we recorded digital video at a rate of 30 frames per second using netbook computers (Model 1104 A7K67UT, Hewlett-Packard) equipped with external hard drives. We positioned these cameras 12 m from the base of each turbine so that they imaged about two-thirds of the rotor-swept zone. Video recording began within 1 h of sunset and continued until ~1 h after sunrise. In addition to the thermal cameras, we simultaneously recorded supplemental near-infrared (NIR) video imagery (*SI Methods* (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=STXT)).

Review of Video Imagery. We manually reviewed video imagery at high speed (scan speed ~1 min/h of recorded imagery) with viewing software (VirtualDub, www.virtualdub.org (http://www.virtualdub.org); VLC, www.videolan.org (http://www.videolan.org)) and then a second time using custom-written code (Dataset S1 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.1406672111.sd01.docx)) and matrix-based statistical software (Matlab with Image Processing Toolbox, Mathworks) that automatically detected events in which animals flew through the thermal video scenes. Automatic processing algorithms identified frames with motion of small objects not associated with the moving turbine blades. Although video was recorded at 30 frames per second, only every 30th video frame was analyzed because of time constraints on automated processing, resulting in detection of events mostly lasting ≥1 s. However, because bats usually took several seconds to traverse the tens of meters of airspace around the turbine, we saw no evidence that this sampling rate consistently missed bats when they were present. Species of bats we observed likely fly at speeds ≤7 m/s (53). The size of the field of view was about 55 × 40 m given the ~110-m resolution range of the cameras. We estimate that a bat at that height would require at least 5–6 s to traverse the imaged area and would be detected in as many video frames. Therefore, any bias associated with missing bats passing through the video scenes in <1 s would involve those passing relatively close to the camera and not affect the detection of bats at nacelle height.

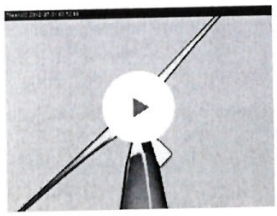
All potential flying objects detected by high-speed scanning or software algorithms were visually reviewed and characterized by at least two observers (P.M.C. and P.M.G.). These detections included insects flying close to the cameras (which were ignored and not tabulated), as well as bats and small birds flying around the turbines up to the airspace above the nacelle, larger birds flying higher above the rotor-swept zone, and airplanes and clouds much higher. Based on the pixel resolution of the thermal cameras and the distance at which a bat could be resolved with more than 1 pixel, we estimate our range of detecting bats with the cameras was upwards of 110 m. With the thermal cameras situated 12 m from the base of the turbine and the nacelles sitting atop 80-m towers, the distance from camera to nacelle was 81 m. Our video observations from the thermal cameras and supplementary imagery from the NIR cameras (*SI Methods* (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=STXT)) revealed that smaller bats (for example, eastern red bats, identified acoustically) (*SI Methods* (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=STXT)) were easily detectable up to nacelle height but tended to become much less detectable as they moved higher than the nacelle, whereas larger bats (for example, hoary bats, identified acoustically) were detectable in the airspace 20–40 m above the nacelle. Although spatial positions of objects are sometimes difficult to determine in 2D video imagery, we were typically able to judge locations of bats in the airspace using reflections in the thermal imagery (e.g., during close approaches thermal reflections of bats could be seen on the turbine tower), shadows in the corresponding NIR imagery (e.g., bat passing close under bottom of nacelle), and by visually observing the parallax of the bat from the different view angles of the thermal and NIR cameras.

For each detection of a bat in the thermal imagery we recorded the following information: number of individuals present, orientation of the nosecone on the turbine nacelle, predominant area of bat activity relative to direction the turbine nose was pointing (leeward, windward), rotor speed (rpm), whether the bat altered course in response to the presence of the turbine (focal behavior), whether the bat made close (<2 m) approaches to the turbine monopole, nacelle, or blades during the event, whether the bat appeared to be struck or displaced by a moving turbine blade, as well as descriptive comments about the event. Turbine orientation was characterized from video, but we also analyzed meteorological and operational data gathered at the turbine nacelle. These data included wind speed (m/s) and rotor speed. Moon illumination was recorded as the proportion of lunar disk illuminated given that it was visible above the horizon. Moon illumination data were obtained from the Astronomical Applications Department of the US Naval Observatory (aa.usno.navy.mil/index.php (http://aa.usno.navy.mil/index.php)).

Analysis of Bat Behavior from Video Detections. Patterns of bat detection in relation to behavior, wind speed, and turbine operation were examined with Kolmogorov–Smirnov and χ^2 tests and logistic regression. Kolmogorov–Smirnov tests of bat behavior compared conditions (e.g., moon illumination) during bat detections relative to that recorded throughout the study period for all nighttime 10-min intervals. All statistical analyses were performed in program R (v2.15.1; R Development Core Team, R: A Language and Environment for Statistical Computing, 2011). The temporal clustering of bat detections within a night at each turbine was evaluated with an index developed for use with temporal sequences where the data are grouped into equally-spaced intervals (14). Detections were grouped by 10-min intervals, and a conservative measure of closeness was specified by limiting the identification of a cluster of detections

those occurring in adjacent time intervals. An α-level of 0.05 was used to determine statistical significance. Temporal cluster analysis was performed with the R script "TangoT.index" (accessed 10/11/13 from www.niph.go.jp/soshiki/gijutsu/download/Rfunctions (http://www.niph.go.jp/soshiki/gijutsu/download/Rfunctions)).

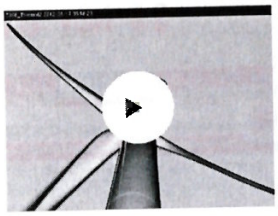
Supplemental Monitoring with Other Techniques. In addition to monitoring the three wind turbines with thermal and near-infrared video surveillance cameras, we concurrently monitored them with acoustic detectors mounted on the turbine nacelles and radar, as described in *SI Methods* (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.201406672SI.pdf?targetid=nameddest=STXT). See Movies S11 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.1406672111.sm11.avi) and S12 (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental/pnas.1406672111.sm12.avi) for examples of bats flying close to turbines with fast-moving blades.



Movie S11.

Bat flying upwind to investigate leeward areas of a wind turbine with blades rotating at full speed at ~0350 hours on July 31, 2012. Bat makes several upwind passes through the moving blades of the turbine without clear indication that it perceives and avoids the fast-moving blades before moving through their plane of motion. Blade rotation speed 14 rpm, wind out of the southwest (228°) at 7.2 m/s, and 95% moon illumination.

406672111/video-11)
f0a41af8cf5f551d064/pnas.1406672111.sm11.avi)



Movie S12.

Bat flying upwind toward moving turbine blades at ~0600 hours on August 17, 2012 and repeatedly returning to investigate after close encounters with blades. Blade rotation speed 14 rpm, wind out of the north-northwest (324°) at 7.6 m/s, and no moon illumination.

406672111/video-12)
f0a41af8cf5f551d064/pnas.1406672111.sm12.avi)

Acknowledgments

We thank C. Willis and two anonymous reviewers for helpful input on earlier drafts of the manuscript; B. Gunderman, B. Gibson, S. Tompkins, C. Newton, C. Wehkamp, R. Linzner, K. Sowers, K. Owens, J. Richards, and the Remote Operations Center Staff for giving us the opportunity to do this research at the Fowler Ridge Wind Farm and for helping with the daily logistics of working at the site; S. Pruitt, L. Pruitt, and T. J. Miller of the US Fish and Wildlife Service provided helpful guidance when we were designing the study; and the field crew and analysis technicians, without whom none of this would have been possible: J. Foster, E. Anstedt, C. Wilkins, K. Scherr, J. Wagner, L. Smith, R. Price, and J. Johnson. This study was supported in part by the Fowler Ridge Wind Farm; the US Geological Survey; Bat Conservation International; and a David H. Smith Fellowship from the Cedar Tree Foundation and Society of Conservation Biology (to D.T.S.H.).

Footnotes

[1]To whom correspondence should be addressed. Email: cryanp@usgs.gov (mailto:cryanp@usgs gov).

Author contributions: P.M.C., P.M.G., C.D.H., M.R.S., R.H.D., M.M.H., F.J.B., D.H.J., K.H., and D.C.D. designed research; P.M.C., P.M.G., C.D.H., M.R.S., R.H.D., and M.M.H. performed research; D.T.S.H., P.D.F., and D.C.D. contributed new reagents/analytic tools; P.M.C., P.M.G., C.D.H., M.R.S., R.H.D., M.M.H., D.T.S.H., and P.D.F. analyzed data; P.M.C., P.M.G., C.D.H., M.R.S., R.H.D., M.M.H., F.J.B., D.H.J., and K.H. wrote the paper.

The authors declare no conflict of interest.

This article is a PNAS Direct Submission.

This article contains supporting information online at www.pnas.org/lookup/suppl/doi:10.1073/pnas. 1406672 11/-/DCSupplemental (/lookup/suppl/doi:10.1073/pnas.1406672111/-/DCSupplemental).

Freely available online through the PNAS open access option.

References

1. Barclay RMR, Harder LD (2003) Life histories of bats: Life in the slow lane. *Bat Ecology*, eds Kunz TH, Parsons S (Univ of Chicago Press, Chicago), pp 209–253.
2. Racey PA, Entwistle AC (2000) Life-history and reproductive strategies of bats. *Reproductive Biology of Bats*, eds Crichton EG, Krutzsch PH (Academic, New York), pp 363–414.
3. Kunz TH, et al. (2007) Ecological impacts of wind energy development on bats: Questions, research

needs, and hypotheses. *Front Ecol Environ* **5**(6):315–324.
CrossRef (/external-ref?access_num=10.1890/1540-9295(2007)5[315:EIOWED]2.0.CO;2&link_type=DOI)
Web of Science (/external-ref?access_num=000248468500017&link_type=ISI)

4. Rydell J, et al. (2010) Bat mortality at wind turbines in northwestern Europe. *Acta Chiropt* **12**(2):261–274. CrossRef (/external-ref?access_num=10.3161/150811010X537846&link_type=DOI)
Web of Science (/external-ref?access_num=000285772400001&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

5. Parsons S, Battley P (2013) Impacts of energy developments on wildlife: A southern hemisphere perspective. *NZ J Zool* **40**(1):1–4.
CrossRef (/external-ref?access_num=10.1080/03014223.2012.758156&link_type=DOI)

SocialCite Appropriate Citation? Strong Evidence? Add More

6. Arnett EB, Baerwald EF (2013) Impacts of wind energy development on bats: Implications for conservation. *Bat Evolution, Ecology, and Conservation*, eds Adams RA, Pedersen SC (Springer, New York), pp 435–456.

7. Cryan PM (2011) Wind turbines as landscape impediments to the migratory connectivity of bats. *Environ Law* **41**(2):355–370.

8. Cryan PM, Barclay RMR (2009) Causes of bat fatalities at wind turbines: Hypotheses and predictions. *J Mammal* **90**(6):1330–1340.
CrossRef (/external-ref?access_num=10.1644/09-MAMM-S-076R1.1&link_type=DOI)
Web of Science (/external-ref?access_num=000273080600007&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

9. Arnett EB, et al. (2008) Patterns of bat fatalities at wind energy facilities in North America. *J Wildl Manage* **71**(1):61–78.

10. Amorim F, Rebelo H, Rodrigues L (2012) Factors influencing bat activity and mortality at a wind farm in the Mediterranean region. *Acta Chiropt* **14**(2):439–457.
CrossRef (/external-ref?access_num=10.3161/150811012X661756&link_type=DOI)
Web of Science (/external-ref?access_num=000314855400017&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

11. Baerwald EF, Edworthy J, Holder M, Barclay RMR (2009) A large-scale mitigation experiment to reduce bat fatalities at wind energy facilities. *J Wildl Manage* **73**(7):1077–1081.
CrossRef (/external-ref?access_num=10.2193/2008-233&link_type=DOI)
Web of Science (/external-ref?access_num=000269484100007&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

12. Arnett EB, Huso MMP, Schirmacher MR, Hayes JP (2011) Altering turbine speed reduces bat mortality at wind-energy facilities. *Front Ecol Environ* **9**(4):209–214.
CrossRef (/external-ref?access_num=10.1890/100103&link_type=DOI)

SocialCite Appropriate Citation? Strong Evidence? Add More

13. Horn JW, Arnett EB, Kunz TH (2008) Behavioral responses of bats to working wind turbines. *J Wildl Manage* **72**(1):123–132. CrossRef (/external-ref?access_num=10.2193/2006-465&link_type=DOI)
Web of Science (/external-ref?access_num=000252624700014&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

14. Tango T (2010) *Statistical Methods for Disease Clustering* (Springer, New York).

15. Chapman JW, et al. (2011) Animal orientation strategies for movement in flows. *Curr Biol* **21**(20):R861–R870. CrossRef (/external-ref?access_num=10.1016/j.cub.2011.08.014&link_type=DOI)
Medline (/external-ref?access_num=22032194&link_type=MED)

SocialCite Appropriate Citation? Strong Evidence? Add More

16. Limpens HJGA, Kapteyn K (1991) Bats, their behaviour and linear landscape elements. *Myotis* **29**:39–48.

17. Verboom B, Spoelstra K (1999) Effects of food abundance and wind on the use of tree lines by an insectivorous bat, *Pipistrellus pipistrellus*. *Can J Zool* **77**(9):1393–1401.
CrossRef (/external-ref?access_num=10.1139/cjz-77-9-1393&link_type=DOI)
Web of Science (/external-ref?access_num=000084047400008&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

18. Allen GM (1939) *Bats: Biology, Behavior and Folklore* (Dover, Mineola, New York).

19. Griffin DR (1958) *Listening in the Dark: The Acoustic Orientation of Bats and Men* (Yale Univ Press, New Haven, CT).

20. Sterbing-D'Angelo S, et al. (2011) Bat wing sensors support flight control. *Proc Natl Acad Sci USA* **108**(27):11291–11296.
Abstract/FREE Full Text (/cgi/ijlink?linkType=ABST&journalCode=pnas&resid=108/27/11291)

SocialCite Appropriate Citation? Strong Evidence? Add More

21. Williams TC, Ireland LC, Williams JM (1973) High altitude flights of the free-tailed bat, *Tadarida brasiliensis*, observed with radar. *J Mammal* **54**(4):807–821.
CrossRef (/external-ref?access_num=10.2307/1379076&link_type=DOI)
Web of Science (/external-ref?access_num=A1973R604300001&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

22. McCracken GF, et al. (2008) Brazilian free-tailed bats (*Tadarida brasiliensis*: Molossidae, Chiroptera) at high altitude: Links to migratory insect populations. *Integr Comp Biol* **48**(1):107–118.
Abstract/FREE Full Text (/cgi/ijlink?linkType=ABST&journalCode=icbiol&resid=48/1/107)

SocialCite Appropriate Citation? Strong Evidence? Add More

23. Griffin DR (1970) Migration and homing of bats. *Biology of Bats*, ed Wimsatt WA (Academic, New York), **Vol 1**, pp 233–264.

24. Boonman A, Bar-On Y, Cvikel N, Yovel Y (2013) It's not black or white-on the range of vision and echolocation in echolocating bats. *Front Physiol* **4**:248.
Medline (/external-ref?access_num=24065924&link_type=MED)

25. Altringham J, Fenton MB (2003) Sensory ecology and communication in the Chiroptera. *Bat Ecology*, eds Kunz TH, Fenton MB (Univ of Chicago Press, Chicago), pp 90–127.

26. Holland RA, Wikelski M (2009) Studying the migratory behaviour of individual bats: Current techniques and future directions. *J Mammal* **90**(6):1324–1329.
CrossRef (/external-ref?access_num=10.1644/09-MAMM-S-086R2.1&link_type=DOI)
Web of Science (/external-ref?access_num=000273080600006&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

27. Cryan PM, Diehl RH (2009) Analyzing bat migration. *Ecological and Behavioral Methods for the Study of Bats*, eds Kunz TH, Parsons S (Johns Hopkins Univ Press, Baltimore), 2nd Ed, pp 477–488.

28. Ruczyński I, Szarlik A, Siemers BM (2011) Conspicuous visual cues can help bats to find tree cavities. *Acta Chiropt* **13**(2):385–389.
CrossRef (/external-ref?access_num=10.3161/150811011X624857&link_type=DOI)
Web of Science (/external-ref?access_num=000301008100013&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

29. Baerwald EF, Barclay RMR (2011) Patterns of activity and fatality of migratory bats at a wind energy facility in Alberta, Canada. *J Wildl Manage* **75**(5):1003–1114.

30. Lima SL, O'Keefe JM (2013) Do predators influence the behaviour of bats? *Biol Rev Camb Philos Soc* **88**(3):626–644. CrossRef (/external-ref?access_num=10.1111/brv.12021&link_type=DOI)

SocialCite Appropriate Citation? Strong Evidence? Add More

31. Jameson JW, Willis CKR (2014) Activity of tree bats at anthropogenic tall structures: Implications for mortality of bats at wind turbines. *Anim Behav* **97**:145–152.
CrossRef (/external-ref?access_num=10.1016/j.anbehav.2014.09.003&link_type=DOI)

SocialCite Appropriate Citation? Strong Evidence? Add More

32. Wyatt TD, Phillips ADG, Grégoire JC (1993) Turbulence, trees and semiochemicals: Wind-tunnel orientation of the predator, *Rhizophagus grandis*, to its barkbeetle prey, *Dendroctonus micans*. *Physiol Entomol* **18**(2):204–210.
CrossRef (/external-ref?access_num=10.1111/j.1365-3032.1993.tb00469.x&link_type=DOI)

SocialCite Appropriate Citation? Strong Evidence? Add More

33. Porté-Agel F, Lu H, Wu YT (2014) Interaction between large wind farms and the atmospheric boundary layer. *Procedia IUTAM* **10**:307–318.
CrossRef (/external-ref?access_num=10.1016/j.piutam.2014.01.026&link_type=DOI)

SocialCite Appropriate Citation? Strong Evidence? Add More

34. Ahlén I, Baagøe HJ, Bach L (2009) Behavior of Scandinavian bats during migration and foraging at sea. *J Mammal* **90**(6):1318–1323.
CrossRef (/external-ref?access_num=10.1644/09-MAMM-S-223R.1&link_type=DOI)
Web of Science (/external-ref?access_num=000273080600005&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

35. Cryan PM, Brown AC (2007) Migration of bats past a remote island offers clues toward the problem of bat fatalities at wind turbines. *Biol Conserv* **139**(1):1–11.
CrossRef (/external-ref?access_num=10.1016/j.biocon.2007.05.019&link_type=DOI)
Web of Science (/external-ref?access_num=000249935400001&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

36. Cryan PM, et al. (2012) Evidence of late-summer mating readiness and early se xual maturationin migratory tree-roosting bats found dead at wind turbines. *PLoS ONE* **7**(10):e47 586.
CrossRef (/external-ref?access_num=10.1371/journal.pone.0047586&link_type=DOI)
Medline (/external-ref?access_num=23094065&link_type=MED)

SocialCite Appropriate Citation? Strong Evidence? Add More

37. Cryan PM (2008) Mating behavior as a possible cause of bat fatalities at wind turbines. *J Wildl Manage* **72**(3):845–849. CrossRef (/external-ref?access_num=10.2193/2007-371&link_type=DOI)
Web of Science (/external-ref?access_num=000254412800035&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

38. Corten GP, Veldkamp HF (2001) Aerodynamics. Insects can halve wind-turbine power. *Nature* **412**(6842):41–42. Medline (/external-ref?access_num=11452297&link_type=MED)

39. Long CV, Flint JA, Lepper PA (2011) Insect attraction to wind turbines: Does colour play a role? *Eur J Wildl Res* **57**(2):323–331. CrossRef (/external-ref?access_num=10.1007/s10344-010-0432-7&link_type=DOI)

Web of Science (/external-ref?access_num=000288553600015&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

40. Rydell J, et al. (2010) Mortality of bats at wind turbines linked to nocturnal insect migration? *Eur J Wildl Res* **56**(6):823–827. CrossRef (/external-ref?access_num=10.1007/s10344-010-0444-3&link_type=DOI)
Web of Science (/external-ref?access_num=000284426300001&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

41. Reimer JP, Baerwald EF, Barclay RMR (2010) Diet of hoary (*Lasiurus cinereus*) and silver-haired (*Lasionycteris noctivagans*) bats while migrating through southwestern Alberta in late summer and autumn. *Am Midl Nat* **164**(2):230–237.
CrossRef (/external-ref?access_num=10.1674/0003-0031-164.2.230&link_type=DOI)
Web of Science (/external-ref?access_num=000282920700005&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

42. Valdez EW, Cryan PM (2013) Insect prey eaten by hoary bats (*Lasiurus cinereus*) prior to fatal collisions with wind turbines. *West N Am Nat* **73**(4):516–524.
CrossRef (/external-ref?access_num=10.3398/064.073.0404&link_type=DOI)
Web of Science (/external-ref?access_num=000331410200011&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

43. Lewis T (1965) The effects of an artificial windbreak on the aerial distribution of flying insects. *Ann Appl Biol* **55**(3):503–512.
CrossRef (/external-ref?access_num=10.1111/j.1744-7348.1965.tb07963.x&link_type=DOI)

SocialCite Appropriate Citation? Strong Evidence? Add More

44. Lewis T (1969) The distribution of flying insects near a low hedgerow. *J Appl Ecol* **6**(3):443–452.
CrossRef (/external-ref?access_num=10.2307/2401510&link_type=DOI)

SocialCite Appropriate Citation? Strong Evidence? Add More

45. Downes JA (1969) The swarming and mating flight of diptera. *Annu Rev Entomol* **14**:271–298.
CrossRef (/external-ref?access_num=10.1146/annurev.en.14.010169.001415&link_type=DOI)
Web of Science (/external-ref?access_num=A1969C420000010&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

46. Wickman PO, Rutowski RL (1999) The evolution of mating dispersion in insects. *Oikos* **84**(3):463–472. CrossRef (/external-ref?access_num=10.2307/3546425&link_type=DOI)
Web of Science (/external-ref?access_num=000078916600009&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

47. Greenbank DO, Schaefer GW, Rainey RC (1980) Spruce budworm (Lepidoptera: Tortricidae) moth flight and dispersal: New understanding from canopy observations, radar, and aircraft. *Mem Entomol Soc Can* **110**:1–45.

48. Weseloh RM (1972) Spatial distribution of the gypsy moth (Lepidoptera: Lymantriidae) and some of its parasitoids within a forest environment. *Entomophaga* **17**(3):339–351.
CrossRef (/external-ref?access_num=10.1007/BF02371186&link_type=DOI)

SocialCite Appropriate Citation? Strong Evidence? Add More

49. LLoyd N, Wilson JA, Barclay RMR (2006) Behaviors of western spruce budworm moths (*Choristoneura occidentalis*) as defences against bat predation. *J Insect Behav* **9**(4):533–544.

50. Lewis JB (1940) Mammals of Amelia County, Virginia. *J Mammal* **21**(4):422–428.
CrossRef (/external-ref?access_num=10.2307/1374879&link_type=DOI)

SocialCite Appropriate Citation? Strong Evidence? Add More

51. Arnett EB, Hein CD, Schirmacher MR, Huso MM, Szewczak JM (2013) Evaluating the effectiveness of an ultrasonic acoustic deterrent for reducing bat fatalities at wind turbines. *PLoS ONE* **8**(6):e65794.
CrossRef (/external-ref?access_num=10.1371/journal.pone.0065794&link_type=DOI)
Medline (/external-ref?access_num=23840369&link_type=MED)

SocialCite Appropriate Citation? Strong Evidence? Add More

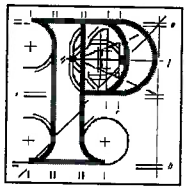
52. Bennett VJ, Hale AM (2014) Red aviation lights on wind turbines do not increase bat-turbine collisions. *Anim Conserv* **17**(4):354–358. CrossRef (/external-ref?access_num=10.1111/acv.12102&link_type=DOI)
Web of Science (/external-ref?access_num=000340255900010&link_type=ISI)

SocialCite Appropriate Citation? Strong Evidence? Add More

53. Hayward B, Davis R (1964) Flight speeds of western bats. *J Mammal* **45**(2):236–242.
CrossRef (/external-ref?access_num=10.2307/1376986&link_type=DOI)

SocialCite Appropriate Citation? Strong Evidence? Add More

An Bord Pleanála



Inspector's Report

Appeal Ref. No:	**PL 04.204928**
Proposed Development:	**Windfarm to include 23 No. turbines, 60m meteorological mast, 110kv substation and switch station, entrances, site tracks and associated works.**
Location:	**Barnadivane (Kneeves), Knockboy, Garranereagh, Lackareagh, Reenacaheragh, Terelton, Co. Cork.**
Applicants:	**Barna Wind Energy Ltd.**
Planning Authority Reg. Ref:	**S/03/2365**
Planning Authority:	**Cork County Council.**
P.A. Decision:	**Grant permission with 35 conditions.**
Appeal Type:	**1st and 3rd Parties.**
Appellants:	**1. Barna Wind Energy Ltd.** **2. Pat Harrington & Bernadette McCarthy Harrington.** **3. Patrick & Margaret Cahalane.** **4. Mary Harrington.** **5. Kevin Harrington.** **6. Kathleen O'Driscoll.** **7. Art Generation Ltd.** **8. H.G. Fitzpatrick.**
Observers:	**1. Dennis Buckley.** **2. C. Glerbeek.**
Date of Site Inspection:	**14th January 2004**
Inspector:	**David Dunne.**

1. Site and Surroundings.

The site is located approximately in the mid point of a triangle formed by Macroom, Dunmanway and Bandon. Macroom lies approx. 9km north of the site, Ballineen/Enniskean approx. 8km to the south while the nearest villages are Terelton (approx. 2km N) and Coppeen (approx. 2km SW). Access is from R585 at Moneynacroha approximately 3km east of Coppeen. There is a network of minor roads between the N22 to the north, the R587 to the west and the R585 to the south and east.

The site of 410ha is on a ridge running east-west with a height of between 170 and 270m OD. To the north the general topography of the wider area drops to about 70m OD to the River Lee Valley. The land to the east consists of a series of hills separated by river valleys. To the west there is also a series of hills and to the south the land slopes to the River Bride. There are pockets of coniferous forest in the general area.

Site is mainly farmland, predominantly cattle and sheep grazing with a 110kv line passing through it. It is characterised by an enclosed pattern of fields. There are 78 dwellings within a 1km offset of the site boundary (or 62 within 1km of the nearest turbine), 15 of which are within the site itself (see fig.4.1 of EIS).

I attach photographs taken during my site inspection.

2. Proposed Development.

The original public notices described the proposed development as a windfarm of 26 wind turbines (60m hub, 80m blade diameter with a total height not exceeding 100m), a 110kv substation, a 110kv switch station, one 60m meteorological mast, construction and upgrading of site entrances, site tracks, and associated works.

The revised public notices dated 20/8/03 referred to the submission of significant further information and revised plans. The submission reduced the number of turbines to 23 and revised the layout.

The capacity of the proposed windfarm is approximately 65 MW. The design of the turbines, substation, switch station, meteorological mast, access roads and foundation pads are typical for windfarms and are explained in 2.2 of the EIS.

3. Environmental Impact Statement.

I have read the EIS in full and it is to be noted that it contains a separate non-technical summary volume. I consider that the content of the EIS and the topics covered are adequate having regard to the provisions of Schedule 6 of the Planning and Development Regulations 2001.

The following is a summary of the main items of factual information contained in the EIS under subject headings and relevant to an assessment of this scheme. It is to be noted that the EIS refers to the original proposal for 26 turbines. The visual and noise

impacts of the EIS were revised to cover cumulative impacts of the amended proposal for 23 turbines (lodged with PA 20/8/03) and the 5 turbines permitted on the adjacent site. The EIS explains international, EU and national policy on alternative energy. It argues that prices offered to wind energy producers in Ireland are significantly lower than those offered to producers on the continent. Consequently, it says that Irish windfarms must generate more power than other European windfarms to be economically viable.

Alternatives.
The site is considered suitable for a wind farm because of good predicted wind speeds, probable on-site grid connection, inclusion within the Strategic Search Area, good access to site and minimal likely impacts on the surrounding environment. It says that alternative designs and layouts were considered during the EIA process but evidence of this has not been submitted. The proposed layout was determined by the criteria listed in 1.4.3 of the EIS.

Landscape and visual impact.
Using the classification of the Altener Study, the landscape is defined as upland intimate rolling farmland mosaic with scrub outcrops. The EIS identifies 3 image units to aid landscape character, (a) the site and surroundings, (b) the Lee Valley and reservoir and (c) the Bandon River valley. The Altener Study classified the site as Level 1 – low landscape sensitivity and the EIS considers the site to have low regional or national importance (see p.45 for criteria) and low vulnerability (Class 1 Alterer Study). The river valleys to the north and south have been classified as more sensitive than the site but the distance from the development and the calculated predicted views indicate that the impact on these areas will be low.

The visual impact assessment consists of a ZVI map of a 20km x 20km area, and a set of wireframes and photomontages from 7 viewpoints. Table 3.1 describes the viewpoints while table 3.2 presents a summary of visual impacts. Table 3.2 states that the impact from viewpoint 1 will be high, and from viewpoints 2 and 7 will be moderate. The cumulative impacts in the submission lodged with the PA on 20/8/03 involve a net increase of 2 turbines but the overall classification of visual impacts remains approximately the same.

Noise.
Noise monitoring was carried out at 3 locations on 1 day/night to determine background levels. Figure 4.1 maps 78 dwellings within 1km offset from the site boundary. The noise prediction model used a wind speed of 8ms at a height of 10m. Table 4.3 lists predicted daytime noise levels for 78 dwellings while table 4.4 lists night-time predictions.

The EIS discusses the noise guidelines of the UK DTI Wind Turbine Noise Working Group, IPI, DoE and EPA. Because existing ambient noise already exceeds the IPI, DoE and EPA guidelines and for other reasons, they are considered unsuitable for assessment of noise impact at this site. Instead the UK DTI and Cork County guidelines are considered more appropriate. The predicted turbine noise levels at 19 of the 62 house do not comply with these guidelines but shareholders in the project or their families own the majority of these houses and the remaining 3 house owners

have signed waivers. Mitigation measures include variable pitch turbines and a computer control system to automatically control power and pitch.

Other impacts on human beings.
The EIS explains that of the 78 dwellings within the 1km offset boundary of the site, only 62 are located within 1km of the nearest turbine and there are 26 within 500m of any turbine. The entire site is located within an area recently designated under the Clar programme designed by Government specifically to address rural areas of special disadvantage. Construction traffic is not likely to lead to any significant adverse effects on local traffic levels.

A summary of shadow flicker results is presented in table 5.3. There are 21 houses which could potentially be affected for more than 20 hours per year, 16 of which are house owners directly involved in the proposed development. Waivers have been signed by 2 others. At the remaining 3 houses, a survey established that there is adequate screening around each of these houses such that the potential for shadow flicker is very low. If mitigation is required, additional screening could be planted or blinds could be installed if necessary. The EIS says that if necessary the turbines can be programmed to stop for a brief period until the shadows have passed the affected window. It is not considered likely to be needed.

Hydrology.
A desk-top study of hydrology was carried out. The potential increased run-off from roads and hard-standings has been calculated. The areas to be cleared for these will account for less than 2% of the total area of the site and the percentage increase in run-off will be insignificant and will be taken up by a number of streams. Mitigation measures for oils and diesel are proposed along with sedimentation traps.

Air and climate.
The windfarm will generate electricity that would otherwise be generated by fossil fuels and the proposed development will therefore have a significant positive impact on air quality and climate.

Cultural heritage.
There is 1 known archaeological monument within the area of the proposed development, CO094-036 a ringfort. There are 7 other monuments within 400m of the site. It is not envisaged that the turbines will significantly affect the visual setting of the ringfort or negatively impact on the other 7 monuments. A 20m buffer zone will be set out around these monuments and no construction works or planting/landscaping will take place within this buffer. A licensed archaeologist will monitor all earthworks during construction. No mitigation measures are necessary for protected structures or other features of cultural heritage in the vicinity.

Ecology.
An ecology survey was carried out 16th to 21st April 2003 and a bat survey on 4th May 2003. The site does not form part of, nor is it in the proximity of any SAC or pNHA. The nearest SAC/pNHA is the Gearagh 7km to N (synopsis in appendix J). There are 2 annexed habitats, wet grassland and wet heath within the site. Of the 117 flora species that occur on site, none are listed in the Irish Red Data Book. No bat rousts were found and no red listed birds were found. A total of 7 species of amber listed

birds were recorded. There is no historical data indicating the presence of the hen harrier and the habitat on site is not suitable for breeding or foraging hen harriers.

Detailed mitigation measures for bats and birds are proposed. The overall conclusions are that the proposed windfarm will not have significant negative impacts on ecology.

Land use.
There are no official public rights of way in the vicinity of the site or recreational uses associated with the site. There are no hospitals, schools, hotels or guesthouses within 1km of the site.

Electro-magnetic effects.
Pre-consultation with ESB, IAA, mobile phone operators, Chorus and Southern Health Board have been carried out. Replies have indicated that they believe that the proposed windfarm will not have any significant adverse effect on telecommunication signals.

Interaction.
Based on the positive impacts of the development and the low to moderate visual impact, it is considered that Barnadivvane is a very suitable site for the development proposed.

4. History.

The 5 history files received from the planning authority refer to individual dwellings. The grounds of appeal refer to a permission granted for 5 turbines on the adjoining site to the east (Reg.Ref. S/03/2047) but details are not on file. However, the applicants have shown the layout of the adjoining windfarm and the cumulative visual impacts in the submission received by the planning authority on 20/8/03.

5. Planning Authority Decision.

Before decision, the PA requested AI on 5 issues – cumulative visual and noise impacts, set back 2-4 blade diameter from site boundaries, house survey classified by occupied or vacant, revised proposals for complying with noise thresholds, and revised layout for turbines and access roads to reduce impacts on annexed habitats. The PA on 20/8/03 received a detailed report by the applicant.

The planning authority decided to grant permission subject to 35 no. conditions. Of particular note are;

- Condition 1: omitting 6 turbines.
- Condition 10: no development shall occur until the developer and the adjoining developer have consulted and cooperated to the satisfaction of the PA on joint connection to National Grid.
- Condition 11: archaeology.
- Condition 15: the developer shall provide such measures as are necessary to minimise the impact of shadow flicker at nearby residences.
- Condition 24: noise levels following "decommissioning" when measured at a noise sensitive location shall not exceed 43 dBa L90 above background levels.
- Conditions 25 and 26: noise monitoring surveys.

- Condition 27: record of bird casualties.
- Condition 28: bird survey.
- Condition 35: construction to be monitored by environmental engineer or ecologist.

Planner's Report.
There are 2 planning reports. Between them they offer a rationale for the omission of 6 turbines in condition 1.

The ***Heritage Officer*** in report dated 2/7/03 examines habitats, earth banks, fauna and water quality and recommends a set of conditions in the event of permission being granted. Of particular note is her requirement that turbines and associated works should not be located on wet grasslands or wet heath as these are annexed habitats under the EU Habitats Directive.

The ***Archaeological Officer*** in report dated 27/6/03 lists a condition.

6. First Party Appeal.

McCutcheon Hogan has submitted the grounds of a first party appeal against the terms of conditions 1 and 10 of the planning authority's decision. I have read the grounds of appeal in full and the following is my summary of the principal planning issues raised:

Condition 1.

- The proposal complies with current Government Policy. Although small-scale wind energy projects have an important role in the government's strategy, it is obvious from the results of AER5 (78% of the capacity was awarded to large scale wind) and AER6 (62% of the capacity awarded to large scale wind) that the government views large scale windfarm development as the most important renewable energy source when it comes to achieving commitments given in the Kyoto Protocol. In this context, planning authorities should only reduce the scale of windfarms if there are very significant, which is not true in this case.
- The proposal complies with the policies of the County Plan 2003. It is located in a "Strategic Search Area" and the planning authority's handling of recent applications for small wind farms (PL 04.155381 & PL 04.129808) would suggest that it is their policy to maximise the potential for windfarm development in suitable areas through the development of large scale windfarms. The proposal represents an intensive and most sustainable use of the wind resource at this location. The site is to the south of scenic route A84, an isolated route in part of the county which is not an important tourist area, does not provide strategic links to important tourist areas, and the views obtained from it are low grade and unspectacular. Scenic routes were designated in the 1970's and are to be re-evaluated in Local Area Plans. The proposal would not be contrary to the planning authority's policy to protect visually sensitive areas and important views from scenic roads.
- The proposal would not have a negative impact on the visual amenities of the area. In recommending the omission of turbines 1, 2 and 23 the Area Planner considered that they would have a serious impact on the scenic route and visual amenities of the area. Having regard to the nature of the scenic route, its relatively

low amenity and tourist attraction and the visibility of these turbines from it, the appellants do no believe the turbines would have a significant negative impact on the visual amenities of the area or the scenic route.

- The proposal does not impact significantly on the residential amenities of the area. The layout attempts to minimise impacts and noise and shadow flicker have been fully assessed in chapters 4 and 5 of EIS. The applicants can accurately predict the times that shadow flicker may affect third parties and are willing to agree to the shutting down of the responsible turbines for these times.
  - The closest dwelling to turbine 1 is dwelling 72 in Fig.4.1 of the EIS. The owner of this unoccupied dwelling is aware of shadow flicker and has given consent (see attached letter). The predicted noise levels are within the PA limits.
  - Turbine 2 is 400m to the east of the nearest dwelling, noise levels are within PA limits and shadow flicker may amount to 15.4.hours per annum. Having regard to distance, the turbine will not have a significant impact.
  - Turbine 23 is 420m north of nearest dwelling where predicted noise is within PA limits and shadow flicker will not impact.
  - Turbine 3 is 300m from nearest dwelling where predicted noise will be within acceptable limits and shadow flicker of 56.3 h/p/a. The owner has no objection (see attached letter).
  - Turbine 12 is 300m from an unoccupied dwelling with acceptable noise levels and shadow flicker of 55.9 h/p/a where the owner has no objection (see attached letter).
  - Turbine 21 is located south of 4 dwellings with the nearest 350m. noise levels within acceptable levels and shadow flicker of 14.6 h/p/a. Having regard to distance, predicted impacts will not be significant.

Condition 1 threatens the viability of the project and should be omitted. In omitting the 6 turbines the PA did not have due regard to the fact that some of these dwellings are unoccupied and that the development has the consent of third parties.

Condition 10.

This condition is unreasonable, unduly onerous and ultra vires. The applicants and the adjacent windfarm developers are in competition for available capacity and it appears unlikely the agreement can be reached between the parties. Having regard to Section 34 of the Act 2000 the condition is ultra vires because the adjoining windfarm is not under the control of the applicant. Having regard to the "Development Control Advice and Guidelines" (DoE 1982), the condition is unnecessary because grid connection will require a separate application. There is an existing 110kv line through the site and preliminary discussions with the ESB have indicated that on-site connection will be possible without the need to construct additional overhead lines. The condition is unreasonable in that it renders the viability of the development dependent on an agreement with a third party who may not be reasonable in negotiations and where no contingency is afforded where parties fail to agree. The condition should be deleted and if necessary replaced by the standard PA condition.

7. Third Party Appeal.

There are 7 third party appeals. I have read the grounds of appeal in full in each case. The following is my summary of the principal planning issues raised.

Patrick & Margaret Cahalane.

This appeal is limited to the terms of condition no.1 and the appellants require the condition to be modified. The appellants have received permission for a windfarm of 5 turbines on an adjoining site (Reg.Ref S/03/2047). They request that turbines T18, T19 and T22 be omitted for the following reasons:

- The size and scale of the development will represent a serious energy production loss for the appellant's windfarm and effectively jeopardise it. It will devalue neighbouring property.
- The estimated loss is €3.06m over the life of the windfarm based on production losses of 2,081MWh per annum due to the proximity and intensity of the upstream wind generators in the prevailing direction as proven in the Garrad Hassan report.
- The Danish Wind Industry Association recommends 5 – 9 rotor diameter separation. The appellant's first row is the fifth row in the combined project development facing the SW prevailing wind direction.
- Inadequate or incorrect evaluation by planning authority. The appellant's windfarm in isolation has a performance of 95.5%. With the current layout this is reduced to 90.3% and with the suggested amended layout this improves to 92.7%. The losses experienced are serious even with turbines 18, 19 and 22 removed.
- The PA did not properly seek clarification from the promoters on the impact of the proposed development on the adjoining planned windfarm. The analysis appears to favour the larger projects over smaller ones, i.e. the greater good of energy produced in an area over and above the devaluation and diminishing of adjoining property. Each landowner should have a right to develop to full potential.
- The benchmark of 4 rotor diameter is only sufficient for small size turbines, single front rows layout at perpendicular angle to the prevailing wind and/or equally dispersed frequency windrows. It was developed when 50m diameter was common in Ireland.
- An impact assessment similar to that required for retail developments should have been carried out.

This appeal has a number of attachments, most notably a report from Garrad Hassan, but also including an extract from a publication by the Danish Wind Industry Association and the terms of a proposed agreement between the appellants and the applicant's. The Garrad Hassan report conclusions have been summarised by the applicant above. This is a study of wake losses using a set of assumptions and comparing (a) the appellant's permitted layout of 5 turbines in isolation, (b) the 5 turbines with the layout for 17 turbines on the subject site as indicated in the planning authority's decision, and (c) the 5 turbines with a revised Barna layout that omits turbines 18, 19 and 22. The report also refers to the effect of turbulence in the wake of turbines leading to fatigue loading which may effect warranties.

Art Generation Ltd.

Art Generation Ltd is the applicant on the adjoining site for a 5 turbine windfarm. This appeal, submitted by Brian Meehan & Associates, requires the deletion of turbines 18, 19 and 22. The grounds of appeal are similar to those submitted by Patrick & Margaret Cahalane and include a copy of the Garrad Hassan report and a letter from Bonus Energy A/S. This letter says that as a general rule of thumb the distance between rows of turbines should be at least 7 times the rotor diameter of the

wind turbine having the biggest rotor. Bonus calculate a loss of 10% for each of the turbines in the Art Generation Ltd scheme and say that such losses clearly tell that the distances are too close. The letter explains the impact of turbulence and fatigue loads. Mr. Meehan's submission also examines the planning authority assessment in detail and presents similar arguments to those of Patrick & Margaret Cahalane.

Pat Harrington & Bernadette McCarthy Harrington.

- Visual impact from residence and on landscape of this beautiful area due to size and quantity.
- Noise will drown out bird song. Noise level is above UK DTI guidelines and this is unacceptable.
- Birds will fly into turbines. Impact on fishing in River Bride.
- Shadow flicker and overshadowing in evenings. The appellant is concerned about the effect of flicker on her history of epilepsy.
- Revised house occupation map does not include house no's 28, 27, 26, 25, 24 and 61 which were shown in EIS dated 7/5/03. The owners of several of these "missing" dwellings are opposed to the development.
- Buildings, particularly housing, should not be nearer than 2km to the wind farm according to Genesis, a UK-German company specialising in turbine manufacture.
- Applicant's letter re S/03/2047 re public knowledge of project incorrect.
- Devaluation of land and properties.
- Impact of historical aspect of area - visitors to Mbeal Na Mblath and ringfort will see these huge distasteful machines. There are at least 7 known archaeological monuments within 400m of site.

Mary Harrington.

- The majority of the 17 turbines would be seen from scenic routes A35 and A36 and from pNHA-1854. Scenic routes should be kept scenic. The safety of walkers will be under threat from possible falling ice. The beauty of the landscape will be damaged.
- Noise – difficulties of enforcement and monitoring are outlined. This raises a question over EIS statements and the possibility that residents will have to take their own legal action when levels are exceeded.
- Visual impact – steel structures of 60m hub and 33m diameter blades. Prof. David Bellamy quoted as saying that turbines are a blot on the landscape. The development will interrupt the prominent skyline. Quotation from Wind Power Monthly. Local residents have to live with these ever present, attention drawing, landscape dominating monstrosities.
- Shadow and reflection – the applicant's say software will be used to ensure that shadow flicker will not impact any house in the area. Given the variables, the appellant has little faith in the applicant's assurances with regard to this issue.
- Change character of remote and attractive rural area – residents will be deprived for two decades of all rural pleasures, swapping it instead for a life of living next to a giant industrial estate.

Kevin Harrington.

- Turbines 6, 10 and 13 have not been positioned at least 132m from site boundaries as requested in planning authority letter of 25/8/03. These turbines should be deleted.

- Turbines 13, 15, 17, 19 and 20 have not been set back 300m from the public roads as required by current Irish guidelines. These turbines should be deleted on grounds of road safety due to driver distraction, distraction from light reflection from blades, traffic disruption in the event of collapse, and flying ice. International studies have shown that ice fragments can fly over 550m and land with impacts of up to 170mph.
- Noise – what will happen if the terms of condition 24 are exceeded? Will the PA force Barna to dismantle and decommission turbines? Table 1-1 of cumulative noise prediction (August 2003) shows that 20 of the 62 listed dwellings are still above the 43dB threshold. There should be a legally binding undertaking that turbines should be dismantled and removed if and when 43dB is exceeded at any of the 62 listed dwellings.
- The submitted EIS reads like a glorified sales advertisement repeatedly using the phrase "probably". EIS's should be carried out by a totally independent firm.
- Permission would not be granted for a two storey house on grounds of visual amenity yet the PA has no objection to an industrial development of 17 turbines that are 93m in height – 10 times the height of a two storey house.
- A development of this scale will effect the lives of residents for 20 years – loss of birds in the area, visual impact. This is not a remote area.
- The appellant will be directly downwind from the turbines and thus subjected to noise as listed.

Kathleen O'Driscoll.

- Substantial negative visual impact – this is a strategic search area for locating windfarms but the scale of the development is out of proportion to the receiving landscape. The strategic search area should not allow the whole hill to be saturated with a huge number of wind towers. There will be a significant negative visual impact due to the number of turbines, their height and diameter, and their concentration and density. It will completely change the character of the area.
- Devaluation of property – due to proximity and visual impact, the development will devalue and cause serious injury to the appellant's property. The appellant supports green energy and windfarms on a more moderate scale.

H.G. Fitzpatrick.

- Like the appeal of Kevin Harrington, Mr. Fitzpatrick advocates deleting turbines 13, 15, 17, 19 and 20 since they are not set back 300m from public roads.
- Mr. Fitzpatrick has decided to sell and move elsewhere because of the consequences that the development will have on his health and the environment.
- In the event of permission being granted, a condition should be attached stating that Barna will not be permitted any further future wind turbine development in the area.
- Mr. Fitzpatrick finds the Senior Planner's remarks extraordinary and says that large wind turbine projects should only be granted if and when County Councils have a very clear picture of precisely how it will effect areas and it's residents.

8. Observations.

Dennis Buckley.
Mr. Buckley has a livestock farm of 100 acres and dwelling directly adjacent to the development and would view turbines 4, 5, 6, 7, 14 and 17 fully, and up to 75% of the height of the remaining 11 turbines. Turbine 5 is 263m and turbine 6 is 123m from his ownership boundary. Turbines 5 & 6 are totally unacceptable because they will significantly reduce the value of his property – international studies estimate 25 to 30% reduction. He will have to abandon planned expansion of bloodstock business due to noise and risk of ice thrown from turbine blades. The close proximity of the 2 turbines to the River Bride may cause sedimentation due to the porous nature of the surrounding grounds. The access roads will permanently scar the landscape. Many locals are afraid of lodging objections. Unlike other schemes, this project is located in a well populated green area with intensive farming. Turbines 5 & 6 should be omitted.

C. Glerbeek.
Mr. Glerbeek lives at Moneygaff East directly facing the proposed development. He says the development will rob him of rural pleasures and greatly reduce his quality of life forcing him to look at giant, 100m, white turbine monsters right in front of his property. To the front he would be able to see turbines 4, 5, 6, 7, 14 and 17 fully and the multitude of access roads, many on sloping grounds making them more noticeable. He is being forced to sell and will be faced with considerable financial loss.

Mr. Glerbeek suggests alterations to the planning regulations regarding colour coding of site notices and that the EIS for commercial developments should be prepared by a company independent of the applicants. The Dunmanway windfarm of 7 turbines is located in an area devoid of dwellings. This compares with the subject site of 17 turbines in an area with 62 dwellings. Windfarms should not be permitted in well populated areas.

Other points raised include

- Disagrees with applicant's statement concerning public awareness of the project.
- Financial donations by developers such as Barna should be banned.
- The PA informed Barna on at least 3 occasions that noise impacts exceeded their standard. In revised EIS table 1-1 20 of the 62 listed dwellings were still above the 43dB threshold with a peak of 52.9 dB.
- Turbines 13, 15, 17, 19 and 20 are not 300m from public roads as clearly required by current Irish Guidelines.
- Windfarms of this magnitude do not belong in a populated area. Just because it is located in a strategic search zone does not automatically mean that a windfarm of 17 turbines should be permitted in the local community.

9. Response by First Party.

In responding to the third party grounds of appeal, McCutcheon Hogan has repeated many of the points they raised in their own first party appeal against condition 1. Excluding repetition of earlier arguments, the following additional points of reply have been made:

- The Harrington family live closer to the Art Generation Ltd project yet they have not objected to that proposal. The Board should note the content of 2 letters attached from Angela O'Sullivan and Conor O'Carroll in relation to the signing and use of the submitted petition.
- Regarding turbine set back from site boundaries, the PA has not published their specific guidelines but the Development Plan contains objectives in accordance with the DOE 1996 Windfarm Guidelines. In discussions with the PA it was agreed that the aim of their request for 2 – 4 diameter separation was to protect the residential amenities of adjacent dwellings and ensure an appropriate separation between the two windfarm proposals. As there are no dwellings in the vicinity of the boundaries of turbines 6, 10 and 13 the PA agreed that the proposed separation distances were appropriate.
- In relation to Kevin Harrington's request that turbines 13, 15, 17, 19 and 20 be omitted because they are not 300m from public road, the PA has not published guidelines. Having regard to the nature and location of these roads, the applicants believe the proposed development will not constitute a traffic hazard or obstruction of road users by virtue of distraction.
- Kevin Harrington's request of further reduction of 8 turbines would reduce the development to 9 turbines on 410ha. Due to the high fixed cost of connecting to the transmission system (110kv) it is necessary that the project maintains a large size. Given the suitability of the site and in the interests of sustainable development intensive use should be made of the wind resource at this location. The reduction to the scale proposed would be contrary to the local and national policies in relation to the production of alternative energy.
- The EIS accurately predicts noise and shadow flicker impacts on residences and can be controlled by automatic shut down.
- Visual intrusion has been dealt with previously. The proposed development will alter the appearance of the area but the democratic decision to alter the character of the area has already been made in the Development Plan.
- Garrad Hassan was requested to propose an alternative layout solution which reduces the overall economic risk to the Garranreagh project – he was not required to propose a layout which maximised the output of both sites. This is the reason for the large inter-turbine distance of 8 – 10 rotor diameters recommended in the Garrad Hassan report. The Irish Industry standard, confirmed by Aertech/ESBI and used by many County Councils is a 4 – 5 rotor diameter separation and Barna have maintained this throughout their development.
- The Garrad Hassan report uses wind rose for Cork Airport – an accurate assessment of energy loss or production is not possible without the collection of real wind data (the reason why developers erect wind monitoring masts for 12 months prior to development). The report acknowledges this fact.
- The Art Generation project would have a total energy output of 6.5MW compared to 42.5MW on the Barna site. The omission of turbines 18, 19 and 22 would result in loss of 7.5MW from the Barna project.
- The degree of the effect of the Barna project on the Art Generation project cannot be quantified accurately at this time. The Art Generation project will adversely affect the Barna project during non-prevailing wind periods. Recent studies from Netherlands and Denmark indicate that climate change is effecting wind direction

and these trends make it more difficult to predict the impact of windfarms on each other.

- The reduction of 7.5MW from a strategic search area on the basis of preserving the economic viability of an adjacent smaller project would be contrary to the principles of sustainable development and current government policy.
- The appellant's argument about reasonable access to available wind resource is given credence by reference to the principle of not prejudicing the development potential of adjoining lands. The simple analogies given are not accepted. Wind is a national resource to which no one has a right in the same way that a view is a national resource. The reduction of 7.5MW would be 1MW more than the total capacity of the Art Generation scheme. The appellants have no rights to the wind resource at this location. The Board should dismiss the appeals of Pat & Margaret Cahalane and Art Generation as they are without substance or foundation.

10. Response by Planning Authority.

Regarding condition 1, Nicholas Manseragh in report dated 25/11/03 says that turbine 2 was omitted because it is located around 300m from dwelling 30 and not 400m as stated in the appeal. Turbine 23 was omitted to leave houses 47, 48, 57 and 61 open to the south. The size of the turbines and their proximity to both occupied and currently unoccupied houses was considered when omitting turbines 3 and 21.

The report says the application is unusual in that it envisages a number of dwellings within a windfarm. The proposal will drastically change the character of the area but the area will continue to have residential and agricultural functions. Consequently, the agreement of the current uninvolved owner of property should not be regarded as a completely decisive consideration.

Condition 10 was imposed because it is one of the functions of planning to coordinate adjoining developments. The appellant has not put forward an alternative suggestion on coordination.

In relation to the Art Generation appeal and the Garrad Hassan report, assessment in this particular case is facilitated by the fact that the loss to the objector involves the same variable as the benefit to the developer and the community. The report does not suggest there is an adequate quantitative case for the omission of the 3 turbines sought by Art Generation. Barna Energy has used a 400m separation between turbines and the 3 turbines that Art Generation want removed are 350-370m. There is sufficient room on the Art Generation site to reposition their turbines more than 400m from the Barna ones.

Regarding the local residents appeals, there will be some adverse impacts particularly the change in the visual character of the area, which will be fairly drastic. The area is attractive, very rural and has amenity value. However, the question is whether these effects outweigh the potential for 50MW of renewal generating capacity well situated strategically and within a search area and with limited tourist potential. The ratio between these effects appears sufficiently positive to justify permission.

11. Further Responses.

Art Generation Ltd.
Brian Meehan & Assoc. in letter of 8/12/03 say that a condition similar to No.10 has been imposed on the Art Generation Ltd windfarm and they are willing to co-operate to facilitate the most efficient and appropriate connection to the national grid in the interests of minimising any visual/environmental impacts on the surrounding landscape. The condition should be retained. They support the appeal of Margaret and Pat Cahalane.

Pat Cahalane.
In letter dated 3/12/03 he says he is surprised at the applicants appealing condition 10 because this would minimise visual impact.

12. Prescribed Bodies.

The ***DoEHLG*** in letter dated 2/7/03 recommends that clarification be sought confirming that there is no impact on the architectural heritage of the area. The letter provides details of cultural and architectural heritage as EIS topics and includes an appendix.

The ***Irish Aviation Authority*** in letter dated 24/6/03 requires conditions.

The ***South Western Regional Fisheries Board*** in letter dated 23/6/03 lists a set of conditions to be applied.

13. Statutory and Other Plans.

National Policy.
It is Government Policy to promote the development of renewable energy sources. This policy is outlined in Sustainable Development – A Strategy for Ireland, 1997. Sustainable Energy policy includes maximising the efficiency of generation and emphasising the use of renewable resources. The policy also seeks to minimise the emissions of greenhouse gases and other pollutants, both by clean generation and by sustainable consumption levels in all sectors.

The National Spatial Strategy 2002 – 2020 states "in economic development the environment provides a resource base that supports a wide range of activities that include agriculture, forestry, fishing, aqua-culture, mineral use, energy use, industry, services and tourism. For these activities, the aim should be to ensure that the resources are used in sustainable ways that put as much emphasis as possible on their renewability" (page 114).

Green Paper on Sustainable Energy 1999 set targets for the generation of electricity from renewable energy sources for 500MW in the period 2000-2005.

DoELG Guidelines.
In 1996 the Department of the Environment produced guidelines for planning authorities on wind farm development. These may be considered somewhat outdated

at this stage, and I note that the Guidelines are currently under review. These Guidelines generally relate to smaller turbines and rotors.

The Guidelines state that visual impact is among the more important considerations. Regard should be had to both the immediate visual impact and views from a distance. Turbines should not dominate landscape features, especially views which are designated and which it is necessary to preserve. Turbines should not be prominent when seen against an elevated skyline background from public roads, towns or village centres. Account should be taken of intervisibility of sites and the cumulative impact of developments. Noise is another important consideration. Account should be taken of the nature and character of nearby surroundings and developments. Generally noise levels measured externally at any dwellinghouse should not exceed 40 dBA.

Rural land uses, other than housing, are generally unlikely to conflict with windfarm developments.

Altener Report.

The Altener Project AL/98/542 or the Altener Report (undated but date stamped 2001 by planning authority) was a joint study between Cork County Council, WIND-Consult and Gestenga which examined wind potential and landscape character on a county basis. It is a non-statutory document.

The wind potential analysis examined wind speed and terrain roughness. A set of exclusion areas were devised (table 5.9.1 page 14) both general and environmental, the latter including forests. When combined with the landscape assessment, a map of "Useable Areas" was produced. The landscape assessment was guided by the DoELG draft Landscape Guidelines and involved a Landscape Character Assessment and a Landscape Values and Sensitivity Assessment. A set of 5 sensitivity classes were devised with class 1 as the least sensitive and class 5 as the most sensitive.

The report of the Cork County Council Planning Policy Unit entitled "Planning for Wind Energy and the Landscape", March 2001, provides a summary of the concepts used in the Altener Report and a discussion of the key technical findings. It says that in its present form, the Altener Report cannot be used as a basis for policy (page 5).

County Development Plan 2003.

The policy for wind farms is contained in Volume 1, chapter 5, paragraphs 5.4.5 to 5.4.8. This identifies in broad strategic terms, two special areas called "Strategic Search Areas" and "Strategically Unsuitable Areas", and these are shown diagrammatically in map form. The "Strategic Search Areas" are described as areas which have both relatively high wind speed and relatively low landscape sensitivity. Developers would be encouraged generally to focus on these areas when searching for potentially suitable sites. The "Strategically Unsuitable Areas" are areas of high landscape sensitivity which are unsuitable for wind energy projects although there may be limited potential for small-scale wind projects. The objectives for wind energy are set out in a table as INF 4-4 and INF 4-5. It is noted that there are no policies relating to maximum size or power output of wind energy projects.

The policy on Tourism Development is presented in Volume 1, chapter 4 at section 4.4. Section 4.4.2 says that the key resources on which the tourist industry relies are

the identifiable features that make up the natural, built and cultural environment of the County and objective ECO 4-1 seeks to protect and conserve such resources. Section 4.4.5 says that the needs of tourists and the tourist industry should always be taken into account when proposals for new infrastructure or other facilities are being considered. This section appears to be directed particularly at public transport, hotel and other visitor accommodation projects.

The policy on Environment and Heritage is set out in Volume 1, chapter 7. There is a note on Hen Harrier Habitats in section 7.2.12 which refers to the Duchas examination of SPA's. Section 7.3 deals with Landscape and Visual Amenity and sets out 16 landscape types. These are shown on the Landscape Character map in Volume 4 and the subject site is in landscape character area 55 "upland of intimate rolling farmland mosaic with scrub outcrops" and landscape type 16 "Glaciated Cradle Valleys". Section 7.3.5 says that assessment of landscape sensitivity will be carried out through a Local Area Plans programme in the future. Scenic Amenity, Views and Prospects are discussed in sections 7.3.6 to 7.3.8 and it is noted that objective ENV 3-5 says it is a particular objective to preserve the character of those views and prospects obtainable from scenic routes identified in the plan. The list of scenic routes is given in Volume 2, chapter 4 and these include the A84 which is identified on the maps in Volume 4 and are particularly relevant to the subject site.

14. Assessment.

Introduction.

I consider that the principal planning issues have been identified in the grounds of appeal and that there are no new issues to be considered by the Board.

It is to be noted that the original scheme proposed 26 turbines. However, the Board is dealing with the revised proposal lodged with the planning authority on 20/8/03 for 23 turbines and revised layout. ***Please note that throughout this assessment I am using the turbine number of the revised layout for 23 turbines but the house numbers from Figure 4.1 of the EIS.*** This is because the house numbers were changed on FIR 1 of the applicant's submission to the PA dated 20/8/03 and that map covered only some of the total of 78 dwellings shown on Fig.4.1 of the EIS.

There are 8 separate appeals and two observers and these fall into two categories. The appeals by the applicants, Patrick & Margaret Cahalane, and Art Generation Ltd are limited to the terms of conditions 1 and 10. The remaining 5 third party appeals and the 2 observers are against the principle of the development. I propose to deal with the third party appeals against the development in the first instance and the planning issues raised by these appeals fall under the headings of visual impact, noise and shadow flicker impact, ecology, cultural heritage and public safety. It is to be noted that the third party appeals of Kevin Harrington and H.G. Fitzpatrick also refer to the distance of turbines from site boundaries and public roads. I will then deal with the third party appeals of Patrick & Margaret Cahalane, and Art Generation Ltd before finally considering the first party appeal.

Before examining the appeals, I propose to deal with hydrology.

Hydrology.
Because the EIS was limited to a desk-top study of this issue, the applicants were requested by the Board to submit a report from a hydrogeologist or qualified engineer regarding the stability of the peat/soil cover on the site and the potential risk of landslides arising from the construction of the development.

The applicant's response lodged with the Board on 1/3/04 concludes that the current ground conditions are stable and the risk of peat slippage is negligible, and the risk of peat slippage during construction is also low once good construction practices re employed with regard to site drainage and handling of excess peat.

It should be noted that this issue was not identified in any of the appeals and, consequently, the report was not circulated to any of the parties. The Board may wish to consider whether such circulation is essential in the interest of natural justice.

National Policy and Development Plan Provisions.
The scale and extent of the proposed development is central to many aspects of the grounds of appeal in this case. The applicants justify the scale and extent of the proposed development by stressing the national requirement to achieve alternative energy targets. The planning authority has also based their decision on achieving the maximum amount of energy production from this site. They have acknowledged that the local and area visual impact will be significant but decided this was acceptable for the greater common good and in the national interest.

While I accept the applicant's criticism of the age of the DoE Windfarm Guidelines for Planning Authorities (1996) and note that these guidelines are currently being revised, it is a tenet of these and other guidelines on planning densities that the scale and extent of development should be influenced by the character of an area. I consider this to be such a fundamental principle of so many aspects of physical planning that it is likely to continue to be enshrined in future revisions of national windfarm guidance. This is embodied in section 4.8 of the 1996 guidelines where the form and characteristics of the landscape and the number and size of turbines, among other items, are listed as influencing the visual impact. In 4.9 it is stated that turbines should not be prominent when seen against an elevated skyline background from public roads, towns or village centres.

In the County Development Plan 2003 the site is not designated as a scenic landscape and is not located within or adjacent to a SAC, NHA or SPA. Scenic route A84 is located immediately to the NW of the subject site. I accept the applicant's general point that such scenic routes were devised prior to the making of the County Development Plan 1996. Nevertheless, the A84 has survived the review of that plan and pending the preparation of a local area plan it is an objective of the Development Plan 2003 to protect views from this scenic route.

The site is located within a "Strategic Search Area" for windfarms on Figure 5.1 of the 2003 Plan. The policy is explained in paragraphs 5.4.5 to 5.4.8 and INF 4-4 and 4-5. Strategic search areas have relatively high wind speeds and relatively low landscape sensitivity to wind projects, developers are encouraged to focus on these areas but not all locations within these areas are suitable (5.4.6). Section 5.4.7 cautions that the identification of such areas does not give any certainty about the

outcome of a particular project and 5.4.8 refers to a range of criteria to be met. This paragraph also refers to forthcoming guidance by the planning authority on the various control considerations including site selection, siting and layout for various types of wind energy. INF 4-4 lists a set of criteria.

The applicants have interpreted these policies as promoting large scale windfarms in strategic search areas and that the adoption of the plan indicates democratic approval. While 5.4.6 refers to small scale in relation to "strategically unsuitable areas", I do not accept that the Plan advocates large scale projects as a matter of course in the "strategic search areas".

It can be concluded that a windfarm at this location would be acceptable in principle in that it would be consistent with national policy and with the enabling provisions of the current development plan. However, the appropriate scale is primarily a matter for visual impact assessment.

Landscape and visual impact.

The landscape and visual impact assessment of this project can be examined under four headings, namely, distant views, intermediate views, views from scenic route A84 and visual impact from residences within 1km offset of the site boundaries. As a general remark I consider that the number of viewing points presented in the EIS is minimal and that it would have been preferable to have additional intermediate area, scenic route and residential area viewpoints.

It is to be noted that the site is not located within or adjacent to a SAC, NHA, SPA or designated scenic landscape in the **County Development Plan 2003**. The County Plan categorises the landscape character of this area as upland intimate rolling farmland mosaic with scrub outcrops. Based on my site inspections I would agree with this categorisation and I consider that there is an intimacy here in comparison to other landscape areas in County Cork. The VZI indicates that because of the rolling nature of the landscape in this area and the absence of significantly high topographical points, the majority of the turbines will be visible over a large proportion of the 20km radius from the site.

The **distant views** are represented by viewpoints 3, 5 & 7 in the EIS. I accept that the distance reduces the overall visual impact on the landscape and I would conclude from these photomontages that the proposed development would not have a significant visual impact on the Lee and Bandon River Valleys, i.e. the more sensitive landscapes in the wider area.

The **intermediate views** are represented by viewpoints 2, 4 & 6 in the EIS/AI submission. I have taken photographs from viewpoints 2 and 4 using 50mm lens and if these are compared with the photomontages in the EIS/AI submission it is my opinion that the latter may underestimate the true extent of the visual impact. I do not accept the conclusion of the EIS/AI submission that the overall visual impact at viewpoints 2 and 4 would be moderate (note – table 3.2 of the EIS presents the visual impact at viewpoint 4 as low whereas the text refers to it as moderate). I consider that the visual impact at these viewpoints will be high due to the extent of visibility from public roads and across a large area of landscape and because of the extent of visibility on the skyline. In addition, the overall view is one of visual clutter by virtue

of the scale of the windfarm and the random nature of the layout. I consider that the landscape is too intimate to take this scale and that a more limited extent of development would be more appropriate and that turbines should be grouped with significant intervening gaps in order to reduce clutter and overall impact. In arriving at this conclusion, I have had regard to section 4.9 of the DoE Guidelines and I consider that the proposed development would not comply with this guidance. I note that the Senior Planner of the planning authority in different reports has said that the area is attractive, very rural and has amenity value, and he has described the visual impact as drastic. I agree with these opinions and consider that this supports my contention that visual impact will be high.

The applicants describe **Scenic Route A84** as an isolated route in part of the county which is not an important tourist area, does not provide strategic links to important tourist areas, and the views obtained from it are low grade and unspectacular. They say the scenic routes were designated in the 1970's and are to be re-evaluated in Local Area Plans. They conclude that the proposal would not be contrary to the planning authority's policy to protect visually sensitive areas and important views from scenic roads.

Teerelton settlement is located at the NW end of the scenic route and at a lower level. I accept that the route at this level does not afford views of a wide area. The route climbs steeply either side of Knockane hill. From the eastern leg there are some views of hilltops and the proposed windfarm will be visible above the skyline. In my opinion, the western leg is more important and affords considerable views of the Shehy Mountains further west. I accept that the scenic route was first designated some time ago and will be reviewed when a local plan for this area is prepared. However, the route and the objectives of preserving views from it survived the recent review of the development plan and the planning authority has not abandoned consideration of its value in that part of the reasoning for deleting specific turbines was because of their effect on the route. I would not accept the applicant's view that the views are low grade and I consider it reasonable to take account of this designation. I consider that the proposed development would have a significant impact visually on this scenic route. On the issue of local tourism, I consider that the applicant's view has not been amplified or substantiated by reference to section 5 of the EIS.

Turning to the **visual impact from dwellings**, I would agree with the planning authority that the application is unusual in that it envisages a number of dwellings within a windfarm and the proposal will significantly change the character of the area. A number of the third party appellants and the observers have said that the proposal will interrupt the prominent skyline and the scale of the development is out of proportion to the receiving landscape. They say there will be a significant negative visual impact due to the number of turbines, their height and diameter, and their concentration and density.

It is to be noted that the applicants have not specifically addressed this issue in their response to the grounds of appeal. They say that visual intrusion has been dealt with previously in the EIS and that the proposed development will alter the appearance of the area but the democratic decision to alter the character of the area has already been made in the Development Plan.

There are no viewpoints in the EIS from the site perimeter near existing dwellings other than viewpoint 1. I have taken a photograph from the SW edge of the site where there is a cluster of four dwellings. Because of the extent of the windfarm across the landscape and the layout of the turbines, I consider that the visual impact on nearby dwellings will be significant.

Noise and Shadow Flicker.

I consider the applicant's arguments in relation to the adoption of the UK DTI noise guidelines to be reasonable in that they tend to support the IPI guidelines. The applicants say that the predicted turbine noise levels at 19 of the 62 houses within 1km of any turbine do not comply with these guidelines but shareholders in the project or their families own the majority of these houses and the remaining 3 house owners have signed waivers. In addition, they propose to purchase the vacant school building. Mitigation measures include variable pitch turbines and a computer control system to automatically control power and pitch. I have no reason to doubt the validity of the predicted noise levels and I consider that the applicant's have demonstrated that all of the dwellings most affected have accepted the impact that will arise.

The shadow flicker impact from the development is likely to be limited to those dwellings to the north and west of the windfarm since, again, the owners of the dwellings within the windfarm are prepared to accept the predicted effects. It has been argued in other applications for windfarms (e.g. PL 04.130546) that a separation of 6 to 8 rotor diameters between a turbine and a dwelling is generally sufficient to ensure that shadow flicker is not a significant problem. This would mean a distance of between 480m and 640m in the subject case. In my opinion the dwellings outside the site most likely to be affected are numbers 72 (unoccupied), 74 (unoccupied), 75, 6, 5 and 4. Having regard to the model predictions in table 5.3 of the EIS, I consider that the development is unlikely to have a significant shadow flicker impact on dwellings outside the site. Consequently, I disagree with the appellant's grounds of appeal on this issue.

However, I am concerned about the noise and shadow flicker impacts of the development on the dwellings within the site because of the number of houses involved. Notwithstanding the acceptance of the situation by the owners of these houses, I would question whether the proposed windfarm would render at least some of them either uninhabitable or difficult to inhabit. It is to be noted that noise levels of over 50dBa for 11 houses and shadow flicker within the range of 60 to 120 hours per year for 10 houses has been predicted. In my opinion, the possible abandonment of a significant number of houses would not be consistent with sustainability principles.

Cultural heritage.

Some appellants have referred to the possible impact of the development on the cultural heritage of the area and specifically on the ringfort within the site and Beal na Blath in the area.

The applicants have said it is not envisaged that the turbines will significantly affect the visual setting of the ringfort or negatively impact on the other 7 monuments within 400m of the site. They say that a 20m buffer zone will be set out around these monuments and no construction works or planting/landscaping will take place within

this buffer and that a licensed archaeologist will monitor all earthworks during construction.

It is to be noted that the ambush site of Beal na Blath is located approximately 5km to the east of the nearest site boundary. The VZI indicates that the topography at Beal na Blath will screen visibility of the proposed windfarm.

I consider that the applicant's mitigation measures for archaeology are reasonable and that the Beal na Blath historic site will not be significantly affected. Consequently, it is my opinion that the proposed development will not seriously affect the cultural heritage of the area.

Ecology.
The appellants have raised the issue of the impact of the proposed development on birds and fish.

It is to be noted from the flora and fauna surveys of the EIS that of the 117 flora species that occur on site, none are listed in the Irish Red Data Book. No bat rousts were found and no red listed birds were found. A total of 7 species of amber listed birds were recorded. There is no historical data indicating the presence of the hen harrier and the habitat on site is not suitable for breeding or foraging hen harriers. Detailed mitigation measures for bats and birds are proposed. The overall conclusions are that the proposed windfarm will not have significant negative impacts on ecology.

Having regard to the EIS and the proposed mitigation measures, I consider that the case presented by the appellants is not strongly grounded.

It is to be noted that in the PA's additional information request dated 10/7/03 the applicants were advised to adjust the layout of turbines and access roads to reduce the impacts on the annexed habitats of wet grassland and wet heath. The revised layout shows turbine 2 and the access road for turbine 9 within a wet heath area, and turbines 8 and 20 and the access road for turbine 8 within a wet grassland area. I consider that further adjustments may be possible to the layout to avoid these habitats but this could be considered to be a new issue requiring comment from the parties.

Proximity of turbines to site boundaries and public roads.
A number of appeals have referred to the proximity of proposed turbines to either the site boundaries or public roads and have requested the Board to omit a significant number of turbines. They have drawn attention to the planning authority's request for additional information dated 10/7/03 where a standard of 2 to 4 blade diameter separation from site boundaries was specified, and they say this has not been adhered to in the revised layout.

It is to be noted that there are no standards contained in the DoE Guidelines or the IPI Guidelines regarding set back from site boundaries. However, Cork County Council have been using a standard of 2 to 4 rotor diameters and in Condition 2(c) of PL 04.130546 the Board stated that "no turbine shall be closer than 2.5 rotor diameters from the site boundary". In my opinion the purpose of setting back from site boundaries is to reduce visual, noise and safety impact from houses or public roads outside the site and to allow for similar developments on adjoining lands. It is to be

noted that the applicant and the planning authority met to discuss this issue and the resultant layout was devised on the basis of separation from dwellings outside the site boundary and to ensure an appropriate separation from the windfarm proposal on the adjoining site to the east.

If a standard of 2.5 rotor diameters was used in the subject case, and having regard to 2.2 of the DoE Guidelines I consider this to be reasonable, then a distance of 200m from site boundaries would be required (80 x 2.5). Examining the revised layout of the proposed development, a total of 12 turbines would be located within 200m of site boundaries (i.e. turbines 1, 2, 3, 6, 10, 11, 12, 13, 20, 21, 22 and 23). It would not be possible to condition such a set back in relation to turbines 1, 2, 3, 10, 12, 13, 21 and 23 because substantial additional separation would be involved and this would significantly alter the overall layout and affect the inter turbines separation necessary in order to ensure their efficiency.

At 4.27 of the DoE Guidelines, it is stated that the height and movement of turbines may distract drivers of motor vehicles and that a prudent approach should be taken to the siting of turbines near *roads with a bad accident record or carrying significant levels of traffic.* A set back from roads is generally advised and such set back *may need to be up to 300m depending on circumstances* (my emphasis). In relation to the "very remote possibility of injury to people or animals from flying fragments of ice or of a damaged blade", 4.25 says that the minimum desirable distance between turbines and occupied buildings, calculated on the basis of visual impact and expected noise levels, will always be greater than that necessary to meet safety requirements.

Some of the appellants have taken this 300m to represent the minimum distance whereas the Guidelines refer to it as "up to" and this can be interpreted as a maximum. The applicants argue that the PA has not published guidelines and that having regard to the nature and location of the roads, the applicants believe the proposed development will not constitute a traffic hazard or obstruction of road users by virtue of distraction.

The roads at issue fall into two categories, those outside the site and those within the site. I consider that the application of a set back standard to the site boundaries as discussed above will take care of the roads outside the site. This would apply to turbines 1, 2 and 3. Regarding the roads within the site, there is no information on file to suggest that any of these roads have a bad accident record or carry a significant level of traffic. However, turbines 15, 17, 20 and 21 are very close to the internal public road system and I consider that they should be further set back. The degree of set back would vary in each case and would have to be determined having regard to road alignment and the knock-on effect of adequate separation from other turbines. This is a matter that could be conditioned for agreement with the planning authority following careful further examination.

Proximity to adjoining windfarm

The appeals of Patrick & Margaret Cahalane, and Art Generation Ltd request that turbines T18, T19 and T22 be omitted because of their impact on the efficiency of the permitted turbines on their site to the east (Reg.Ref. S/03/2047). They have supported their grounds of appeal by reference to the Garrad Hassan report. They say that the estimated loss is €3.06m over the life of the windfarm based on production losses of

2,081MWh per annum due to the proximity and intensity of the upstream wind generators in the prevailing direction as proven in the Garrad Hassan report. They cite the Danish Wind Industry Association recommendation of 5 – 9 rotor diameter separation. They refer to the planning tenet used in other types of development of not prejudicing the development potential of adjoining property.

The applicants have responded by saying that the Irish Industry standard, confirmed by Aertech/ESBI and used by many County Councils, is a 4 – 5 rotor diameter separation and Barna have maintained this throughout their development. They criticise the Garrad Hassan report for using the wind rose for Cork Airport and say that an accurate assessment of energy loss or production is not possible without the collection of real wind data (the reason why developers erect wind monitoring masts for 12 months prior to development). The say the Garrad Hassan report acknowledges this fact. They say the Art Generation project would have a total energy output of 6.5MW compared to 42.5MW on the Barna site and the omission of turbines 18, 19 and 22 would result in loss of 7.5MW from the Barna project. They say the degree of the effect of the Barna project on the Art Generation project cannot be quantified accurately at this time.

The DoE Guidelines at 2.2 state that "in order to ensure the aerodynamically efficient operation of turbines, they require to be sited 5 to 10 rotor diameters apart". I consider that this not only identifies efficient operation as a legitimate planning consideration, but goes further by specifying a separation standard. This standard compares favourably with the Danish Wind Industry Association standard quoted by the appellants. Only its lower end compares with the standard presented by the applicants. The minimum of 5 rotor diameters in the DoE Guidelines would equate to a 2.5 rotor diameter set back on each side of a party site boundary whereas the upper end would represent a 5 rotor diameter set back.

An examination of the proposed layout reveals that turbine 18 is 246m from site boundary, 19 is 207m and 22 is 147m. These distances are the equivalent of 3.075, 2.58 and 1.84 rotor diameters respectively from the subject site boundary. This means that turbine 22 would not achieve the minimum set back.

The Board may wish to request an accurate map of the position of turbines permitted in Reg.Ref. S/03/2047 in order to determine the precise distance between the nearest turbines of each windfarm. However such a map may not resolve the issue because the matter is further complicated by the fact that in the subject case 80m diameter blades on 60m hubs are proposed whereas a different specification and possibly a different type of turbine (see assumptions in Garrad Hassan report) is to be used by Art Generation Ltd. In these circumstances, it is not clear whether the 5 to 10 rotor diameter separation advocated by the DoE Guidelines should be calculated on the basis of the larger or smaller blade.

I accept the applicant's general point that the Garrad Hassan report may be indicative rather than absolute because it is difficult to make an accurate assessment of energy loss or production in the absence of real wind data. This is acknowledged in the Garrad Hassan report. Nevertheless, I consider that the Garrad Hassan report is an aid to decision making. It is to be noted that the applicants have agreed that their project will have an impact on the Art Generation windfarm.

The applicants argue that the loss of output consequent upon omitting the three turbines is greater than the predicted loss of output on the Art Generation windfarm. They say that the reduction of 7.5 MW of wind energy from a strategic search area on the sole basis of preserving the economic viability of an adjacent smaller windfarm would be contrary to the principles of sustainable development and current government policy. I cannot agree with this argument. In my opinion there is an onus on a competent authority under administrative law to apply fair procedures, equity and natural justice in procedures and decision making. This means that the same rules should apply either side of the party boundary. It is not clear from the documentation on file whether the DoE Guidelines were applied by the planning authority to the Art Generation Ltd application. However, the Board cannot alter the position of turbines in the Art Generation scheme.

The only conclusions I can reach on this matter are that there is a standard in the DoE Guidelines, that turbine 22 would not achieve the minimum set back of 2.5 rotor diameters from the party boundary, and that there appears to be agreement between the appellants and applicants that the subject application will impact on the efficiency of the Art Generation scheme. In the absence of specialist modelling using real data, the simple imposition of a numerical set back standard by the Board will not resolve the matter. Equally, the omission of the three turbines may be unjust having regard to the set back of the Art Generation project turbines from the party boundary. I consider that this difficulty can only be resolved by a redesign of the layout of the subject application. This highlights the necessity in general of adequately setting back turbines from site boundaries and that a 2.5 rotor diameter set back is perhaps the minimum.

Condition No.1 – first party submission.
The applicants have appealed against the terms of condition 1. The planning authority decision is based on 2 planning reports and between them they offer the following rationale for the omission of 6 turbines in this condition:

- *Turbine 1*: high impact to 3rd party, visual impact to scenic route.
- *Turbine 2*: high impact to 3rd party, moderate visual impact to scenic route.
- *Turbine 3*: c.280-300m from an inhabited house by a non-participant to SSE.
- *Turbine 12*: c.300m from unoccupied farmhouse on farmed land to SE.
- *Turbine 21*: due S of a line of 4 houses all occupied by non-participants with the nearest c.350m.
- *Turbine 23*: high impact to 6 dwellings (3rd party & 5 landowner occupied).

I have previously given my opinion on the visual impact of the proposed development on the scenic route, intermediate area and existing houses within 1km of the site boundaries, the impact of noise and shadow flicker on the houses within the site and the deficiency in separation of turbines from site boundaries. Consequently, I would support the rationale presented by the planning authority for omitting these particular turbines and would disagree with views of the applicants.

Condition No.10.
The wording of this condition places a stay on development until agreed arrangements have been made between the applicants and a third party, to the satisfaction of the

planning authority. I would agree with the applicants that the terms of the condition appear to be ultra vires and unreasonable. I understand the commendable motivation of the planning authority to reduce multiple grid connections in the interest of visual and environmental impact. However, grid connection for both wind farms will involve further planning applications and the grid connection for the subject application does not form part of the current application itself. In the event of a grant of permission in the subject case, the standard condition regarding grid connections should suffice. I consider it to be a matter for the planning authority to bring the parties together if necessary but this is beyond the remit of the Board.

Other conditions.
In the event of a grant of permission, I consider that the terms of conditions 15, 25, 26, 27 and 28 of the planning authority decision would require more precision and the typographical error of "decommissioning" in condition 24 should be corrected.

Summary and Conclusion.
Essentially the decision in this case hinges on national policy versus local impact, and the Board must have regard to both.

The applicants have pointed to the national policy regarding alternative energy targets, the absence of conservation or landscape designations, the enabling provisions of the development plan, the agreements reached with house owners on noise and shadow flicker impacts, and the EIS conclusions and mitigation measures regarding environmental issues. They have been supported by the planning authority principally on the basis of the development being in the interests of the greater common good and national policy.

I have examined the appellants arguments concerning local impact and concluded that there will be a significant visual impact on the scenic route, on the intermediate area and on the amenities of houses outside the site but in the immediate vicinity, principally due to the scale and extent of the development, and visual clutter arising from the proposed layout in an intimate landscape area. I have referred to the impact on the amenities of houses within the site due to noise and shadow flicker predictions notwithstanding the acceptance of these impacts by the current owners. I have agreed with the appellants arguments concerning inadequate set back from site boundaries. The planning authority has acknowledged that the area is attractive, very rural and has amenity value, that the application is unusual in that it envisages a number of dwellings within a windfarm, that the proposal will significantly change the character of the area and they have described the visual impact as drastic.

On balance, I consider that this application should be refused. The "strategic search area" designation in the development plan is qualified in objective INF 4-4 and its parameters are to be the subject of refinement. A significantly revised proposal would be acceptable which involved a reduction in scale and extent, reduced visual clutter perhaps by grouping turbines, and set back turbines at least 2.5 rotor diameters from site boundaries. Conditioning revisions to the current layout is not an option in my view because of the number of turbines involved and the specialist knowledge of layout design required for this particular type of development.

15. Recommendation.

Having considered the contents of the application, the decision of the planning authority, national policy, the provisions of the Development Plan, the grounds of appeal and the responses thereto, my site inspection and my assessment of the planning issues, I recommend that permission be refused for the reasons and considerations set out hereunder:

Reasons and Considerations.

1. The proposed development by reason of its scale, extent and random layout would conflict with the development plan objective of preserving the character of those views and prospects obtainable from scenic route A84, would give rise to visual clutter in an attractive rural area, and would be unduly prominent when seen against an elevated skyline background from public roads and from residential properties in the vicinity. The proposed development would be visually obtrusive, would seriously injure the amenities of property in the vicinity, and would, therefore, be contrary to the proper planning and sustainable development of the area.

2. Having regard to the provisions of the Wind Farm Development Guidelines for Planning Authorities published by the Department of the Environment, September 1996, it is considered that the majority of the proposed turbines are not adequately separated from the site boundaries and the proposed development would, therefore, be contrary to the proper planning and sustainable development of the area.

3. Having regard to the number of dwellings within the site of the wind farm, and the predicted noise and shadow flicker impacts described in the environmental impact statement, it is considered that the proposed development would seriously injure the amenities of such dwellings and would, therefore, be contrary to the proper planning and sustainable development of the area.

David Dunne,
Senior Planning Inspector.

11th March 2004.

An Bord Pleanála

Inspector's Report

Appeal Reference No: 04.219620

Development: Windfarm with 18 no. turbines, with hub height up to 70m and rotor diameter of 70m, and base to blade-tip height of 105m, 18 no. associated transformers, a 70m meteorological mast, substation and switch station compounds, construction of internal tracks, turbine foundations, hardstands and associated works and a grid connection to the National Grid at Barnadivane, near Terelton, Co. Cork.

Planning Application

Planning Authority:	Cork County Council
Planning Authority Reg. Ref.:	05/5907
Applicant:	Barna Wind Energy Ltd.
Type of Application:	Permission
Planning Authority Decision:	Grant subject to conditions

Planning Appeal

Appellant(s):	(1) Pat & Margaret Cahalane; (2) Stephanie Larkin & Michael O'Donovan; (3) Barna Wind Energy Ltd.
Type of Appeal:	2 no. third party and 1 no. first party
Observers:	(1) Kathleen O'Driscoll; (2) An Taisce
Date of Site Inspection:	18th January 2007

Inspector: Mary Kennelly

SITE LOCATION AND DESCRIPTION

The site of the appeal is located in an upland area approx. 9km to the south of Macroom. The area is served by a number of regional and local roads linking Macroom town with Bandon to the south-east and Dunmanway to the south-west. The closest settlements are Terelton, (approx. 2km to the north west) and Coppeen (approx. 2km to Southwest) of the site. The site is located within a broad triangular area bordered by the N22 (Crookstown-Macroom), the R584/587 (Macroom to Dunmanway) and the R585 (linking the R587 north of Dunmanway back to Crookstown). The R585 travels in a NE-SW direction to the south of the upland area (through Bealnablath, Copeen and Slieveowen). The appeal site is located just over 1km north of the R585. The site is located within the town lands of Barnadivane, Knockboy, Garraneragh, Lackareagh, and Reenacaheragh.

The appeal site is an elongated S-shaped site with a stated site area of approx. 9.8 acres (3.9 hectares), but the study area consists of 355ha. It consists of a ridge which ranges in elevation from 170m OD in the south to 270m OD in the north along an E-W axis. To the north of the site, the topography generally drops to about 70m OD towards the Lee Valley. The land slopes to the south towards the River Bride and there are a number of hills (generally around 250m OD) separated by river valleys to the east of the site, and a further series of hills to the west. The majority of the site consists of primarily agricultural grassland (cattle and sheep grazing) with grassland and commercial forestry in the surrounding area, which is characterised by an enclosed pattern of fields. There is a 110kv line passing through the site and several public roads traverse parts of the site. There are three stretches of local roads which serve the site. These are

- The road running from Terelton (NW) to the R585 near Moneynacroha Cross Roads (S), the middle section of which adjoins part of the western site boundary;
- The road from Poulnairgid (NE) to R585 near Moneynacroha Cross Roads (S), part of which travels through the eastern section of the site (adjoining Lackeragh School) and part of which adjoins part of the eastern site boundary;
- The road which runs East-West linking the above two roads bisecting the site.

There are 44 dwellings within a 1km offset of the site boundary of which 11 are within the site itself.

PLANNING HISTORY

PL04.204928 Planning permission was refused by the Board following third party and first party appeals against the grant of planning permission for a windfarm with turbines of 60m hub height and 80m blade diameter, 110

kV substation, 110 kV switch station, one 60 m high meteorological mast, entrances, tracks etc. The original application was for 26 turbines but this was revised to 23 turbines, and the planning authority decided to grant permission for 17 turbines. The Board refused permission on the basis of excessive dominance and visual obtrusion in the landscape due to the layout, number and size of the turbines, having regard to the landscape character and pattern of residential development in the area.
In the Board direction, it was stated that the Board agreed with the Inspector that a revised proposal might be possible but considered that the impact of the proposed development by reason of the layout, number and size of the turbines would be excessive.

There is also some relevant planning history in the vicinity as follows:

03/2047 Permission granted for 5 no. wind turbines on a site to the east, Art Generation project, (no plans and particulars provided by P.A., but Area Planner (PA) provided the following summation in his report of 11/10/05: hub ht. 60m, blade diam. 66m, tip ht. 93m).

PROPOSED DEVELOPMENT

The proposed development as originally submitted consisted of the construction of 18 no. turbines which were spread fairly evenly throughout the site, the construction of an ESB substation (110kV) and switch station (110kV), one 70m meteorological mast, construction and upgrading of site entrances, site tracks and associated works. The *revised submission dated 30/6/06* reduced the number of turbines to 14 and revised the layout, with a corresponding reduction in the number of transformers to 14. The site boundary was also revised to exclude part of the E-W local road through the NW part of the site and a further area of land around Garranereagh in the SW of the site. The turbines omitted from the original layout were T1 (adjoining Lackeragh School), T13 (near 100m contour at Barnadivane N), T15 (500m east of Lackeragh School) and T17 (adjoining local road about 1km south of school). Other revisions to the layout include a reduction in the number of access points to the internal track network from local roads and the shortening of internal tracks. These can be seen in a comparison of Fig 2 (17/8/05 EIS) and Fig. 2.2 (30/6/06 EIS).

It is stated that it is intended to connect to the existing ESB 110kV overhead transmission line which passes through the site. The proposed substation and switch station compounds are adjoining and are located adjacent to the eastern boundary of the site, adjoining a local road about 600m south of Lackeragh School. The 14 no. turbines are relatively evenly

distributed across the site, generally around 3-400m apart, with T2-T10 running in a E-W line approx. 400m south of the school, with T3 south of this line and T16 east of the line and road, and further to the south another linear cluster with 2 no. groupings, T4-T14 and T9-T18 both running on a W-E axis. The northern linear cluster is approx 1km (T10-T16), and the southern cluster is approx. 1.4km (T14-T18), with a gap of approx 400m between the groupings. It is noted that it is proposed to access T16, T3 and the substation compound from individual tracks off the local road, and that 2 no. shared access tracks would be constructed to serve the remainder (see Fig. 2.2).

The key elements of the proposal may be summarised as follows:

- ***Access to and within site*** – There are two principal access points for site traffic one approx. 400m south of Lackeragh School, with two further access points on either side of this, and the other from a point at a bend in the road bisecting the site. The tracks will be approx. 4.5m wide along straight sections and wider at turns. The tracks will not be surfaced but will be drained and culverted. The length of new and upgraded tracks is estimated at 3,470m and 1.890m, respectively;
- ***Turbine construction*** – Erection of 14 no. Wind Turbine Generators with a maximum Hub Height of 70m and rotor diameter of 70m, (giving an overall height of 105m) and reinforced concrete foundations (varying from 10m x 10m to 16m x 16m). There will be a hardstanding area (40m x 20m) beside each turbine for the operation of large cranes used in the assembly of the turbines. Each turbine will have a transformer located adjacent to it or within the base of the tower and will generate electricity at approx. 660 volts and the transformer will step up the voltage to 10 or 20 kV. The turbines will be spaced a minimum distance of 4 to 5 blade diameters apart. The wind monitoring mast consists of a narrow lattice tower of approx. 70m in height with 3 no. anemometers and will be located in the NW section of site;
- ***Substation*** – Construction of a control building and compound surrounded by a 2m high security fence is proposed adjacent to the local road on the eastern side of the site. Installation of underground cable network (at 10 or 20 kV) along track ways between turbines and substation. An application for a power line connection to the national grid has been submitted to the ESB which necessitates the construction of a switch station which will be located adjacent to the proposed substation on a 70m by 45m compound.;
- ***Site drainage management*** – internal site drainage will consist of open swales at the site track edge and 300mm diameter pipework at track crossings. Run-off from the site will discharge to streams via sediment traps to the north and south of the site;
- ***Construction activity*** – The materials for access tracks, hardstands and foundations will be largely sourced on site from excess materials from road cuts, or will be

sourced locally. A temporary site compound will be provided on site during construction phase.

Environmental Impact Statement

The proposal falls within the scope of Part 2, Schedule 5 –Development for the purposes of Part 10 (Environmental Impact Assessment) of the 2001, Planning and Development Regulations. The application is accompanied by an EIS, as required under these regulations, which was revised and submitted to the planning authority on 30/6/06 together with the revised proposal. I have read the EIS and in my view, it complies with the requirements of Article 94 and Schedule 6 of the Planning and Development Regulations 2001. I note that it contains a separate non-technical summary volume. The following is a summary of the main items of factual information contained in the Revised EIS (dated 30/6/06) under the subject headings and relevant to an assessment of the current proposal.

Alternatives

The site is considered suitable for a wind farm due to the good predicted wind speeds (which is of considerable importance in Ireland due to the relatively lower prices offered to wind energy producers in this country), the likely connection to the national grid on site, the inclusion of the site within the Strategic Search Area identified in the Development Plan, good access to the site and minimal probable impacts on the surrounding environment. It is stated that the EIA process itself provided the greatest influence on the final choice of turbine layout and that considerable effort has been put into the consideration of alternative designs, including an examination of alternative machine brands and sizes in terms of both electrical capacity and visual impact. It is also stated that following the Board's previous decision to refuse permission, the numbers, sizes and location of turbines has been discussed on several occasions with the planning authority as well as the previous landscape architects.

It is stated that the approach taken was intended to address the concerns arising from the previous refusal decision. It is further stated that particular attention was paid to the Inspector's comments that "a significantly revised proposal would be acceptable which involved a reduction in scale and extent, reduced visual clutter perhaps by grouping turbines, and set back turbines at least 2.5m rotor diameters from site boundaries." Following the submission in August 2005, further changes were made in November 2005 (omitted T13 and relocated T10, T11 and T14) in response to the withdrawal of one of the landowners from the project. The wind farm was redesigned again between Feb and April 2006 and submitted to the planning authority on 30th June 2006 following a request for further information.

Landscape and visual assessment

The classification applied in the Altener Study was used, whereby the landscape was classified as upland intimate rolling farmland mosaic with scrub outcrops. 3 no. image units were used to aid landscape character, (a) the site and surroundings; (b) the Lee Valley and Reservoir and (c) the Bride River Valley. The Altener Study classified the site as being low landscape sensitivity (Level 1). The EIS also considered the site to have low regional or national importance and low vulnerability (Altener Study). It was noted that the river valleys to the north and south have been classified as being more sensitive than the site and its surroundings. However, it was considered that the site was sufficiently far removed such that the calculated predicted views indicate that the visual impact on these areas will be low.

A detailed visual impact assessment has been undertaken consisting of a ZFI map, which identified the areas most likely to have the highest visibility of the wind farm, and a set of wireframens and photomontages from selected viewpoints (9 no. including nearby villages, scenic route, regional and national roads). Table 3.1 describes the viewpoints, the number of turbines/blades visible and the distance from the respective turbines. Table 3.2 summarises the visual impacts from each viewpoint and it should be noted that the assessment includes the cumulative impact of the proposed development together with the permitted Art Generation project (5 turbines to the east of the site). It states that the impact would be moderate/high from two points on the Scenic Route and from the R585 east of Coppeen. Otherwise the impact would be moderate or low. However, it is noted that only one viewpoint was considered to be of high sensitivity, i.e. No. 9, view from R618 near Carrigadrohid.

Noise

Noise monitoring was carried out at 3 locations on 1 day/night (12th July 2005) to determine background levels. Fig. 4.1 shows the location of the monitoring stations, the houses and the proposed turbines, and the background noise levels recorded are shown in Table 4.1. The map shows 44 houses within the 1km offset from the site boundary. The noise prediction model used a wind speed of 8ms at a hub height of 70m. Table 4.2 lists the predicted noise levels for the permitted Art Generation project and for the combined effect of both the proposed development and the Art Generation Project at each of the 44 house locations. The results of the noise prediction modelling are presented in Table 4.4 and Table 4.5 for daytime and night time, respectively.

The results were compared with the standards contained in several noise guideline documents, including those of the DoE, the IPI, the EPA and the UK DTI Wind Turbine Noise Working Group. It was concluded that the UK working group guidelines and Cork County Council conditions were the most relevant as they work from the background noise

level and also provide for situations where the background noise is higher. The predicted turbine noise levels at 13 of the 44 houses do not comply with these guidelines but shareholders in the project own 10 of these, two of the remaining three are derelict/in ruins and the other is owned by a developer of an adjacent wind farm. Noise mitigation measures include restrictions on working hours during construction, variable pitch turbines (if deemed necessary). It was noted that the Board's Inspector had raised concerns regarding predicted noise levels above 50 dB at 11 no. dwellings, and that in the revised proposal, the predicted noise levels at or above 50 dB only apply to two dwellings, both of which are owned by developer shareholders.

Other impacts on human beings

Table 5.1 shows that there are 44 dwellings within 1km of the nearest turbine and the table lists the turbine numbers and distances to dwellings. It is acknowledged that there will be an increase in daily traffic during the construction period but it is stated that this would be relatively low and the construction period would be of limited duration, approx. 6 months.

A shadow casting model was used to predict the impact of shadow flicker on the 44 houses within 1km of the nearest turbines (incorporating both the current proposal and the Art Generation project). The results are presented in Table 5.4 . There are 13 houses that could potentially be affected for more than 20 hours per annum, and all but two are either in the ownership of the developer or are derelict/in ruins. It is pointed out that the model does not take into account any obscuring features which would lessen the effect (e.g. screening vegetation) and that it assumes that every house has a window facing the wind farm, and that the wind direction is parallel with the line between the sun and the house at all times. Thus it is stated that the model is quite conservative and that the actual results are likely to be much lower. It is also stated that if necessary, additional screening could be planted or blinds installed and the turbines could be programmed to stop for a brief period until the shadows have passed the affected window. However, this is not considered likely to be needed.

Soils and Geology

A geotechnical assessment of the study area was carried out by Mr. Dan Keohane in Feb. 2004. This study was undertaken in respect of the previous application and appeal (Ref. 03/2365 and PL04.204928, respectively). The conclusions reached may be summarised as follows:

- The bedrock geology consists of sandstone and siltstone of the Old Red Sandstone formations, and superficial geology consists primarily of green gravely clay (observed at 1.5m thick). Minor peat layers were observed up to 0.4m thick. An area of wet heath exists on higher ground in the west with areas of intact wet grassland

spread throughout the study area. It is stated that these areas were avoided in the turbine layout.

- The ground conditions within the study area were considered to be stable with no evidence of failure or slippages observed. The risk of peat slippage during construction was also considered to be low.
- The main impacts are likely to be changes to site drainage (blockages to natural drainage pathways) and the creation of excess subsoil spoils, with the possibility of water logging of excavated spoil and slippage of soil stockpiles and in-situ soil. However, the likelihood of these occurring was considered to be negligible due to topography, soil composition and site layout, provided that good construction practices are employed.

Hydrology and Hydrogeology

The northern part of the site drains to the River Cummer and the southern part drains to the River Bride. Both of these rivers are tributaries of the River Lee. A desk top study of the hydrology of the area was carried out. The main hydrogeological impact was considered to be an increase in run-off from a rain storm event, which would increase the peak flow of the streams (operational phase), as well as increased sediment loading of streams, spillage of oil/diesel, release of cement to watercourses during construction. The areas to be cleared for hardstanding and site tracks represents only 1% of the study area and it is stated that the percentage increase in run-off would be insignificant and will be taken up by existing streams. Mitigation includes the use of sediment traps and storage of oils/diesel in bunded containers.

Air and climate

The wind farm will generate electricity that would otherwise be generated by fossil fuels and the proposed development will therefore have a significant positive impact on air quality and climate.

Cultural heritage

There are two known archaeological monuments within the area of the proposed development, CO094-036, an enclosure and CO083-078, a ringfort. The enclosure is within the site and was visited as part of a field inspection. It consists of a mound surrounded by a small man-made bank/fence, and is currently overgrown by rushes and bog grasses. The ringfort falls outside the revised site boundary. There are a further 38 archeological monuments within 1km of the study area boundary. It is stated that the proposed site layout will not have a direct impact on any of the known archaeological monuments and that the turbines will not significantly affect the visual setting of the two recorded monuments. However, excavation during construction could have an impact on any unrecorded or buried archaeological artefacts. A licensed archaeologist will be

employed during construction to monitor all earthworks and any archaeological sites discovered will be recorded and preserved in the best manner possible. It is not envisaged that the development will have any negative effect on protected structures or other features of cultural heritage outside the study area boundaries.

Ecology

An ecological impact assessment was carried out by Hygronomics Ltd. which consisted of a botanical survey, a mammal survey (including bats), an avian survey and a freshwater quality survey in April and May 2003 in respect of the previous proposed development (204928). It is stated that as the current proposal is a scaled down version of the previous scheme, the reports are still considered to be valid by Hydronomics Ltd. The site does not form part of, nor is it in the proximity of any SAC, SPA or pNHA. Nor does the site fall within any Conservation Areas or Special Amenity Areas listed in the Cork County Development Plan. The nearest SAC/pNHA sites are Boylegrove Wood (NHA), approx 4km to NW, Killaneer House Glen (NHA), approx. 5km to SE and Gearagh (SAC/NHA/SPA and Nature Reserve), approx. 6km to the north of the study area (see fig 10.1). Fig 10.2 maps the habitats. None of the habitats that occur within the study area are priority under the EU Habitats Directive but there are two annexed habitats, wet grassland and wet heath, some of which are of poor quality. Those that are intact have been avoided by the turbine location.

Of the 117 species recorded, none are listed in the Irish Red Data Book, the Berne Convention Annex II or are protected by law. The site is considered to be of low ecological importance as the area is comprised predominantly of improved agricultural grassland. No bat roosts were found and no red listed birds were recorded. A total of 7 species of amber listed birds were recorded. There is no historical data indicating the presence of the hen harrier and the habitat on site was not considered suitable for breeding or foraging hen harriers. An assessment of micro-invertebrates indicates that the two streams within the site are of high quality and show no signs of pollution.

The only impact on flora will be as a result of landtake for the development which amounts to 1% of the study area. Some hedgerows will be removed for road widening but is not considered to be significant. Habitat loss will be minimised due to the layout of the proposed windfarm and species diversity is not expected to be negatively affected. It is not expected that the development would have a significant impact on mammals (including bats) using the site or on macro invertebrate or other invertebrate populations. Mitigation measures are proposed for bats and birds. However, the proposed development site does not fall into the category of high potential bird strike. The impact on bird species is described as being limited to disturbance and minor habitat changes and as such would be of less significance then land changes in the past due to afforestation and agriculture.

Land use

The area is agricultural with sheep and cattle grazing the main uses. There are no significant public buildings (e.g. schools, hospitals, hotels) located within 1 km of the site and there are no known recreational activities associated with the site.

Electro-magnetic effects

Pre-consultation with telecommunication companies, the ESB, IAA, mobile phone operators, chorus and Southern Health Board (ambulance service) and RTE have been carried out. Replies have indicated that it is not expected that the proposed windfarm would have any adverse impact on telecommunication signals. However, it is stated that there is a possibility that some house may require remedial measures in relation to television reception. The developer has undertaken to implement any such measures and has signed a protocol with RTE.

Interaction

Based on the positive impacts of the development and the low to moderate visual impact, it is considered that Barnadivane is a very suitable site for the proposed development.

PLANNING AUTHORITY REPORTS AND DECISION

Planning Authority Department Reports

The main issues that concerned the ***Area Planner*** included the impact of the scale, layout and size of the proposed turbines on the landscape character of the area and in particular the Scenic Route, the impact of the development on the residential amenity in terms of noise and shadow flicker, and the potential impact on any Barn Owls should they be found to be nesting around the site. These issues and others were discussed at length in the Planner's report (dated 11th October 2005). The **landscape character** of the area was of particular importance. It was considered that although the number of turbines had increased from 17 to 18 and the overall height had increased marginally (since ABP refusal), a genuine attempt had been made to cluster the turbines on a tighter footprint and that proportionally, the new design was better as the previous turbines appeared top heavy. However concerns remained over the high level of visibility from the Scenic Route and the failure of the layout to comply with the separation distances recommended in the Guidelines. Concern was also expressed about the impact on visual amenity and human beings (specifically noise and shadow flicker) due to the proximity of the turbines to houses.

A query was raised in a request for additional information (11/10/05) on the ownership of the properties within the site. The response (dated 15/11/05) included an almost complete set of land ownership details and letters of consent regarding the current proposal, but the ownership details regarding House No. 31 was omitted in error. The response of 15/11/05 also included a revised layout which omitted T13 (due to the withdrawal of one of the land owners) and a slight variation of the location of T10, T11 and T14. Concern remained regarding the close proximity of some of the turbines to third party houses (T10-45m, T11-45m, T12-163m, T14-40m and T17- 47m) and the unsuitable impact in terms of visual amenity and human beings of T1, T15 and T18. A further request was issued on 22/12/05 which resulted in the response of 30/6/06.

The revised proposal of 30th June 2006 included a revised EIS, a revised site boundary, a revised site layout and information confirming ownership of House No. 31 as being that of one of the stakeholders in the wind farm. The revised layout omitted T1, T13, T15 and T17. It also showed revised locations for T10, T11, T12, T14 and T18 further away from existing residential properties. The revised proposal was re-advertised following a request to do so by the planning authority. The final report of the Area Planner (dated 11/8/06) indicated that he was satisfied with the ownership details of House No. 31 and that the revised layout meets the separation distances recommended in the guidelines. However, it was stated that the revised layout, whilst achieving a generally compact and clustered layout included two turbines which were disconnected from the clustered approach, i.e. T12 and T14. It was considered that these two turbines should be deleted as they resulted in a randomly dispersed layout as confirmed by Photomontage 3, taken from a busy Regional road between Crookstown and Bantry.

The issues of **noise** and **shadow flicker** were also considered. It was considered that a distance of 490m was required from each turbine (to a noise sensitive source) in order to comply with the requirements in terms of noise. However, it was noted in the original submission (dated August 2005) that 22 of the 52 houses did not comply with this standard, of which 19 were in the ownership of the developer. Following deletion and relocation of turbines in the revised layout these distances were revised, and will be discussed in the assessment section of this report. It is noted that the wind farm will have an impact in terms of shadow flicker (in excess of 20 hours per annum) on 22 houses in the original layout, all but 3 of which were owned by the developer. It was considered that the most serious impact was on House No. 28 which was owned by a third party.

Other Reports

Heritage Officer was satisfied that the issue of natural heritage had been adequately addressed in the EIS, and that there would be a low negative impact on the area, but advised that further information would be required to ascertain if any barn owls were

breeding and if so, sought an assessment of the impact. It is noted that the NPWS subsequently advised that there was no record of barn owls in the area but considered that the habitat would be suitable. It was considered that in order to avoid disturbance of nesting birds, there should be no construction activity during the breeding season (May-July), that construction be monitored by an ecologist and that other mitigation works be carried out.

Executive Scientist had no objection but recommended a list of conditions (26/9/05) regarding matters such as control of noise levels, excavated soil, shadow flicker, electromagnetic interference etc. The Senior Environment Engineer (7/10/05) recommended conditions requiring contour plans and a restriction on noise levels not exceeding 43dB(A) L_{90} or 5dB(A) above background levels.

PA Engineers had no objection subject to the payment of a bond of €200,000 to secure repairs due to damage to roads, bridges or culverts; a special contribution of €75,000 towards works to facilitate the development such as roadworks, silt traps on water courses etc.

Further unsolicited information was submitted by the first party on 10th August and 14th August 2006. The former related to a revised photomontage (Fig 3.8, View No. 3 from R585 East of Cappeen), whereby the view submitted on 30th June 06 had inadvertently omitted a turbine to the left of the viewpoint. The latter related to fig 4.1 (map of turbine locations in relation to noise sensitive properties and noise monitoring stations), whereby the revised version had not been included with the submission of 30/6/06.

DoEHLG, Development Applications Unit archaeology (27/9/05). It was stated that the Dept. agreed with the findings of the EIS and recommended that a licensed archaeologist be employed to monitor all earthworks during the construction phase and a report furnished to the DoEHLG.

Failte Ireland (26/9/05) recommended refusal for the original proposal of 18 turbines on the basis that the cumulative effect together with the 5 permitted turbines nearby, would result in a negative effect on the landscape. In forming this view, regard was had to published research of attitudes to windfarms in Ireland and elsewhere, with particular attention to the SEI study. [It is stated that in this study it was found that wind farms containing 25 turbines or more are likely to elucidate a negative response from the public in terms of landscape impact]. Since the proposed cumulative development is most visible from a Scenic Route and will contain 23 turbines, it would set an undesirable precedent for siting wind farms close to or within designated landscape areas, the cumulative impact of which would be detrimental to Ireland's Scenic Landscapes as a tourist resource. Specific

reference is made to the failure of the EIS to address why a smaller number of larger turbines could not be considered, which is perceived by the public to be likely to have less of an impact, and also to the issue of 'skylining' which is considered to be inappropriate in this instance.

Planning authority decision

The planning authority decided to grant permission for 12 turbines on 24th August 2006 subject to 39 conditions, following a request for further information on 11th October 2005 and a request for clarification of that further information on 22nd December 2005. The revised information submitted on various dates included proposals to omit four of the wind turbines and relocate others as discussed above.

The *conditions* are generally of a standard form for this type of development. They include conditions requiring:-

- The omission of two Turbines (T12 and T14) (1);
- the payment of a special contribution of €75,000 towards the provision of roadworks and certain improvements facilitating the development (10);
- lodgement of a bond of €200,000 to cover damage to roads, bridges, culverts (11);
- commissioning of windfarm shall be subject to an approved connection to the national grid (8);
- noise level restrictions (15 and 23) and after commissioning (32), as well as noise monitoring surveys (25, 26) and contour plans (31, 33). Other noise related conditions specify the use of BANTEEC principles (16, 17) and noise measurement standards (24). The noise level restrictions during construction are specified as not greater than 55dBA 15 min Leq between 0800 and 1900 hours Mon-Sat and otherwise 45dBA and not greater than 6dBA above background noise levels at the existing position at an occupied dwelling. After commissioning, the noise levels shall not exceed 43dBA L_{90} or 5dBA above background levels with the usual penalties of +5dBA for indiscrete elements etc. The noise monitoring surveys must be conducted within 1 year and any excessive noise source to be investigated. Contour plans of projected noise levels where they exceed 40dBA Leq for a wind speed of 8ms-1, must also be prepared and the developer is required to notify the occupiers of all sensitive noise receptors on the plan and obtain a declaration that there is no objection to the development;
- measures to minimise shadow flicker (18) and electromagnetic interference (30);
- monitoring of the construction works by an ecologist (38) and prior to development commencing, a survey to determine whether there are any barn owls present and if

so, assess the risk to these birds and proposed mitigation measures to be agreed with the P.A (12);

- record of bird casualties and a bird survey within 2 years (27, 28), no development within the breeding season of May-July (34) and a mitigation workplan for wildlife commitments made in Chapter 10 of the EIS;
- Details of fencing and full landscaping scheme with a view to screening the control building and substation compound;
- Oils and fuels are to be stored in bunded areas, details of interceptors to be submitted, (22) and road embankments to be gently sloped following completion of the works (19, 20) and grazing animals to be removed until soil has recolonised (35).

It is noted that the requirement by the DoEHLG that archaeological monitoring be undertaken by a qualified archaeologist with appropriate arrangements for recording and removal of any archaeological material has not been included in the schedule.

SUMMARY OF GROUNDS OF APPEAL

Third party appeals

The main points may be summarised as follows:

Pat and Margaret Cahalane (local residents and owners of adjoining permitted windfarm)

- Scale not reduced and clustering does not address reasons for refusal by the Board. Too many turbines in a limited space. Would support green energy and a windfarm of a more moderate scale as recommended in the Guidelines for hilly and flat farmland;
- Will result in abandonment of houses and reduction in property values;
- Lackareigh School is not owned by the developer and is a community facility owned by the parish and the noise impact on this property should be assessed as it is not derelict as implied in the EIS;
- Noise levels would be too high.

Stephanie Larkin and Michael O'Donovan

1. *Inadequacy of EIS* - claims that EIS is totally inadequate as it is based on only a two-day study of the area in April with no night sightings, which is considered to be insufficient. The low ecological rating and survey results are also strongly disputed and a comprehensive list of bird sightings from the appellant's house is given. It is also stated that one of the appellants is a former committee member of Bird Watch Ireland and Irish Wildlife Trust. This list includes sightings of Hen Harrier and Barn

Owl (Red Data List) and Cuckoo (Amber list species), all of which were missed by the EIS. A comprehensive list of flora is also given which it is stated is more varied that the results of the EIS survey, and it is stated that there is a colony of bats in the attic of the appellant's house.

2. *National and local policy* - Disputes compliance with policies for area and low sensitivity designation of landscape in Altener Report (which it is claimed was carried out by vested interests). The inclusion in a Strategic Search Area does not imply suitability for windfarm development as other criteria need to be complied with. West and North Cork has already sufficient wind farm development to comply with the objectives of national policy.
3. *Noise impact* - Predicted noise levels are excessive and methodology used is flawed as the experience at the noise monitoring sites is very different to the survey results for background noise. It is generally much quieter, especially at night than implied. The hours of construction are inappropriate for a rural area;
4. *Visual impact*- The reasons for refusal by the Board have not been addressed. It would jeopardise the integrity of the Scenic Route and result in serious visual intrusion over a very wide area (Lee and Bandon Valleys). There would be a significant impact on the visual amenity and views from the appellant's property due to proximity to the turbines and would devalue their property;
5. *Socio-economic environment* – the area is not depopulated and consists of a viable community with an increasing population;
6. *Recreational environment* – the area is popular for recreational walking and the local Archaeological Society has recently created 4 walks in the vicinity of the site. The area is also used by hunters and visitors to Beal na Balth and the site of the ambush at Kilmichael.

First party appeal

The appeal is against Condition No. 1 which seeks the omission of turbines 12 and 14, and the appellants seek to have these two turbines reinstated at revised locations. Revised wireframes of view points 1, 2 and 3 respectively, have been submitted to assist the visual impact of the revised locations (Fig. 10.2, 10.3 and 10.4). A commentary is given on the effects of the revisions on each of the viewpoints. It is stated that the spatial extent of the windfarm would be reduced at View 1 (from the Scenic Route, where 13 of the 14 turbines are visible from approx. 1km distance). It is claimed that the revisions result in two benefits from View 2 (additional view from Scenic Route (1.2km distant) where 13 of the turbines are visible together with 5 of the adjoining windfarm turbines), in that the spatial extent is reduced and the grouped layout of the other turbines is matched. Similar benefits are produced, it is submitted, from View 3 (R585 East of Coppeen, 1.8m distant from nearest turbine) in terms of reduced visual impact, improved grouping and reduced spatial extent.

Noise modelling was conducted to assess the differences in the predicted noise levels at the 44 dwellings within the 1km range. Table 2 shows that there would be slight changes for 12 dwellings, four of which would result in an increase of up to 1dB(A), (dwelling nos. 38, 41, 48 and 49). Each of these would have night-time levels which would exceed the 43dBA guidelines. It is stated that in two of these cases (Nos. 41 and 49), the levels would only be marginally above 43dBA at 43.55 and 43.59 dB(A) respectively. No. 38 it is stated is in ruins and No. 48 is owned by one of the developers, who has no objection.

The shadow casting model was also repeated for the revised turbine locations. It is stated that there is negligible change in shadow casting hours with two additional dwellings (Nos. 47 and 48) having shadow flicker at greater than 30 hours per year due to the revisions, but that these belong to the developers, (as shown in Table 2).

Observations

An Taisce

- The proposed development does not address the reasons for refusal of the Board's decision in terms of the number of turbines or the size of the turbines.
- There is a preoccupation with the visual impact from the Scenic Route and Regional and National roads rather than the impact on the general landscape character of the area.
- The application fails to address the connection to the national grid and the environmental impact of grid connection as an integral part of the proposed development, and as such the requirements of the EIA Directive on Environmental Impact Assessment have not been met.

Kathleen O'Driscoll

- The proposed development does not address the reasons for refusal by the Board. The turbines are 10m higher than those refused by the Board. The site cannot accommodate the vast number of turbines proposed and the visually negative impact is unacceptable, is disproportionate to the local landscape and is out of character with the immediate surroundings. The area is popular with walkers and the development would change the landscape beyond recognition.
- The observer's house is featured in Viewpoint 3 of the EIS from where the development is unsightly and will seriously devalue her property. Two previous objectors have since sold up and moved out and surely this will lead to further abandonment of properties.
- The decision is based on inaccurate information. Confusing information submitted in the revised EIS involves amendments to the house numbers and it is impossible to decipher which properties are owned by the developers and to which the noise levels relate.

RESPONSES TO GROUNDS OF APPEAL

Planning authority response
The planning authority has not responded to the grounds of appeal.

First party response
The response to each of the third party appeals (dated 12/10/06 and 25/10/06 respectively) is in the form of a detailed rebuttal of the grounds of appeal and includes photographs of Lackareigh School. It is pointed out that there had been a discrepancy between EIS text and drawings whereby the number for Lackareigh School had been confused with another property. However, it is confirmed that the correct numbering is contained in the EIS drawings, and that the errors were corrected in the revised drawing submitted on 14th August 2006. It is also confirmed that the School has been included in the environmental impact assessment but night-time noise levels were not assessed as the building is not likely to be used for residential use, but is likely to be used as a community building.

The rebuttal includes a lengthy and detailed response to the criticism of the adequacy of the EIS and it is confirmed that it incorporated several surveys and visits including night-time visits which it lists. It reiterates that the EIS complies with the requirements for such studies, that the studies were conducted on a scientific basis as opposed to casual observation and that the conditions proposed by the Planning Authority would address any outstanding issues, such as the Barn Owl survey.

NATIONAL POLICY

Sustainable Development – A Strategy for Ireland 1997
This policy document promotes the development of renewable energy sources, including maximising the efficiency of energy generation as well as the use of renewable resources. It also seeks to minimise greenhouse gas emissions and other forms of pollution in terms of both cleaner energy generation and more sustainable energy consumption.

The National Climate Change Strategy 2000
This document, published by the DoEHLG identifies compliance with the Kyoto Protocol as one of the main objectives in the energy sector. It encourages the expansion of the renewable energy sector in order to reduce emissions, with wind energy being one of the main means for achieving this.

Department of Environment Heritage and Local Government Planning Guidelines for Wind Energy (June 2006)
These guidelines supercede the previous Windfarm Guideleines (1996). Relevant points include:-

- The need to identify suitable areas in development plans;
- Making and assessment of planning applications, including suggested conditions;
- The siting and design of wind farms including advice for different types of landscapes. Visual impact is among the more important considerations and advice is given on spatial extent, spacing, cumulative effect, layout and height. There is an emphasis on the distinctiveness of landscapes and their sensitivity to absorbing different types of development;
- Environmental considerations such as the impact on habitats and birds and the need for habitat management. It is noted that designation of an area of natural and cultural heritage does not in itself preclude development, unless it is judged to be such that it would impact on the integrity of such sites and their natural heritage interests;
- The need for information on the underlying geology of the area including a geotechnical assessment of bedrock and slope stability and the risk of bog burst or landslide. Geological consultants should be employed to ensure that sufficient information is submitted.
- Other impacts on human beings such as noise and shadow flicker.

LOCAL POLICY

Altener Report

This was a joint study between Cork County Council and Gestenga (2001) which examined wind potential and landscape character on a county basis. It is a non-statutory document. The wind potential analysis examined wind speed and terrain roughness. A set of general and environmental exclusion areas were devised, and these were combined with the landscape assessment to produce a map of "Useable Areas". It is stated that the landscape assessment was guided by the DoEHLG Draft Guidelines (now adopted) and involved a Landscape Character Assessment and a Landscape Values and Sensitivity Assessment. A set of 5 sensitivity classes were devised with Class 1 as the least sensitive. A report of the Cork county Council Planning Policy Unit entitled "Planning fro Wind Energy and the Landscape", March 2001, summarises the concepts used in the Altener Report and discusses the key findings. However, it is stated that in its current form it cannot be used as a basis for policy. In any case, it would seem that the Landscape Assessment contained in the Local Area Plans (2005) has superceded this report.

Development Plan

The statutory plan for the area is the Cork County Development Plan, 2003. Chapter 5, Volume 1 contains the policy for wind farms, which includes the identification of two broad strategic areas known as "Strategic Search Areas" and "Strategically Unsuitable Areas". These were identified having studied wind speeds and landscapes on a broad level. The appeal site is located within the only Strategic Search Area in the West Cork area (Fig. 5.1). It is stated that developers would be encouraged generally to focus on these areas when searching for sites but that not all locations would be suitable for wind projects, and

inclusion in an area does not give any certainty about the outcome of any particular project. The objectives for wind energy are set out in INF 4-4 and INF 4-5, including 6 criteria for Strategic Search Areas which will be referred to in the assessment section of this report.

Chapter 4 (Vol. 1) contains the policy for Tourism Development. The key resources on which the tourist industry relies are listed in 4.4.2 and include the identifiable features that make up the natural, built and cultural environment of the County and Objective ECO 4-1 seeks to protect and conserve such resources. Chapter 7 (Vol. 1) contains the policy on Environment and Heritage. The section on Landscape and Visual Amenity includes policies on Scenic Amenities, Views and Prospects and ENV3-5 seeks to preserve the character of those views and prospects obtainable from Scenic Routes identified in plan (Vol. 2, Chap. 4, which includes the A84 near Terelton).

Chapter 7 also addresses landscape character. A total of 76 Landscape Character Areas have been identified in the County, and these have been amalgamated into 16 generic landscape types, which are shown on the Landscape Character Map in Volume 4. The appeal site is located in Landscape Character Area 55 "upland of intimate rolling farmland mosaic with scrub outcrops" and Landscape Character Type 16 "Glaciated Cradle Valleys". Section 7.3.5 states that this work will form the basis of assessing the sensitivity of landscapes to different kinds of development having regard to the character and values associated with local areas, and that this process will be carried out through the Local Area Plans. A series of Local Area Plans based on the Electoral Areas has since been adopted (Sept. 2005). The site falls between two Electoral Areas, Skibbereen and Macroom. Chapter 7, Environment and Heritage contains the landscape assessment. This consists of a description of the landscape type and the values associated with it. The appeal site falls into "Fissured Fertile Middleground" and "Valleyed Marginal Middleground". The description and associated values for these landscape areas will be discussed further in the assessment section of this report.

ASSESSMENT

I consider that the principal planning issues have been identified in the grounds of appeal and that there are no new issues to be considered by the Board. It should be noted that the original scheme proposed 18 turbines but that this was subsequently revised to 14 turbines. There are 3 separate appeals and two observers. I propose to deal with the 2 no. third party appeals initially and will then consider the first party appeal. The main issues arising from the third party appeals are :

- Compliance with national and local policy and in particular the Local Area Plans (2005) and the DoEHLG Guidelines (2006);
- Impact of the proposal on the visual and scenic amenities of the area;
- Impact on residential amenity in terms of Noise and Shadow flicker; and
- Adequacy of the Environment Impact Statement;
- Impact on natural and cultural heritage.

National and local policy

It is noted that the Inspector (PL04.204928) considered that the scale and extent of the proposed development to be central to many aspects of the grounds of appeal, and acknowledged that the developer had justified this by stressing the national requirement to achieve alternative energy targets. However, he was firmly of the view that the scale and extent should be influenced by the character of an area. The Development Plan is supportive of renewable energy projects and the policies and objectives are in accordance with national policies. It is acknowledged that there can be environmental and visual impact problems associated with wind farm developments but it is considered that these must be balanced against the environmental benefits of such developments. Since the previous decision of the Board, there have been two material changes to policy, namely the publication of the DoEHLG Guidelines on wind energy and the adoption of the Local Area Plans for Skibbereen and Macroom. It is noted that each of these documents advocates/adopts the approach of identifying distinctive landscape character types/areas and assessing their individual sensitivity to absorbing different types of development. The Local Area Plan process has developed this further by establishing the values associated with each landscape type.

The "Fissured Fertile Middleground" and "Valleyed Marginal Middleground" are summarised as follows:

"*Fissured Fertile Middleground* (Skibbereen Electoral Area Plan) ……..has characteristics of both the flatter fertile farmland and the higher marginal hilly farmland…. It is an elevated landscape, which is fissured by fairly gentle slopes, with reasonably fertile agricultural land comprising a mosaic of small to medium sized fields with broadleaf hedgerows and is used predominantly for dairy as well as some arable production. Houses, farmsteads and sheds are dispersed across this landscape, while villages and hamlets nestle against hillsides…" (7.10.19). The values associated with this landscape type are described at 7.10.20 as follows. "This landscape is valued locally, not only as a place to live and for the quality of its agricultural land, but also for its aesthetic quality, particularly due to its fertile and complex topography, even though there are limited areas of particular significance regarding scenic amenity"

"The *Valleyed Marginal Middleground* (Macroom Electoral Area Plan) is characterised by low rounded hills of red sandstone enclosing fairly broad undulating river valleys……Small to medium sized fields of marginal quality consisting of uncultivated peaty soils, and include clumps of willow, birch, heather, bracken, the occasional rock outcrop and are bounded by low broadleaf hedgerows. Coniferous plantations are mostly located on higher ground. Dwellings, farmsteads and sheds are interspersed across the landscape and are generally well screened by hedgerows", (7.7.7). The values associated with this landscape type include scenic amenity, mix of fertile river valleys and upland areas, agriculture and as a place to live.

The 2006 Guidelines provide advice on locating windfarms in various landscape character types. In general terms, it is stated that spatial extent and scale (6.4), i.e. the area covered by a wind energy development, should be balanced and in scale with its landscape context. This involves consideration of the perceived size (extent and height) of landform, landcover and structures relative to the wind energy development. Many turbines viewed at close proximity in a spatially enclosed area, such as a hilly mountain moorland or farmland area will be large while a few turbines on open moorland will be regarded as small.

For "*hilly and flat farmland*", (6.9.2) location on ridges and plateaux is preferred, not only to maximise exposure but to ensure a reasonable distance from dwellings. Sufficient distance should be maintained from houses, farmsteads and centres of population in order to ensure that the turbines do not dominate them, as where they are too close/overlap other landscape elements e.g. buildings, they can result in visual clutter and confusion. The spatial extent in this landscape type should be quite limited in response to the scale of fields and such topographical features as hills and knolls. Sufficient distance from buildings, most likely at lower elevations, must be established to avoid dominance by the wind energy development. The optimum spacing is likely to be regular, responding to the underlying field pattern. The optimum layout is linear with clustered layouts on hilltops. Turbine height should relate in terms of scale to landscape elements and will tend therefore not to be tall. With regard to cumulative effect for these landscape types, it is stated that it is important that wind energy development is never perceived to visually dominate. However, given that these landscapes comprise hedgerows and often hills, and that views across the landscape will likely be intermittent and partially obscured, visibility of two or more wind energy developments is usually acceptable.

There have been no changes in terms of the site's location with respect to designated landscapes, SACs, NHAs or SPAs in that none of these designations apply to the site. Scenic Route A84 is located immediately to the NW of the site, and whilst the applicant has described it as being of low tourist value, this Scenic Route designation has survived both the Development Plan review (2003) and the Local Area Plan process (2005). The Development Plan objective (ENV 3-5) is to protect views from this scenic route. It is noted that there had been an intention in the Development Plan 2003 to examine such designations, but it is stated in the LAPs that the current stage of the process is at the 'values stage' whereby the values associated with a landscape character have been established and that this information will inform the next stage of the process, i.e. an examination of the scenic routes and scenic landscapes.

The Environment chapter of each of the LAPs (7.3.2 to 7.3.12, Skibbereen LAP) contains an explanation of the purpose and value of the Scenic Route designation and advice on assessing development which might affect such a route. It is stated that development may contribute to the quality of the experience of traversing the route or add value to the route. However, where the development has a negative impact on the quality of the route, the scale of that impact will be judged against any positive planning benefit arising from the development. Developments which would have a significant negative impact on the quality of the Scenic Route which is not outweighed by any other planning considerations will not normally be acceptable.

The criteria for choosing a site in a Strategic Search Area are set out in the 2003 Development Plan, (Vol. 1, Chap. 5. Obj. INF 4-4). The matters to be considered in selecting a site for a wind farm include sensitivity of the landscape; the scale/size and layout of the project as well as any cumulative effects and the degree to which the impacts are visible across a wide landscape; the visual impact on protected views/designated landscapes etc.; the impact on nature conservation, archaeology and historic structures; local environmental impacts e.g. noise and shadow flicker; and the visual/environmental impacts of access roads, plant, grid connections etc.

In conclusion, it is considered that a wind farm in this location would be acceptable in principle in terms of both national and local policy subject to appropriate scale, size and layout, visual impact on the landscape character of the area and in particular the Scenic Route, impact on human beings (noise and shadow flicker), and natural and cultural heritage (ecology and archaeology).

Visual and scenic amenities/landscape impact

The EIS assessment described the landscape character type as '*Upland intimate rolling farmland mosaic with scrub outcrops*'. This was based on the Altener classification. The landscape values were described as rural socio-economics, tourism and ecological (Lee Valley visual unit). The landscape sensitivity was described as low, based on the Altener Study. Having travelled the area and viewed the site from a number of near and distant vantage points, my assessment of the character of the landscape is that it matches very well with the description of "Fissured Fertile Middleground" as described in the preceding section (as taken from the Skibbereen LAP), and with the Hilly and flat farmland landscape type description in the DoEHLG Guidelines. I would also agree with the landscape character description in the EIS, which coincides with the Inspector's assessment in the previous appeal (04.204928), that the area could be described as an upland intimate rolling farmland mosaic. I consider that this intimacy is a function of the closeness and accessibility of the hills as a result of the undulating topography and rolling nature of the landscape, the absence of any distinctively high topographical points and the intensively farmed and highly populated nature of the land. The ZVI indicates that because of this topography, a large number of wind turbines would be visible over a wide area.

I consider the values associated with the fissured fertile middleground landscape character to be very apt in that the land appears to be very fertile with a considerable amount of scattered housing/farmsteads and evidence of a number of planning application site notices. As such the values/benefits that are derived from the landscape character are mainly aesthetic, and in socio-economic terms, employment from agriculture would be considered to be of considerable importance to the local community. Thus whilst the landscape character and value assigned in the EIS are considered appropriate, I would not

agree that the landscape sensitivity is low given the intimate nature of the landscape described above, which would make it less adaptable to change.

I note that the Inspector in the previous report on the site had considered that the number of viewing points presented in the EIS was minimal and that it would have been preferable to have had additional intermediate area, scenic route and residential area viewpoints. It is noted that the same viewpoints have been used in the analysis of the current proposal, (although renumbered) and that only two additional viewpoints have been added. One of these two would fall into the Scenic Route category (current Viewpoint No. 1) and the other into the intermediate area category (current Viewpoint No. 4). It is stated (3.3.3 EIS) that the photos taken from the viewpoints to create the photomontages were taken using a 50mm lens. This is consistent with advice in the DoEHLG Guidelines, appendix 3. However, I used a 50mm lens for each of the photos taken during my site inspection (attached to this report), and when compared with the majority of the photomontages, it would appear that the lens used for the photomontages was a wide angle lens, probably 33mm, as the 50mm lens is more akin to the view from the human eye. Thus the true extent of the visual impact appears to be understated in the EIS.

The **distant views** in the current proposal (7, 8 and 9) can be directly compared with the viewpoints in the previous application/appeal (3, 5 and 7). It is considered that the visual impact from Viewpoints 7 (Glan), 8 (Carrigeen Crossroads) and 9 (Carrigdrohid in the Lee Valley) is reduced by the reduction in the number of turbines and the more orderly and clustered layout. I also consider that the camera lens used at these viewpoints is more appropriate as it presents a more realistic view, (although I do not accept that a 50mm lens was used as the view differed from the human eye view). Given that the number of turbines has been reduced and the layout improved, the proposed development would not have a significant visual impact due to the distance with reduces the overall impact.

The **intermediate views** are represented by viewpoints 3, 5, 6 and 4 (additional) which correspond with viewpoints 2, 6 and 4 respectively, in the previous proposal refused by the Board. It is considered that the impact from Viewpoint 6 (Newcestown) is significantly improved (even though the turbines appear more prominent due to the better angle of camera lens used), due to the reduced spatial extent but in particular, due to the more ordered layout. However the aesthetic impact is still considered to be quite high due to the wide spatial extent and visual presence of the turbines which dominate the view of the hill and the scale of the turbines is completely at odds with the scale of the underlying field pattern. The viewpoint from East of Kilmurray (No. 5 in the current EIS) appears to be missing from the file and it was not therefore possible to compare the impact of the current and previous schemes from this location. However, as an intermediate view, it is considered that impact would be low to moderate due to the mitigating factors of the

topography, larger field pattern, the coniferous forest to the west of the turbines and the distance to the turbines. The visibility is also low as only 9 hubs are visible (cumulative effect).

Viewpoint 4 (Boxers Cross) is a new intermediate view, from the R585 to the SE of the site. It is considered that the wind farm from this location is highly visible and its all of the turbines are visible along the top of the hill. The height/scale of the turbines relative to the scale of the hill, the underlying field pattern and farm buildings is considered to be overly dominant and results in a very strong visual presence and poor aesthetic impact. I would disagree with the conclusions of the EIS that the visual impact is moderate from this location and consider that it is high. I consider the visual impact from Viewpoint 3 (near Cappeen) to be one of the most problematic due to the very strong visual presence and the extremely poor relationship with the existing houses nearby, notwithstanding the improved spatial extent. The scale and height of the turbines together with the scale, layout and spatial extent of the wind farm when viewed from this location (and for some distance on either side along this stretch of the R585) results in visual dominance of the landscape and dwarfs the houses close to the road. I consider the visual intrusion on these houses to be excessive and would be unlikely to be capable of mitigation by merely relocating or redesigning the turbines. It is simply out of scale with the intimate nature of the landscape.

Scenic Route viewpoints (1 and 2) are taken from the A84 to the NW of the site, just east of Terelton village. I have previously discussed the value of scenic routes as described in the Local Area Plan and would accept that this particular Scenic route is quite remote and isolated and relatively remote from the normal tourist trails. However, it is in a location which is valued by the local community and appears to be popular with walkers. The area is relatively accessible to centres of large population such as Macroom and Cork and despite the poor quality of the road (in terms of surfacing, width and alignment), it is nonetheless a designated Scenic Route from which views are to be protected as an objective of the Development Plan. The views from the south-eastern section of the A84 are attractive and are currently dominated by the unspoilt hilltops. The visual presence of the wind farm turbines is very high as the turbines are quite close to the viewpoint. It is considered to be visually dominant due to the scale and height of the turbines and the spatial extent of the development. I consider the sensitivity to be high rather than moderate and as such would disagree with the visual impact assessment in the EIS and consider it to be high from these viewpoints.

I consider that the **visual impact from the numerous residential properties** scattered throughout and close to the site is considerable due to the proximity of turbines, their visual dominance in a number of locations (from regional roads, scenic routes etc.) and the poor relationship of the windfarm with the character and intimate scale of the landscape.

This is particularly noticeable from the roads traversing the site where the siting of turbines of the scale proposed would be so close to individual houses, farm house and public roads that they would be overbearing and excessively dominant features in the landscape. Thus the visual presence and aesthetic impact are high, and as such I consider that the visual impact on nearby dwellings will be significant.

In conclusion, it is considered that the proposed 14 turbine windfarm (as revised) would affect the visual and scenic amenities of the area, which consist of an intimate landscape with a scattered settlement pattern, with high visibility from the visually sensitive sites in the locality. Whilst it is acknowledged that the reduced spatial extent and improved layout have resulted in improvements from some of the viewpoints, it is considered that the spatial extent is still far too great and does not respond to the scale of the topographical features and underlying field pattern as recommended in the DoEHLG Guidelines. Neither has sufficient distance from buildings been achieved in order to avoid dominance by wind energy development (pg 52 of guidelines). In addition, it is considered that the height of the turbines does not relate to the scale of the landscape elements in the vicinity of the site.

Residential Amenity – Noise

The DoEHLG Guidelines for Wind Energy Developments (2006) state that an appropriate balance must be struck between power generation and noise impact, which should be measured at noise sensitive locations. These are defined as including any occupied dwelling, hostel, health building or place of worship, but the guidelines do not differentiate between properties owned/occupied by promoters of the windfarm (as in the Draft Guidelines). Noise limits should apply to external areas (daytime) but internal areas at night to protect sleep. The measurements should be made using LA90, 10min which allow for reliable measurements without corruption from relatively loud transitory events. The Guidelines recommend a lower fixed level of 45 dB(A) or a maximum increase of 5dB(A) above background noise at noise sensitive locations. However, it is indicated that in low background noise environments (less than 30 dBA) the daytime level of the LA90 10 min of the wind farm noise should be limited to an absolute level within the range of 35-40 dBA. A fixed limit of 43dBA is set for night time to protect sleep inside properties. In general, it is stated, noise is unlikely to be a significant problem where the distance from the nearest turbine to any noise sensitive property is more than 500m.

The EIS (Chapter 4) included a baseline survey which included monitoring (of daytime and night time levels during the 12th July) at three locations. It is clear from the monitoring results that the area could be described as a quiet rural environment with daytime background noise levels (L_{AF90}) ranging from 23.8 dB(A) to 27.2 dB(A), and night-time background noise levels (L_{AF90}) ranging from 19.6 dB(A) to 23 dB(A), which is the noise

level that is exceeded for 90% of the measu rement period, thereby excluding intermittent noise such as dogs barking, cars passing etc. The predicted noise levels were assessed against various noise guidelines. It was stated that when both wind farms were operating, the predicted turbine noise at 32 of the 45 houses is less than or equal to 43dB(A) at a wind speed of 8 ms-1, which meets the night time level. However, at the remaining 13 dwellings, the turbine noise is greater than 43dB(A) and greater than 5 dB(A) above background noise levels but this was justified on the basis that 11 of these house owners are directly involved in the wind energy development and have no objection to the increased noise levels; one is owned by the developer of the Art Generation project and the noise at this location is from the Art Generation turbines; and the remaining dwelling is in ruins. However, it is noted from Table 5.1 that the proximity of the turbines to dwellings exceeds that recommended in the DoEHLG Guidelines for noise of 500m in the case of 19 of the 44 dwellings, with distances (under 500m) ranging from 200m to 490m. This represents 43% of the dwellings.

It is clear that the proposed development is likely to alter the noise environment around the site, and that the predicted noise levels for the closest residences exceed the levels recommended in the DoEHLG Guidelines on Wind Farms. I would be concerned about the impact of noise on these dwellings notwithstanding the fact that the majority are owned by shareholders in the wind farm and would consider that it could render some of these dwellings uninhabitable and lead to abandonment or at least a reduction in property values.

Residential Amenity – Shadow Flicker

Shadow flicker is addressed in Chapter 5 of the EIS. It is stated that for shadow flicker to occur, the right conditions must be present (eg sunshine and rotating blades), the distance between the turbine and the house and the orientation of the turbines with respect to dwellings. The DoEHLG Guidelines recommends that shadow flicker at neighbouring offices and dwellings within 500m should not exceed 30 hours per year, and states that at distances of greater than 10 rotor diameters the potential for shadow flicker is very low. As stated above, it is noted that there are 19 houses within 500m of the wind turbines. The rotor diameter for the wind turbines is 70m, giving a 10 rotor diameter distance of 700m, and it is noted from table 5.1 that an additional 10 dwellings would fall into this category, giving a total of 29 dwellings within 700m. Notwithstanding this, the results of the shadow casting model indicate that only 13 out of the 44 dwellings would result in the potential for shadow flicker of 20 hours a year and it is noted that the figure is 11 for 30 hours or more a year (assuming 40% sunshine). However, it was concluded that the actual potential for shadow casting (taking into account factors such as the percentage of time that the wind direction is parallel to the windows of the houses, the screening effects of vegetation and that not every house would have a window facing the turbine(s)).

Adequacy of EIS

The appellants have criticised the duration of the surveys and the low ecological rating for the site and area. The developers in response have listed the relevant legislation and best practice guidance documents that were relied on when preparing the EIS. It is stated that the "2 or 3 day survey" referred to by the appellants related to part of the ecological study which comprised a desk top study as well as an ecology field study from 16-21 April 2003 and a bat survey on 4th May. In addition to this field work, day time and night time noise surveys were carried out on 12 July 2005, a traffic survey on 17th February 2005 and landscape surveys between January 2003 and May 2005. It is also stated that the EIS was carried out in full consultation with the National Parks and Wildlife Service. The appellants had also prepared a list of bird species that they had seen from their house. In response it is stated that the survey results had included 11 of these species including 7 amber listed species. It is stated that "no ecological study can claim to record all bird species….this is not a consequence of bad scientific methodology but other aspects such as behaviour, timing, weather, food availability, habitat and so forth". The lack of evidence of any known breeding Hen Harrier is reiterated and it is suggested that the sighting made by the appellant may have been a non-breeding individual.

The developer is prepared to comply with the P.A. conditions regarding the conducting of a barn owl survey, monthly monitoring of bird casualties, bird surveys within 2 years of development, a restriction of construction works during the breeding season and a mitigation workplan in relation to wildlife mitigation measures. References to other species sightings are generally responded to in terms of the lack of any precise evidence of the location of such species and the low numbers involved, which are not of ecological concern for a wind farm development. It is also stated that the bird survey was carried out by a bird expert using appropriate standard bird census methodology.

I accept the overall conclusions that the proposed windfarm will not have significant negative impacts on ecology or natural heritage. Having regard to the legislation and the published best practice guidance, and given that the site is not within or adjacent to any SAC, NHA or SPA, and the lack of any serious concerns raised by the DoEHLG/NPWS, and in light of the comprehensive response contained in the developer's submission of 25/10/06 (part of which is summarised above), I am of the opinion that the EIS is adequate. In addition, having regard to the findings of the EIS and the proposed mitigation measures, I consider that the case presented by the third party appellants is not strongly grounded.

Impact on Archaeology

It is recommended that archaeological monitoring be undertaken by a qualified archaeologist with appropriate arrangements for recording and removal of any archaeological material as advised by the DoEHLG applications Unit. A condition to this effect should be attached to any planning permission.

First party appeal

The planning authority had given its rationale for requiring the omission of 2 turbines (T12 and T14). This was based on achieving a tighter format and clustering effect. I have previously given my opinion on the visual impact of the proposed development on the scenic route, intermediate area and existing houses within 1km of the site boundaries, and would therefore support the rationale of the planning authority in the requirement to omit. I have examined the additional material submitted with the grounds of appeal and consider that whilst the relocated turbines would probably achieve a better layout, I do not believe that the revisions would be sufficient to overcome my concerns about the visual impact of the overall windfarm as set out above.

Summary and Conclusion

The decision requires a balance to be achieved between compliance with national policy and the impact on the local environment. In this regard, the developer has set out how the proposed development would help meet the national policy regarding alternative energy targets and local policy objectives, the lack of any conservation and landscape designations, the extensive consultation with local communities and the agreements reached with house owners regarding noise and shadow flicker impacts. The planning authority supported the revised application on the basis that the proposed development is in the interests of the greater common good and that the revised proposal had addressed the shortcomings of the previous scheme that was refused by the Board, with a reduced number of turbines in a tighter format.

I have examined the appellants' arguments regarding the local impact and concluded that notwithstanding the improvement in the layout and reduction in the number of turbines, there would be a significant impact on the Scenic Route, on the immediate area and on the amenities of the houses in the vicinity, (notwithstanding the acceptance by house owners of the noise and shadow flicker impacts), principally due to the scale and height of the turbines, the scale and spatial extent of the development and the visual dominance and cluster arising from the layout in an intimate landscape area.

On balance, I consider that permission for the proposed development should be refused. In reaching this decision, I have had regard to the Local Area Plans for Macroom and Skibbereen (published Sept. 2005) and the DoEHLG Guidelines for Wind Energy Development (published June 2006) as well as the previous decision of the Board in respect of

PL04.204928. I have noted the comment by the Inspector in his report dated 11th March 2004, that a significantly revised proposal may be considered, which was reiterated in the board direction of 22/3/04. However, I consider that the current scheme fails to address the concerns regarding the need to respect the intimate nature of the landscape area. I would agree with the Inspector of the previous report that conditioning revisions to the current layout is not an option because of the number of turbines involved and the specialist knowledge of the layout design required for this particular type of development.

RECOMMENDATION

Having considered the contents of the application and appeal, the decision of the planning authority and the previous decision of the Board, national policy, the provisions of the Development Plan (including the Local Area Plans for Skibbereen and Macroom), the grounds of appeal and responses thereto, and having visited the site, I recommend that permission be refused for the reasons and considerations set out hereunder.

REASONS AND CONSIDERATIONS

Having regard to the landscape character of the area and the pattern of residential development in the vicinity and notwithstanding the designation of the site within a Strategic Search Area it is considered that the proposed development, by reason of the layout, number and size of the turbines, would be excessively dominant and visually obtrusive in the landscape. The proposed development would, therefore, seriously injure the amenities of the area and property in the vicinity and would be contrary to the proper planning and sustainable development of the area.

Mary Kennelly
Senior Planning Inspector
22nd January 2007

List of appendices
Site Location Plan
Extract from EIS, Fig. 4.1 (14/10/06) plan of houses in area/noise monitoring stations
PL04.204928 Board decision, Board direction, Inspector's report.
Extract from Cork County Council Development Plan 2003
Extracts from Skibbereen and Macroom Local Area Plans (Sept. 2005)

BY HAND
The Secretary,
Planning Department,
Cork County Council,
County Hall,
Cork.

9th July 2015
Our ref: 26310-14/JN/PW

RE: **Planning Register Reference 14/6760**
The construction of six wind turbines, with a maximum tip height of up to 131m and associated turbine foundations and hardstanding areas, 1 no. permanent meteorological mast up to 90m in height, upgrade of existing and provision of new site tracks and associated drainage, new access junction and improvements to public road to facilitate turbine delivery, 1 no. borrow pit, underground electrical and communications cables, permanent signage and other associated ancillary infrastructure. This application is said to be 'intended to replace' development already granted permission under PL04.219620 (05/5907) and subsequently extended under 11/6605. This application is seeking a 10-year planning permission.

Development Address – Lackareagh and Garranereagh, Lissarda, and Barnadivane (Kneeves) Terelton, County Cork
Applicant – Barna Wind Energy (BWE) Ltd
Our clients – Denis Buckley and others known as Barna Wind Action Group, c/o Denis Buckley, Moneygoff East, Castletown, Enniskeane, Co Cork

---

Dear Sir/Madam,

We refer to your letter of 28th May 2015 and to the Response of the Applicant to the Council's Request for Further Information.

We set out below our clients' observations and submissions on the Applicant's Response for consideration by the Council.

1. Our clients were pleased to note the County Council Request for Further Information (RFI) of 20th February 2015 setting out significant areas of concern.

2. Having reviewed the Response of the developer to the RFI, our clients' concerns are undiminished and in certain respects have been made more serious.

3. The planning application is invalid. We alerted the Council to this in our observation letter of 2nd February 2015. This is still the case. Specifically the EIS fails to comply with the requirements of the EIA Directive and with the requirements of Article 94 of the Planning & Development Regulations. In particular, it fails to provide the information necessary for the Council to conduct an assessment as defined in the EIA Directive and in the Planning & Development Act of the impacts arising for an assessment in relation to the entirety of the project of which the proposed development forms part. This information is elaborated on in Schedule 6 to the Planning & Development Regulations. By reason of that failure to comply with the requirements of Article 94 and Schedule 6, the application does not comply with Article 16 of the Planning & Development Regulations, in particular Article 16(1) which requires a Planning Application to be accompanied by an EIS which complies with the requirements of Part 10 of the Planning & Development Regulations. It follows that the application is invalid. An invalid application must be rejected.

4. The purpose of the planning code is to reconcile competing interests. As part of that planning authorities adopt and implement policies and practices that facilitate coherent functioning of the different sectors in society and that provide a certain minimum level of protection of each those sectors having regard to their particular needs. By way of example residential areas and heavy industrial areas are identified and zoned separately from one another. This enables both areas to thrive secure in the knowledge that their essential requirements will be preserved and maintained without undue interference from conflicting developments.

5. These principles are at the heart of the planning code and it is essential to recall that fact when addressing an application to locate multiple sets of industrial scale wind turbines close to private homes and farms and places of public amenity and recreation.

6. The developer has placed great stress on national and European energy policies relating to renewable energy. Energy is a necessity of life. However that fact alone does not negate the essential planning principles described above. There is no national or European policy to say that it

is permissible to privilege either commercial energy generators or the energy needs of one sector of society to an extent that expropriates others or devalues their homes or diminishes their normal established life style. In the very carefully prescribed circumstances in which the State or other public bodies have been given power to interfere with a person's property rights, a balance is struck between the rights of affected citizens and the rights of the affected landowners through the compulsory purchase compensation system.

In addition of course even the compulsory system is limited to situations advancing the common good. None of that applies here. These factors were considered in the High Court by Judge Haughton recently when he said:

"The force of Coillte's argument is somewhat undermined by the fact that the proposed windfarm development is a commercial development. Ultimately it is primarily intended to produce profit for Coillte. The fact that it may contribute to Ireland meeting its renewable energy targets is not necessarily proven, but even if that is assumed, the primary objective is that of a successful commercial enterprise and the public benefit to the State would seem to be secondary."[1]

Outside of the compulsory purchase arena the public and in particular our clients are entitled to freedom from undue interference with their personal family and property rights. The Council has a duty to protect the public and to vindicate their property rights and their rights to family life when it is carrying out its planning functions.

7. An example of the ways in which our clients' concerns have actually been intensified by the developer's Response is in relation to Noise. It has emerged in the Response that this key Section of the EIS was fundamentally inaccurate and deficient in several respects. There is also now a fatal vagueness about what is to be built.

8. The developer had placed on record in the EIS their acknowledgement that their acoustic consultants made noise predictions based on one specific model of turbine, a Nordex N100 2.5MW turbine. The consultants in turn said that they worked with what are called 'declared sound pressure levels' relating to that model of turbine alone[2].

9. However in the Response to the Council's RFI the developer makes it clear that they regard themselves as free to use a completely different model of turbine produced by a different

[1] People Over Wind v An Bord Pleanala Judgement delivered 19.06.2015. Copy judgement already furnished with our observation letter of 2nd February 2015.
[2] Section 9.5, Volume 2, EIS.

manufacturer if necessary and importantly that any turbine ultimately constructed may have a power output capacity of 3MW. Indeed from their Response it is not possible to be sure that they will not install turbines of even greater power output. The only turbine parameters to which they are committed relate to matters such as hub height and blade length. In other words the physical dimensions. Everything else is open including maximum power output. Noise is a function of power output. Noise impact cannot be assessed in these circumstances.

10. Cork County Council would not give much sympathy to a person seeking to build a house who presented such sketchy information in relation to their building project. Saying that one wants to build a house of certain overall dimensions is not enough. This is self evident. Yet essentially that is the approach the developer is taking in relation to these turbines. To emphasise the point, houses do not generate noise. Turbines do. The more power they generate, the more noise they make. No-one can assess the noise to be generated by this development.

11. The Council requested (Question 32) that the impact of the final choice of turbine (if different to the one used in the model) on predicted noise levels be clearly demonstrated and illustrated. That request has been ignored.

12. The proposed turbines will be tall enough to be visible from the North side of Cork City. We are instructed that the existing Garranereagh turbines nearby are visible from County Hall and Shanakiel. The proposed turbines will be significantly taller. Their declared apparent sound pressure levels will be in excess of 100 dBA[3]. Bear in mind this predicted level is for the model which may or may not in fact be the one actually constructed on site. We refer to the attached graphic of relative turbine sizes – taken from the EIS.[4] We know how visible they will be. We do not know, and cannot know, how loud.

13. Having noted that astonishing degree of vagueness, we must now deal another remarkable situation which arises from the Response. In the Response, the developer makes an admission[5] that completely inappropriate information was contained in the EIS with regard to background noise measurements. As a result multiple tables[6] in the EIS contain information which is now said to be no longer appropriate. An effort is made in the Response to substitute a large quantity of new information with the assurance that the information is appropriate this time.

---

[3] EIS Table 9.1
[4] Table entitled 'Increased Efficiency with Increased Turbine Size. Volume 3 of EIS.
[5] Section 34 of the Response.
[6] EIS Tables Nos 9.6, 9.7, 9.9 and 9.10 and others.

The Response provides a new set of Baseline Noise Survey Results by way of revised Figures 1 to 8 inclusive, to replace those in the original EIS. The Response also provides revised Time History Charts of the Measured Noise Levels at each monitoring location. Further changes have also been made according to this section of the Response.

No explanation is offered for the blunders in the original EIS.

14. The Council requested details and supporting documentation regarding predicted noise levels. That request has not been complied with. Paragraph 34.1 of the Response says: '*Hayes McKenzie is unable to supply noise test reports from Nordex because of a non disclosure agreement but Appendix 4 contains a noise data sheet from Nordex showing source noise levels for this turbine.*' Appendix 4 relates to supporting ecology documentation. It does not contain any noise data sheet from Nordex. If this was intended to be a reference to Appendix 5, we can see no Nordex noise data sheet there either.

15. We note the assertion in paragraph 34.1 of the Response that Hayes McKenzie is unable to supply noise test reports from Nordex because of a non disclosure agreement. The existence of such a non disclosure agreement has two immediate implications. The first is that essential information which is sought by the Council is being withheld even though it exists. This means that the Council is deprived of material data which in its opinion (an opinion our clients share) it is necessary to have in order to complete an assessment of this aspect of the development. The Council cannot now complete that assessment. As a result it cannot grant permission.

16. Secondly, if there is a commercial relationship between the developer and/or the developer's acoustic consultants and the equipment manufacturer which restricts their ability to furnish necessary information, this means the Council is only being presented with part of the picture. This in turn puts a doubt of a significant degree over the weight which the Council can place on this noise section of the EIS and the Response.

17. In Question 32 the Council requested that an assessment of tonality with reference to the proposed wind turbine manufacturer's octave sound power data at all operational speeds and modes of operation be undertaken. The Response states *'it is not possible to determine tonal content from octave band data but a warranty will be obtained from the manufacturer of the eventual turbine for the site to the effect that tonal content will not be significant.'* This Response cannot be taken seriously. Tones are particular sources of noise nuisance. If they cannot be assessed, the project cannot be permitted.

18. The central importance of an EIS to the EIA process is obvious but may need to be recalled briefly here. The proposed project is a highly complex expensive intrusive industrial type development. In certain respects the technology being deployed will be new or relatively novel. The developer makes the point that they will be keeping their options open as the technology develops before deciding what form of turbine they are going to erect. In turn this means that the assessment of the impact of the technology on the local environment is not an easy task. The Council therefore has to make an independent assessment of the noise issue and should retain independent expertise to help it to do so if necessary.

19. The Council is obliged to complete an EIA. Under the legislation that means it must identify describe and assess the likely significant impacts of the proposed project. That is a distinct stand alone legal obligation on the Council. That obligation cannot be displaced for example by simply inserting a noise condition in the planning permission.

20. The local authority's legal duties under the EIA Directive and under planning and development law are separate and distinct from each other and must not be confused. We refer in this regard to the comments of Judge Finlay Geoghegan in Kelly v An Bord Pleanala[7] where she says:

> *15. The ultimate decisions taken by the Board on the appeals were whether or not to grant planning permission for the developments that were the subject of each of the appeals pursuant to s. 37 of the PDA. In taking those decisions, by reason of the nature and location of the proposed developments, there were three separately identifiable requirements deriving from Statute (in part enacted to give effect to EU obligations) with which the Board had to comply:*
> *(i) Consideration of what might be termed normal or general planning requirements under the PDA and compliance with its procedural requirements; and*
> *(ii) The carrying out of an environmental impact assessment required by the EIA Directive as implemented by Part X of the PDA; and*
> *(iii) The carrying out of an appropriate assessment as required by Article 6(3) of the Habitats Directive implemented by Part XAB of the PDA including making a determination.*

21. Noise is a seriously problematic topic from our clients' perspective. A study commissioned for the Scottish government has found that environmental impact statement predictions for noise levels from turbines are not always reliable. A look-back study on wind turbine developments found

[7] Kelly v An Bord Pleanala. Judgement of 25 July 2014, para 15. Copy judgement already furnished with Observation letter of 2nd February 2015.

unreliable predictions of noise levels, visual impact and shadow flicker[8]. Cork County Council will be aware that in a number of parts of the country people have abandoned their homes in circumstances where wind turbine developments nearby have rendered them unfit for human habitation. No local authority would consciously grant permission for a development which would have this drastic consequence. Yet these consequences have resulted.

22. In summary therefore, the noise impact assurances are seriously incomplete, excessively theoretical and utterly unreliable. To compound matters there is a notorious difficulty in enforcing noise conditions. In fact we are unaware of any local authority successfully mounting a prosecution for a noise breach under planning conditions relating to a wind turbine. This reality goes to the heart of our clients' concerns. In theory an appropriate noise condition in a planning permission is supposed to protect people. In fact, that is not what happens as enforcement may prove impossible to achieve. This underlines the importance of a full and proper EIA at the outset by the Council.

23. We note the Response from the developer to the Council's Question 15. The Response evades the question. The fact that there is a lengthy answer given does not change that fact.

24. As we set out in our observation letter 'project splitting' is the term given to a development presented in different parts with the effect that one or more of the parts falls below an EIA threshold and escapes assessment in the manner which is legally required under the EIA Directive as implemented in the Planning and Development Acts. That is precisely what has happened here. This central charge has not been answered by the developer at all.

25. To recap there are three parts to this windfarm project and they are being dealt with under three separate planning applications. Two of them have not been subjected to EIA at all. The three applications in legal and planning terms form a single project. They must therefore be assessed together in accordance with the law governing EIA. That simply has not happened and it cannot happen as matters stand.

26. In attempt to give some form of answer to the Council's question, the developer goes on at great length about something called 'cumulative impacts'. This is a different topic. Assessment of cumulative impacts arise when one is considering the effects of a development in conjunction with other developments. For example, the visual impact of a windfarm when seen in combination with adjacent windfarms can be cumulatively assessed. However, each of those windfarms will themselves have been subject to complete environmental impact assessment in their own right.

[8] BBC News Report of 2nd July 2015. Copy enclosed.

Cumulative assessment is simply one part of the EIA process and it is not a replacement or substitute for the EIA process.

In this case we are dealing with a single development chopped in three. The developer cannot turn to the language of cumulative impact assessment in order to remedy that circumvention of requirement for integrated assessment of the development in line with the EIA legal requirements. The road development has not been subjected to EIA, nor has the sub-station development. As a result, there has been no EIA of the overall project yet that is precisely what is required. We have given the Council a copy of the O'Grianna judgement explaining in detail why that is so. This is a further core objection advanced by our clients and we expect it to be addressed fully in the Planner's Report.

27. In this regard we would refer the Council to the following extract from 'Planning and Development Law' by Garrett Simons SC on the topic of project splitting:

> *"13.83 It is important that the full extent of a project be properly identified. If a project is identified in a restricted way, this may result in the evasion of the obligation for environmental impact assessment. For example, if what is, in reality, only one project is artificially presented as a series of separate projects it may be that none of these on its own will trigger an environmental impact assessment. This practice is known as "project splitting" sometimes also referred to as "salami slicing". In other instances the failure to identify correctly the entire project can result in only a partial assessment."* .....
>
> *"In most cases the full extent of the project will be readily identifiable. The regulatory authorities should be vigilant however, so as to ensure that where separate applications for development consent are made, in quick succession, by the same person or body, a project is not being artificially divided. This is especially so where the use of separate applications results in the individual development consents coming in sub-threshold."*[9]

28. The developer has it within its own power to present the development for planning permission in a proper fashion that would enable the local authority to conduct an EIA as it is legally obliged to do. All the developer has to do is to present the three elements of the project as a single development application.

[9] Planning & Development Law by Garrett Simons SC 2nd Edition. Para 13.83.

We note that they say that they cannot run the road application and the windfarm application together by reason of an email from the Council that requires development sites that are not contiguous to be the subject of separate applications. It is significant that the Council email goes on to say that the applications can be linked. It would thus be perfectly feasible for the developer to apply for permission for the windfarm and for the sub-station (which is within the windfarm footprint) and to submit simultaneously a linked application for the road construction. It has chosen not to do so.

For the record, we do not share the interpretation the Council places on Article 22 of the Regulations as set out in the Council's email of 6th March 2015.

29. The project splitting issues are further complicated by the assertion in the public press on behalf of the parent company of the Applicant that the sub-station is intended to act as an utility to serve windfarms in a 25 km radius. We flagged this in our letter of observation dated 29th October 2014 to the Council in relation to the sub-station under planning reference 14/557 and it has not been denied. We take it therefore that this is in fact correct. This declared intention to service future windfarms within a 25 km radius is plainly something which should trigger a cumulative impact assessment yet none has been made.

We enclose a copy of our letter of Appeal of 6th February 2015 to An Bord Pleanála in respect of the sub-station development with the enclosures thereto.

30. The public and other stakeholders are waiting for revised guidelines from the Department covering issues including noise and shadow flicker for over 18 months. We think it follows as a matters a logic from the fact that the Department decided to review the 2006 Guidelines that they see those Guidelines as in need of updating. This is no doubt in part due to the immense increase in size and in impact of the current generation of industrial wind turbines. The review also takes into account some of the advances in understanding of the effects and intrusive impacts of larger turbines on people living and working nearby.

31. We submit that it follows as a matter of logic that the 2006 Guidelines are not fit for purpose. Therefore we submit that the County Council when assessing the present application in 2015 should assess it having regard to the published Draft Guidelines issued by the Department in December 2013 for consultation. We enclose a copy of the Draft Guidelines.

32. The draft Guidelines prohibit shadow flicker outright within 10 rotor diameters of any wind turbine. They also reduce the maximum permissible noise levels to 40 dBA. Each of these factors have a

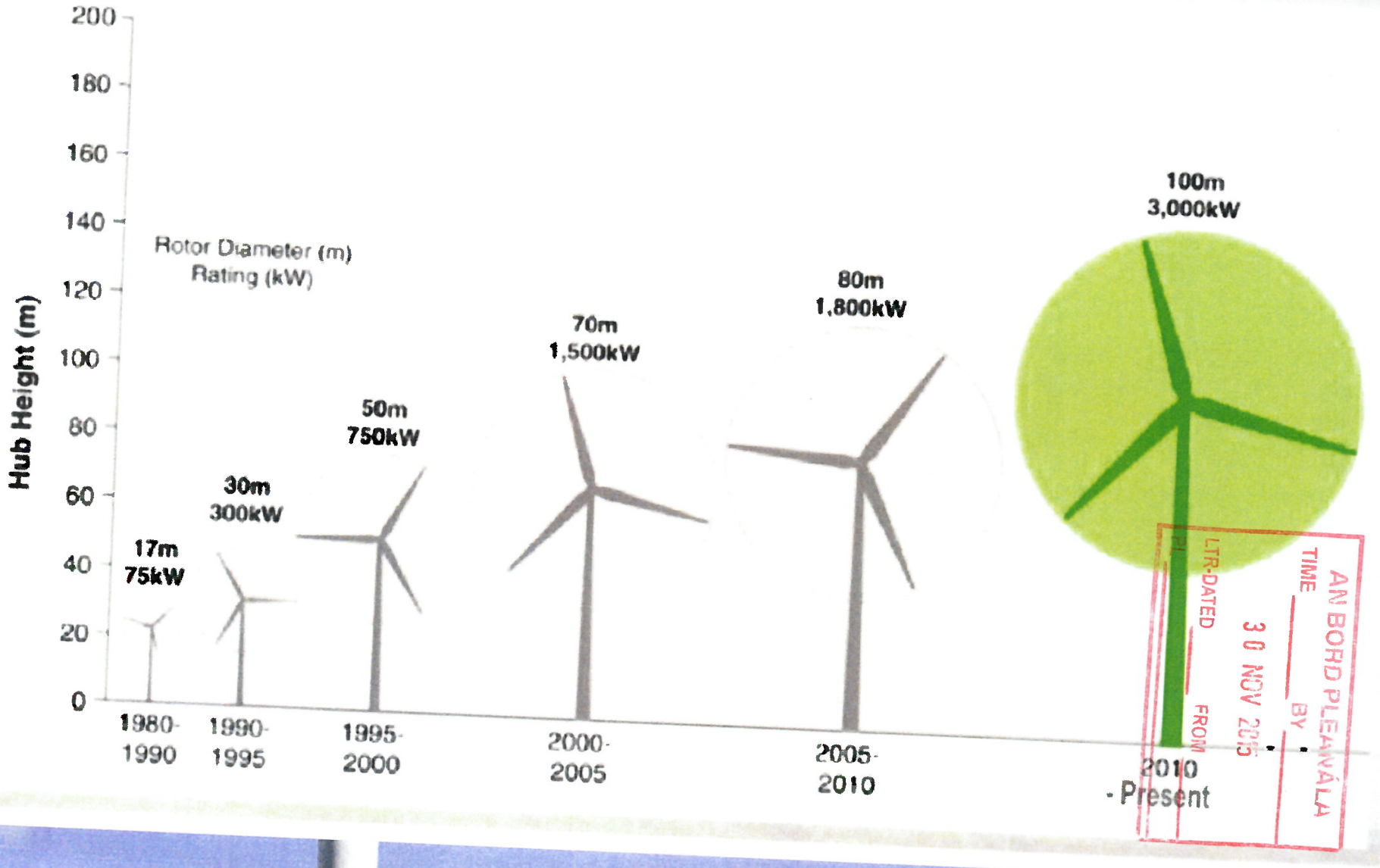
direct relevance to the current application and would form a basis for refusing it. Once again this issue is a core submission of our clients to the Council for consideration and we expect to see it addressed in the planner's report.

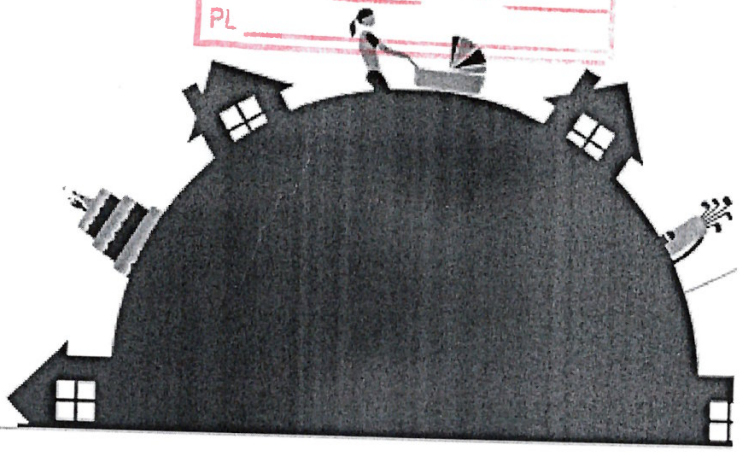
33. Conclusion. Cork County Council stands between our clients and the likely destruction of their way of life. We ask the Council to refuse the application.

Yours sincerely,

Joe Noonan,
NOONAN LINEHAN CARROLL COFFEY

Increased Efficiency with Increased Turbine Size





South Scotland

Scottish wind farm impact 'underestimated'

2 July 2015 | South Scotland

Developers sometimes under-assess the impact of wind farm noise and appearance on residents living nearby, according to new research.

The study looked at **how the visual, shadow flicker and noise impacts predicted by**

developers at the planning stage compared to reality.

Climate change body ClimateXChange looked at 10 wind farms in Scotland.

It concluded that in some cases what was set out in planning applications did not match the actual impact.

The test sites included wind farms at Dalswinton in Dumfries and Galloway, Achany in the Highlands, Drone Hill in the Borders, Hadyard Hill in South Ayrshire, Little Raith in Fife and West Knock Farm in Aberdeenshire.

It also found that efforts to engage with the public had not always adequately prepared residents for the visual, shadow flicker and noise impacts of a development.

The information was gathered through a combination of residents' surveys and assessments by professional consultants.

Project manager Ragne Low said: "As the study has focused on issues relating to the planning process, we are confident that the findings will feed into improved practice in measuring the predicted impacts of proposed wind farms and in communicating this to decision-makers and those likely to be affected.

"The findings point to several possible improvements in planning guidance and good practice.

"Some have been implemented in the time between the case study wind farms being planned and built, and the present. The study will contribute to building on these improvements."

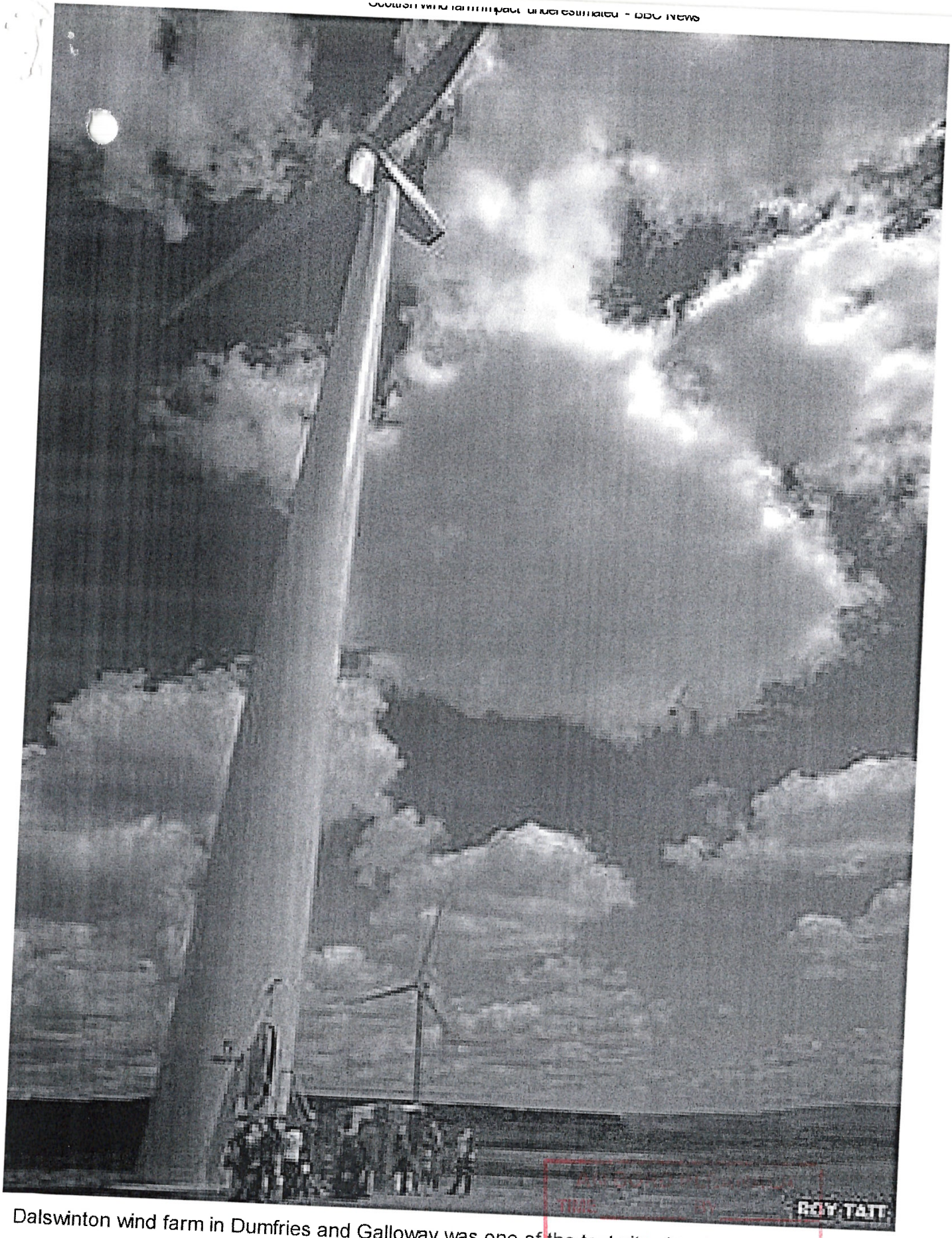
'High standards'

Linda Holt, spokeswoman for the campaign group Scotland Against Spin, welcomed the findings.

She said: "For too long, people who have complained about wind farms have been dismissed as nimbies and we applaud the energy minister Fergus Ewing for commissioning this work.

"The recommendations show that the planning system is ill-equipped to address potentially adverse impacts on wind farm neighbours and we urge the Scottish government to lose no time in implementing them.

"For too long, decision-makers on wind farms have been asked to determine applications while blind-folded about the true impacts of placing enormous industrial machines near people's homes."



Dalswinton wind farm in Dumfries and Galloway was one of the test sites involved in the study

A spokesman for Scottish Renewables said: "This study highlights the high standards of guidance available for those planning an onshore wind farm in Scotland, and we were pleased to see the sector has been putting these into practice.

"The industry has long worked with government and its agencies to put these high standards in

place and this report demonstrates how much we have continuously improved, while identifying areas for further improvements for future schemes."

A Scottish government spokeswoman said: "We welcome the publication of the wind farm impacts study report which is the first of its kind in the world and presents the findings of a two-year study involving a wide-range of interest groups.

"The report shows improvements have already been made in our planning system, which is rigorous and ensures appropriate siting of wind farms, and studies like this will make sure this improvement continues, and we look forward to considering the recommendations carefully.

"Our policy on wind farm applications strikes a careful balance between maximising Scotland's huge green energy potential and protecting environmental interests and residential amenity."

Share this story About sharing

More on this story

End of wind farm subsidies 'could cost Scotland £3bn'
18 June 2015

Earlier end to subsidies for new UK onshore wind farms
18 June 2015

Onshore wind farms subsidies would be scrapped by Tories
24 April 2014

Related Internet links

Scottish government

Scottish Renewables

Scotland Against Spin

ClimateXChange

The BBC is not responsible for the content of external Internet sites

South Scotland

The Secretary,
An Bord Pleanála,
64 Marlborough Street,
Dublin 1.

6th February 2015
Our ref: 26310-14/JN/PW

RE: **Cork Co Council Planning Register Reference – 14/557 Barnadivane Kneeves Terelton Co. Cork**
Permission for construction of an electricity substation compound; this is said to be intended to replace the substation already granted permission under PL04.219620 (05/5907) and subsequently extended under 11/6605. The electricity substation layout includes 3 no. control buildings, associated electrical plan and equipment, security fencing and ancillary works. This application is seeking a 10 year planning permission.

Applicants – Arran Windfarm Limited

Our clients –

1. **Stephanie Larkin of Moneygaff East, Castletown, Enniskeane, County Cork**
2. **Michael O'Donovan of Moneygaff East, Castletown, Enniskeane, County Cork**
3. **Denis Buckley of Moneygaff East, Castletown, Enniskeane, County Cork**
4. **Noelle Sheehan of Moneygave, Coppeen, Enniskeane, County Cork**
5. **Pat Sheehan of Moneygave, Coppeen, Enniskeane, County Cork**
6. **Nora Sheehan of Moneygave, Coppeen, Enniskeane, County Cork**
7. **Aisling Connolly of Moneygaff East, Enniskeane, County Cork**
8. **Gerard Connolly of Moneygaff East, Enniskeane, County Cork**
9. **Dan Galvin of Gurranreigh, Lissarda, County Cork**
10. **Patrick Manning of Barnidivane, Terelton, Macroom, County Cork**
11. **Sabrina Hurley of Moneygaff East, Enniskeane, County Cork**

Dear Sir/Madam,

Our clients wish to appeal the decision of Cork County Council herein. We enclose cheque in the sum of €220 being your fee herein together with original Cork County Council acknowledgement of receipt of Submission dated 30th October 2014.

The grounds for our clients' appeal and the materials supporting those grounds are set out below and are further contained in the **enclosed** letter by Michael O'Donovan and Stephanie Larkin dated 23rd October 2014. While that letter was originally addressed to Cork County Council, its contents were not addressed satisfactorily by the Council. It is therefore to be read as part of this appeal submission.

Stated justification for enlargement of substation

The application is stated to relate to a previously permitted wind farm development incorporating an electricity substation. The relevant planning authority register reference numbers are cited in the heading to this letter. Figure 1.2 of the Applicant's Environmental Report helpfully shows the comparative size of the permitted and the proposed substations. The proposed substation site is substantially greater in area.

The following explanation is offered by the Applicant for the necessity to seek permission for the present substation:

> *'The original wind farm planning application included for a substation, however, since receiving the original planning consent new Eirgrid standards have been adopted which require 110kV substations to have a larger development footprint which includes available land for potential future expansion. As a consequence, a new planning application is required for this substation.'*

We submit that no convincing reason has been given for the enlargement of the substation in the context of the permitted turbine development. The permitted development could proceed with the permitted substation. The present application only makes sense if it is being enlarged to facilitate multiple future windfarm connections, of which no details have been presented. That this is the *de facto* intention is supported by remarks attributed to the parent company of the applicant in the local newspaper the Southern Star published on 10th January 2014, copy **enclosed**. Their spokesperson is reported as stating that the intended new substation is designed to facilitate connections from other potential windfarms up to 25km distant.

The present substation is considerably larger in scale than the previously permitted substation. It is also being moved to a more visually prominent location. The existing site is said to be unsuitable as it is 'constrained' to the east (by the road) and to the west (by a 110kv line). However it is not constrained to the north or to the south. In addition so far as the eastern 'constraint' goes, proximity to the 110kv line is an advantage, not a constraint. As the Applicant says in the Environmental Report (p.20)

> *'Proximity to transmission system:*
> *The substation site needs to be capable of connecting directly to the existing 110kV overhead cable traversing the site, and therefore needs to be along the line of the cable.'*

None of the elements of the previously permitted development has yet been constructed. Indeed permission was about to lapse when an application for extension to the original five year term was made. This was duly granted under reference no. 11/6605.

10 year permission issue

Without prejudice to our other grounds of appeal, it is noted that the applicant asks for a ten year permission. It is not made clear why construction of a substation requires a ten year permission. Normally, planning permission is for a five year period. That makes eminent sense for reasons which the Board is well aware of. A longer duration is in principle undesirable as it creates uncertainty and risks creating planning blight. The Applicant says that Barnadivane Wind Farm is scheduled for a connection to the national grid in 2015. There is no reason for a ten year permission for the substation.

EIS needed but not submitted

The substation is an integral part of a yet to be built wind farm. The related wind farm is one which is subject to the mandatory EIA provisions under Irish and European Law and to mandatory requirements arising under the Habitats Directive including the carrying out of an appropriate assessment. Despite that, the Applicant, who has submitted an Environmental Report, asserts in his planning application form (at Question 22) that the application does not require an EIS. We disagree.

In addition to being an integral part of a permitted windfarm, it is clear from the scale of the enlarged substation and from the reported words of the developer's parent company spokesperson, that the substation is in fact an integral part of a much larger series of windfarms, entailing as yet unknown and therefore completely unassessed connection infrastructure. The only disclosed information on those windfarms is that they are to be within a 25km radius.

Multiple planning applications

Two further planning applications are pending in relation to the project of which this substation forms part. They are in relation to a new private road linking two existing public roads, and in relation to a windfarm on the site with 6no. 131 metre high wind turbines each having a power output of 3 megawatts. We **enclose** our submission on behalf of clients to Cork County Council in relation to the windfarm application. Please treat that letter as part of the material relied on in relation to this appeal. Viewed objectively, we submit that it would be hard to imagine a more blatant case of project splitting.

Application invalid

The European Court of Justice has made it clear that there can be no piecemeal approval of elements of a larger EIA type development which when taken together with the remaining elements would require EIA or AA. Trying to obtain so-called salami style development consents, where an overall development is broken down into smaller elements which of themselves appear not to trigger the EIA or Habitats Directive obligations and so which would defeat the purpose of the directives is legally impermissible as well as contrary to proper planning and sustainable development principles. Ireland has been condemned by the Court for failing to ensure that this approach is respected in its planning legislation, as you will be aware.

That principle has recently been upheld by the High Court in the case of *Ó Grianna v. An Bord Pleanála*. We rely on that judgment, copy of which is **enclosed**.

A project cannot be sliced and diced with the intent that only fragments of it are put forward for assessment by a planning authority at any one time. Plainly this salami style approach is what is happening here. Legally, the proposed substation cannot be considered in isolation, yet that is how it has been presented.

We submit accordingly that the application is invalid.

Habitats Directive

The Applicant has presented a limited Appropriate Assessment Screening Report. We submit that this is wholly inadequate and fails to enable the Board to meet the mandatory test laid down under the Habitats Directive. The obligations on planning authorities in relation to appropriate assessment have recently been helpfully clarified in the **enclosed** High Court Judgement of Finlay Geoghegan J. in *Kelly v. An Bord Pleanála* delivered 25th July 2014 Record Number: 2013/802JR. We refer the Board to that decision and we rely upon it.

The decision of the High Court in the Kelly case establishes that the previous practice of planning authorities, including the Board, did not meet the legal standard required under the Habitats Directive.

Board ought not give persuasive weight to previous planning permission

That fact also means that the Board can place no reliance on the previous planning permission when considering the present application. It was granted under a procedure now seen to be unlawful, and it related to a 14 turbine windfarm that may be unlikely to bear much resemblance to what is intended for this site.

True scope and extent of the project unknown

The Applicant has submitted an Environmental Report, prepared with, it is claimed, some regard to EIA guidance, but the Report tells the public nothing at all about the impact of the turbines that will be connected to the new substation. The inference is that those turbines will be as already permitted, but nowhere is that expressed in any binding way. Our clients do not accept that they will be the same turbines (in terms of number, size, scale or power output) as those that were the subject of a planning permission sought almost ten years ago. The Board and the public are entitled to know what is proposed. At present, only the Applicant has that knowledge. That is legally unacceptable by reference to the EIA Directive, the Habitats Directive and the Aarhus Convention as incorporated into EU and Irish Law.

Further observations

The following additional observations relate some further specific physical planning issues and policy issues of concern to our clients. Some of these are elaborated on further in Mr O'Donovan and Ms Larkin's enclosed letter:

1. Though it may be the case, there is a lack of clarity on whether this development is intended to replace and therefore make obsolete, the previously permitted substation. This must be clarified.

2. Visual intrusion on landscape. This development is on a very prominent hillside location. The site is the size of a GAA pitch and it is on the brow of a hill. It will be highly visually obtrusive over the area. It is industrial in nature and therefore entirely at odds with its rural surroundings. Of itself and in terms of precedent, it is not in keeping with the proper planning and sustainable development of the area.

3. There is a lack of clarity on the necessity for having two control buildings with the same layout: offices, staff facilities, toilets and both with control rooms. According to the planning application there will be no onsite staff. These facilities mean extra development has to take place to accommodate all these extra buildings but also for water and waste water treatment. The nature of these buildings seems to be very much at odds with the idea of an electrical substation which would be unmanned. They increase the size of the site unnecessarily and pose the question of what other activities might be envisaged for this site by the Applicant.

4. This is a scenic walk route and an important amenity in the area. Putting this huge industrial site on it will detract massively from the scenic and rural nature of the route both for visitors to our area and for locals. This is in conflict with the relevant provisions of the County Development Plan, both in its current form and in its latest Draft form.

5. The field of the proposed substation is a wintering ground for Golden Plover, Curlew, flocks of Red Wing and Fieldfare. The data presented is utterly deficient in this regard. This again underlines the necessity for appropriate assessment of all likely significant environmental impacts arising under the overall development. That is of course only feasible when the nature of the overall project is known, which is not the case now.

6. As the site is sloping excavation will have to take place to level it. This will produce a lot of traffic from large vehicles. The one lane road infrastructure will be unable to cope. The conditions in the planning permission notification from the local authority are inadequate to address this fact and unenforceable.

7. The application is said to be consistent with certain national energy policies. On national energy needs, Ireland's peak electrical power demand is about 5GW. Installed wind power generation capacity is already about 2GW. There is no need either in terms of EU policy on renewables or in terms of national economic benefit, for increasing the proportion of wind

generation connected to the grid. On power station capacity and other sources such as interconnectors, as UCD Economist Colm McCarthy has observed:

> *'The new gas units were planned before the bust. There is now 3300 MW of modern gas capacity, plus 880 of peaking plant. Plus 500 MW of new interconnection to Wales. Plus almost 900 MW at coal-fired Moneypoint. Plus hydro at about 500 MW, plus peat at about 340, plus oil - the total dispatchable is 7400 MW. Non-dispatchable, mainly wind, adds 2400, grand total 9800, twice peak demand.'*

Our clients' established sustainable way of life and their enjoyment of reasonable residential amenities in this quiet rural area are significant factors to be considered, respected and protected within the planning system. The purported policy and technical justifications offered in support of the present application do not stand up to scrutiny. Reasonable planning balance is best preserved by refusing this application.

We ask the Board to refuse the application as it is invalid in the absence of adequate information as required under the EIA and Habitats Directives and on the basis that the development is in conflict with the proper planning and sustainable development of the area.

Yours faithfully,

Joe Noonan,
NOONAN LINEHAN CARROLL COFFEY

List of Enclosures:

1. Cheque in the sum of €220.
2. Original Cork County Council Acknowledgement of Receipt of Submission, dated 30th October 2014.
3. Copy Submission of Michael O'Donovan & Stephanie Larkin dated 23rd October 2014 with enclosures.
4. Southern Star Newspaper Article "Wind farm a second power-related blow to Lee Valley resident over 50 years on" by Catherine Ketch.
5. Copy Noonan Linehan Carroll Coffey Submission to Cork County Council under Planning Register Reference 14/6760 dated 2nd February 2015.
6. High Court Judgment of Mr Justice Michael Peart, *Ó Grianna & Others v. An Bord Pleanála,* 12th December 2014.
7. High Court Judgment of Ms Justice Finlay Geoghegan, *Kelly v. An Bord Pleanála*, 25th July 2014.

Comhairle Contae Chorcaí
Cork County Council

Rannóg Pleanála, Teach Norton,
Bóthar Chorcaí, An Sciobairín,
Co. Chorcaí.
Fón: (028) 40340 • Faics (028) 21660
Suíomh Greasáin: www.corkcoco.ie
Planning Section, Norton House,
Cork Road, Skibbereen,
Co. Cork.
Tel: (028) 40340 • Fax: (028) 21660
Web: www.corkcoco.ie

Joe Noonan
c/o Noonan Linehan Carroll Coffey
Solicitors
54 North Main Street
Cork

30/10/2014

APPLICANT: Arran Windfarm Ltd
DEVELOPMENT: Construction of an electricity substation compound, this application is intended to replace the substation already granted permission under PL04.219620 (05/5907) and subsequently extended under 11/6605. The electricity substation layout includes 3 no. control buildings, associated electrical plant and equipment, security fencing and ancillary works. This application is seeking a 10 year planning permission
AT: Barnadivane, Kneeves, Terelton, Co. Cork
FOR: Permission

PLANNING REGISTRATION NO: 14/00557

A Chara,

I wish to acknowledge receipt of your submission/observation on 30/10/2014 concerning this application. I enclose herewith receipt no. PLG0008203 in respect of correct fee paid. I wish to confirm that your submission/observation has been received within the period of five weeks beginning on the date of registration of the application and is therefore considered a valid submission/observation.

Copies of site map/plans and particulars submitted in connection with the application will be available for inspection at this department during office hours (9.00 a.m. to 4.00 p.m., Monday to Friday) until the application, or any appeal thereon, is finally determined. The applicant shall be given your name and content of the submission/observation should it be requested.

Your letter will form part of the documentation available for inspection by the public. You will be notified when a decision is made on the application.

This letter should be retained. If you wish to appeal such decision a copy of this acknowledgement together with the attached official document must accompany your appeal to An Bord Pleanála.

Yours faithfully,

Clare O'Donovan

Form no. 3

Articles 28 and 35

ACKNOWLEDGEMENT OF RECEIPT OF SUBMISSION OR OBSERVATION ON A PLANNING APPLICATION

THIS IS AN IMPORTANT DOCUMENT

KEEP THIS DOCUMENT SAFELY. YOU WILL BE REQUIRED TO PRODUCE THIS ACKNOWLEDGEMENT TO AN BORD PLEANÁLA IF YOU WISH TO APPEAL THE DECISION OF THE PLANNING AUTHORITY. IT IS THE ONLY FORM OF EVIDENCE WHICH WILL BE ACCEPTED BY AN BORD PLEANÁLA THAT A SUBMISSION OR OBSERVATION HAS BEEN MADE TO THE PLANNING AUTHORITY ON THE PLANNING APPLICATION.

PLANNING AUTHORITY NAME **Cork County Council**

PLANNING APPLICATION REFERENCE NO. 14/00557

A submission/observation, in writing, has been received from:

Joe Noonan
c/o Noonan Linehan Carroll Coffey
Solicitors
54 North Main Street
Cork

ON 30/10/2014 in relation to the above planning application.

The appropriate fee of €20 has been paid.

The submission/observation is in accordance with the appropriate provisions of the Planning and Development Regulations, 2001 and will be taken into account by the Planning Authority in its determination of the planning application.

Claire O'Donovan
Clerical Officer

CORK COUNTY COUNCIL
PLANNING AUTHORITY
NORTON HOUSE
SKIBBEREEN
Co. CORK

Local Authority Stamp

Date: 30/10/2014

Concerned Residents
c/o Noonan Linehan Carroll Cof
54 North Main Street
Cork

30-OCT-2014
12:43:24

Cork County Council
County Hall
Cork
Tel - 021 427 6891
VAT Registration No - 0007458M

Receipt : PLG0008203

Header Details

Receipt Reference:	PLG0008203
Received From:	Concerned Residents
Billing Address:	c/o Noonan Linehan Carroll Cof 54 North Main Street Cork
Account No.:	POS 7000004
Amount Paid (EUR):	20.00
Type:	CHEQUE
Comments:	Submission 14/557
Receipt Issued By:	DWHELTON
Receipt Date:	30-Oct-2014
Site:	0300 : Planning Applications/Submiss
D/N/U:	D
Invoice Reference:	9000057341 : CHEQUE

Line Details

From Reference	To Reference	Transaction Date	Remarks	Amount
PLG0008203	9000057341	30-Oct-2014	Submission 14/557	20.00

RECEIPT IS ISSUED SUBJECT TO CLEARANCE OF CHEQUE/CREDIT CARD
ISSUED ON BEHALF OF
Planning Applications/Submiss,
Planning Front Office, Floor 1,

Moneygoff East,
Castletown,
Enniskeane
Co Cork

Michael O'Donovan & Stephanie Larkin

Planning Department
Cork County Council
Western Division
Norton House
Cork Road
Skibbereen
Co. Cork

23 Oct 2014

Planning application no. 14/557, Substation Compound at Barnidivane, Kneeves, Co. Cork

To whom it may concern,

We the undersigned object to planning application no. 14/557 of a Substation Compound at Barnidivane, Kneeves, Co. Cork for the following reasons.

- We believe that there is a lack of transparency with regards to the planning intentions of the applicants. They already have planning permission for a substation. The increase in structures / buildings in this new application is in our opinion to facilitate a future change to the original wind farm planning that has been granted by the authorities. This so called Salami Slicing approach to planning is underhanded and illegal under European law.
- Visual Impact- The site location on a hill top is directly visible from our house being only a few hundred metres away. This new location is in fact much more visible to the general public than the original location and cannot be effectively screened in any way because of the elevation. It will be clearly visible from the main road (R585 Bantry Line)and all the way across towards Newcestown and to a huge amount of houses in the area. We are firmly against the relocation of the compound as an Industrial Site of this nature would be an eyesore and an unacceptable blight on the landscape.

The applicants keep referring to a document that describes the 'landscape value as being of the lowest level, being monotonous with only a local level of natural or cultural heritage' as if it were a gospel cast in stone. The local in habitants would argue strongly against this designation, see the website www.coppenheritage.com, when it is possible to stand on the proposed site and see the mountains of WestCork including the SugarLoaf on the Beara, the Paps, Reeks and Mangerton to name a few and at night to watch the lights of the Oldhead,

Galley and Mizen Lighthouses while the surrounding area has sites of National Importance like, Beal na Blath, Kilmichael, Castltownkinneigh Round Tower, Cahervagliar Stone Fort and Leabaowen Wedge Tomb.

- The proposed compound is huge compared to the original planning. It is now the size of a football pitch and is totally unsuited to the new location.
- The buffer zone map of 1km radiating from the site cleverly puts at least 29 dwellings just outside it, including our own house. This illustrates much of the bias in the application which at no point is willing to encompass the local community.
- The new site will be visible from the only Designated Walks in the community (see maps attached). The walks are widely used by locals and tourists alike and local children cycle the routes and some children ride their ponies along here almost every day. Apart from the visual impact which will spoil the beauty and spirit of these walks, the construction phase poses an unacceptable and unnecessary health and safety risk to the public, especially children who have no voice in this matter. The statement of a 'Negligible impact on amenities' is nonsense.
- It is our belief that the reasons given for the relocation of the site are spurious and reflect economic interests rather than the stated restrictions which we failed to see on examination of the site.
- The local community has worked hard to promote the local Archaeology, History and Culture of the area (see notes attached). This development goes directly against this Community Initiative who see the area as an Amenity for all and not as something to be exploited by a few for whatever reasons.

We believe that the EIS carried out with regard to birdlife in particular is biased and furthermore has been engineered to facilitate the planning needs of the applicants. We would refer the planners to the Scottish National Heritage website and in particular (www.snh.gov.uk/doc/c278917.pdf) which the applicants claim to have been following as best practice but on examination it can be clearly seen that they have cherry picked their guidelines to suit their own agenda. Firstly there was no consultation with the public with regards any noteworthy birds. This process would have delivered the preparatory information needed as no reliable data(<5years old exists) which forms a key part of the basis for identifying target species. If they had done so they would have found that Cuckoo breeds in some years(2014 being the best in a while) and a rare and declining species in Cork, that Woodcock winters along the river Bride(red data species, that snipe is a common breeder(notoriously difficult to survey according to www.birdwatchireland)and that Kneeves is important during migration and wintering waders especially but also to roving passerine flocks like Meadow Pippits, Skylarks, Redwings and fieldfares to name but a few. One of the main reasons that the birds were missed was that the target species were ludicrously small in number and the guidelines for observation times greatly reduced. Guidelines also state that observations should cover all seasons(only 2 days in summer and 36 hours in winter were carried out, no Spring or migration periods were observed) and that the period should be of a minimum of 2-5 years in duration as birds can alternate the use of traditional sites. The area of the search was also far smaller than recommended. Also no reference was made to the elevation of the site and the strategic location with regard to the Gearagh and Bandon river SACs that have many threatened birds commuting back and forth

(Connectivity of sites). It is not just the habitat that matters and in any case grassland is favoured by many wading species. The cumulative impact of sites was also ignored.

- The applicants stated in the original windfarm planning that there would be no more environmental damage to the site and gave assurances of this. Clearly this proposal is in contradiction of these promises.

- The amount of soil etc to be removed from the site is also a concern, where is it going to go? If put somewhere else on the site will it cause further ecological damage? The site is above a river which will be put at risk from sedimentary pollution and possibly other unforeseen contaminants from the site. Does the development pose a threat to ground water? For these reasons and many more an EIS is essential.

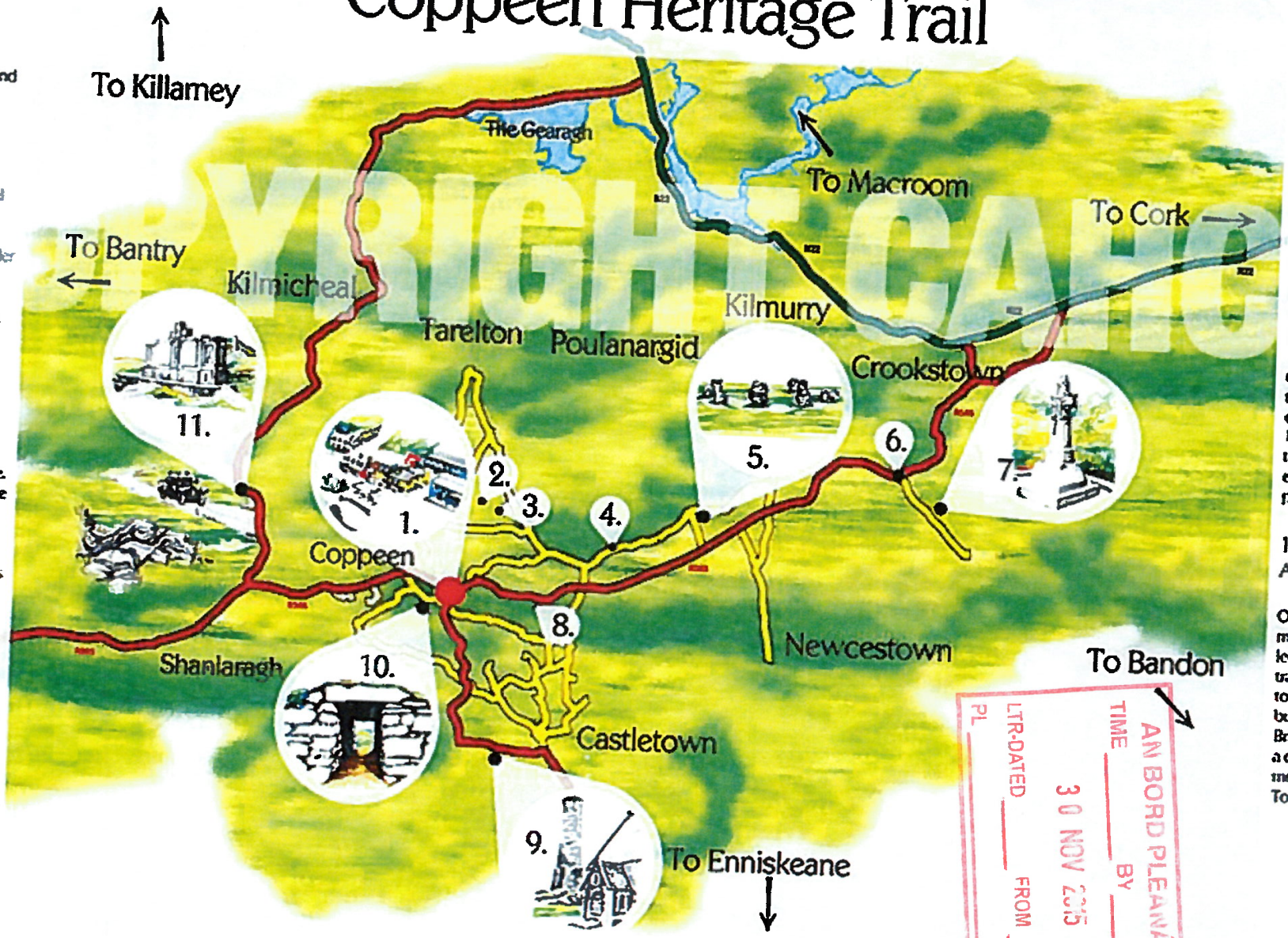
- We would also like to point out that as ordinary tax paying citizens of the state we do not have access to Consultants to draw up documents supporting our argument. This costs money. The windfarm which has planning permission is being imposed on us by the State. It cost us money to object to that. This further application is imposing further cost on us. The Environmental Reports attached to this application are provided by the applicants. Therefore, the responsibility is on Cork County Council and the State to ensure what is being claimed is complete, correct and unbiased. Any doubt over this should result in refusal of the application. If these basic principals cannot be upheld then this is not a democratic process but a mere charade which will leave a physical scar on our landscape for a very long time.

Signed

Michael O'Donovan

Stephanie Larkin

Coppeen Heritage Trail



1. Coppeen Village

Starting point for the Coppeen Heritage Trail and Waymarked Walks.

2. Boulder Burial

Shevreowen Boulder Burial consists of an impressive large round stone, which rests on a number of smaller stones, dating 2,400 – 500BC. Note deep cup marks/solution pits on top.

3. Wedge Tomb

Located in a state-owned forest, Shevreowen Wedge Tomb (Labbatowen) measures 7m long, X 1.4m wide. This structure represents the earliest man made construction on our local landscape, dating from between 5,000 and 3,500 years ago.

4. Famine Monument

Gurranaregh Famine Monument is a grim remander of the savage devastation which befell a village that stood close to this monument, totally wiping out its entire population during the Irish Potato Famine (1845-1850)

5. Hornhill Stone Circle

Stone Circles are believed to date from 1200 to 2000BC. Knockaneark Lower (Hornhill) Stone Circle consists of seven stones, with (probably) 2 stones missing. Orientation is likely to be towards the Winter Solstice.

6. Beal na Bláth

7. Micheal Collins Ambush Site

A Celtic Cross memorial marks the spot near where General Michael Collins was shot dead during an ambush on Tues. 22nd Aug. 1922.

8. Wedge Tomb

9. Kinneigh Round To[illegible]

The original monastery at Kinneigh was located approx. half a mile west of the present location. According to the Annals of Cork, it was founded in 619AD by St Mocolomóg.

10. Cahirvagliair Ringfort

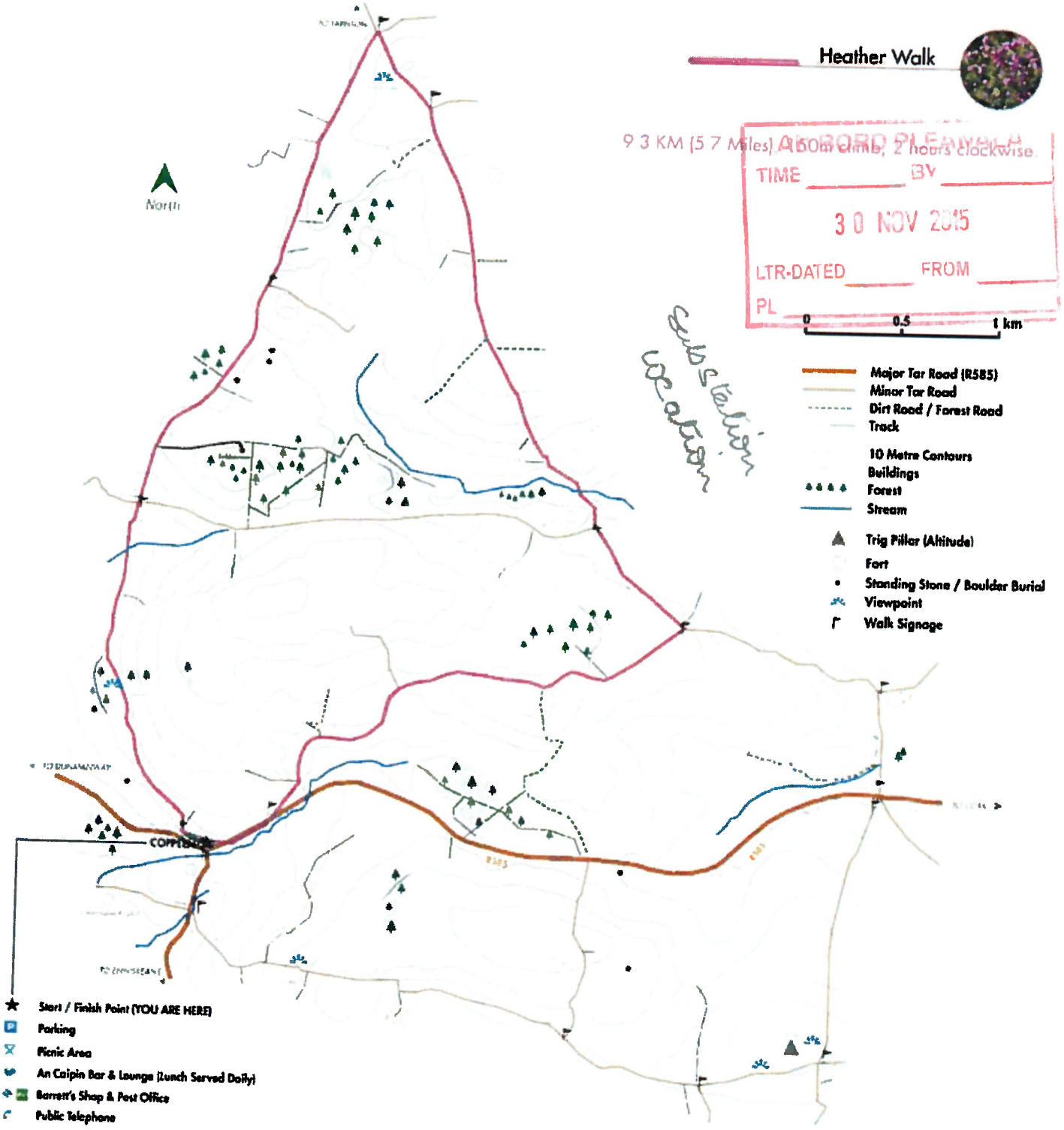
Cahirvagliair Ringfort is said to have been a Royal Residence. Dating from approx. 1000AD, its unique stone lintelled entrance is of particular interest.

11. Kilmicheal Ambush

On 28th Nov 1920, IRA commander General Tom Barry led a bunch of hastily trained, mostly farmers sons, to this site where they ambushed two lorries of elite British Auxiliaries, imposing a crushing defeat. The monument was unveiled by Tom Barry in 1966.

Coppeen Waymarked Walks

More info at coppeenheritage.com



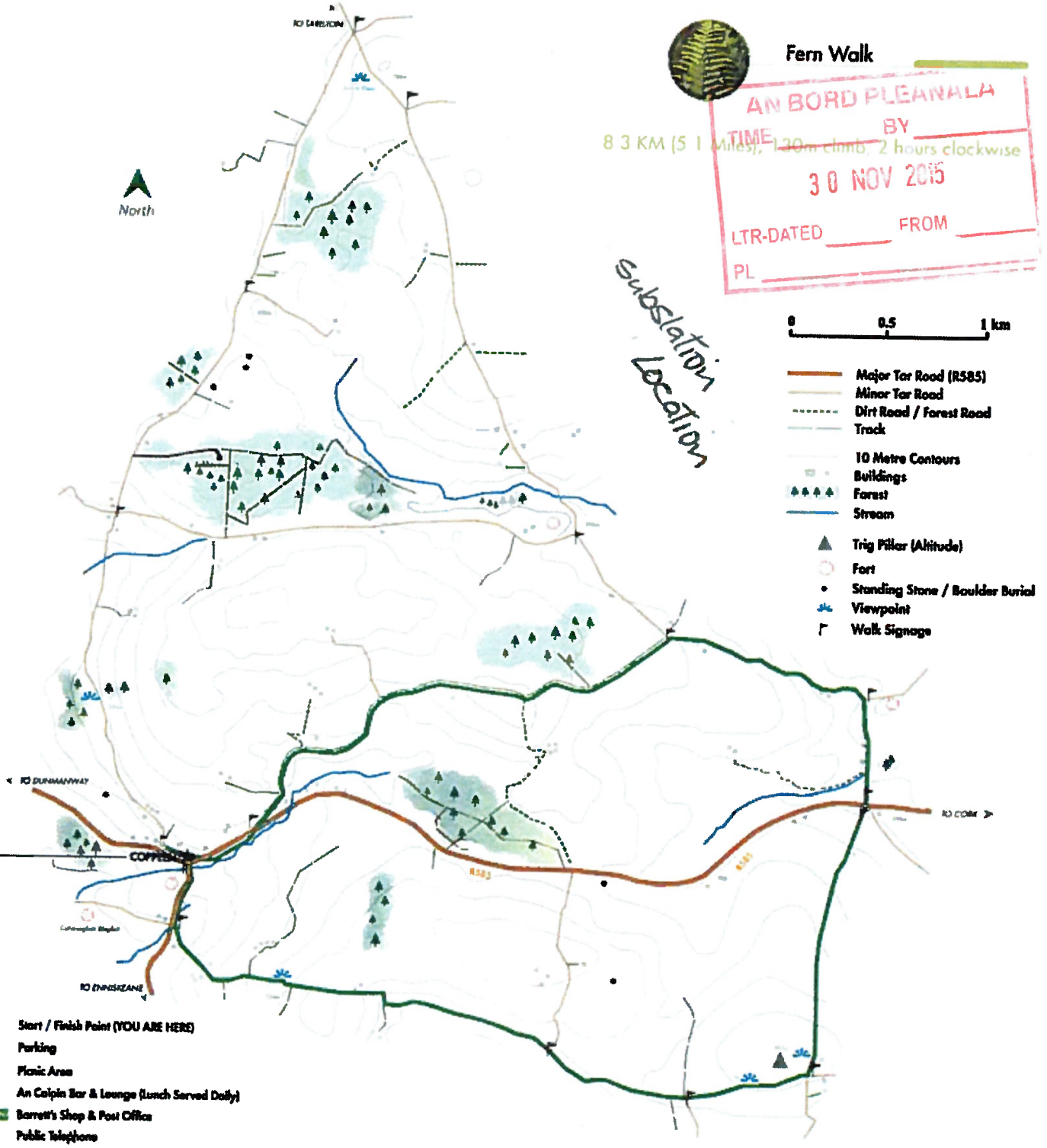
This project was conceived and developed by Coppeen Archaeological, Historical & Cultural Society. For more information visit our web site or email info@coppeenheritage.com

Coppeen Waymarked Walks

More info at coppeenheritage.com

Fern Walk

8.3 KM (5.1 Miles), 130m climb, 2 hours clockwise



This project was conceived and developed by Coppeen Archaeological, Historical & Cultural Society. For more information visit our web site or email "info@coppeenheritage.com"

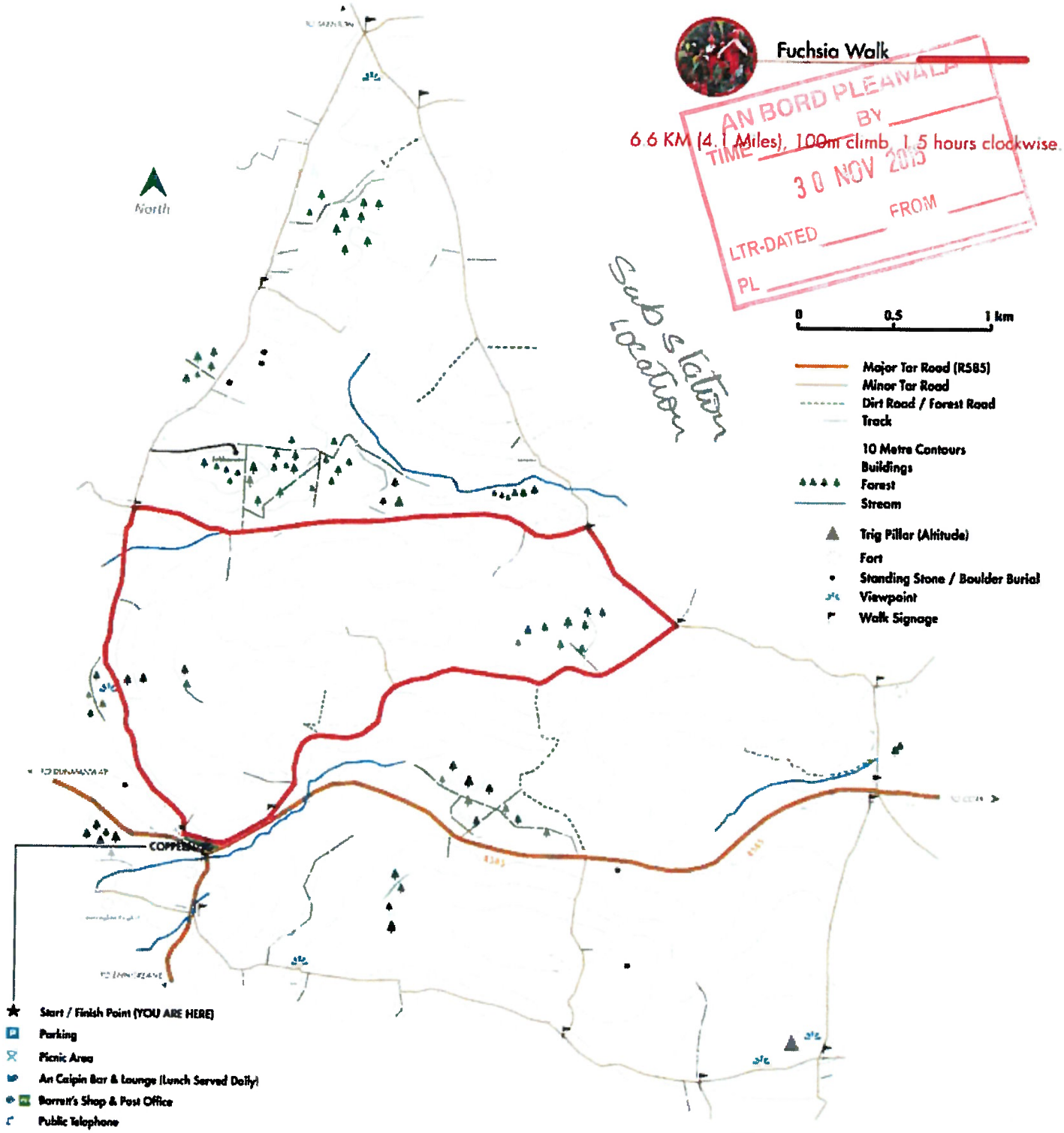
Designed by Solas Nua Digital Media (www.solasnua.com)

Coppeen Waymarked Walks

More info at coppeenheritage.com

Fuchsia Walk

6.6 KM (4.1 Miles), 100m climb, 1.5 hours clockwise.



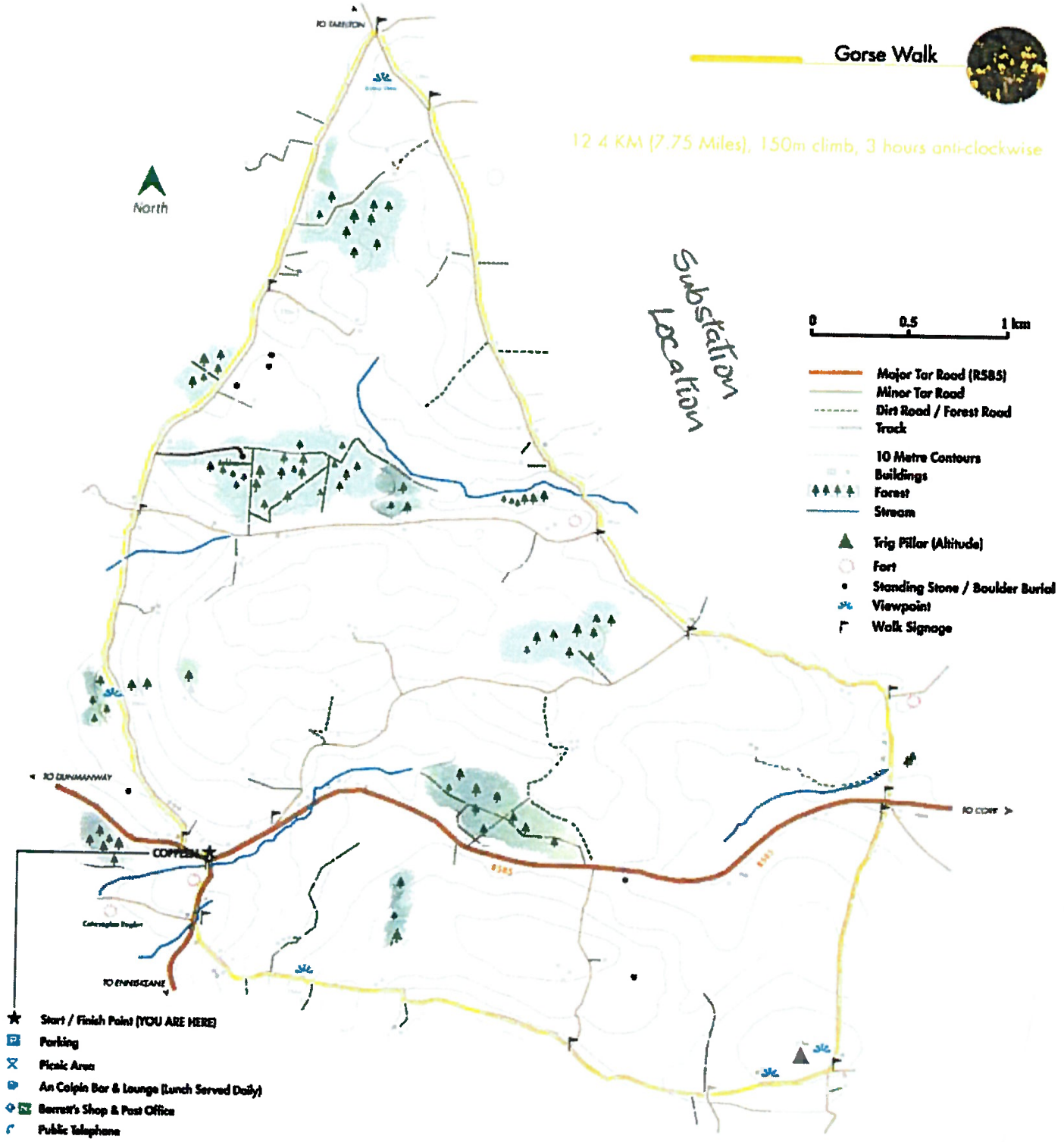
This project was conceived and developed by Coppeen Archaeological, Historical & Cultural Society. For more information visit our web site or email info@coppeenheritage.com

Coppeen Waymarked Walks

More info at coppeenheritage.com

Gorse Walk

12.4 KM (7.75 Miles), 150m climb, 3 hours anti-clockwise



This project was concieved and developed by Coppeen Archaeological, Historical & Cultural Society. For more information visit our web site or email "info@coppeenheritage.com"

Designed by Solas Nua Digital Media (www.solasnua.com)

Wind farm a second power-related blow to Lee Valley resident over 50 years on

BY CATHERINE KETCH

ONE resident of the Lee Valley could find himself the victim of two separate power generation developments half a century apart.

Patrick Manning of Barnadivane, Terelton, was just three years and nine months when his family had to move from the Gearagh near Macroom when the Lee was flooded for hydroelectricity by the ESB in 1957.

'Thirteen families had to leave that area at that time and we came up to my mother's home place which is where I am now,' Patrick said.

It's here at Barnadivane that Patrick is now faced with a wind farm development less than 600m from his house. He is particularly concerned about the noise and unsightliness.

'You live in the country for a bit of peace and quiet. I'm 61 now since June and, in a few years, I would be hoping to retire. With that noise you couldn't open a window,' Patrick claimed.

'I might have to move again on account of th[illegible]nd it's all pertaining to po[illegible]he added wearily.

Four existing turbines at Gurranereagh shocked locals when they were erected. 'They look horrible on the landscape. I don't know what it's like for people living near them,' Peter Kelleher, Knockane, said. The proposed unrelated turbines will be taller and more visible, he believes.

'Visually it's very intrusive. I will be looking straight at it, so it will devalue my property. It's ugly. It's totally inappropriate in the setting,' Stephanie Larkin, Moneygave East, said.

Barna Wind Energy (part of Enerco Energy, Lissarda) has permission for 14 turbines of 105m max at Barnadivane with planning for an 110kv substation. They applied on December 19th last to replace these with six larger turbines of 131m max.

Aran Wind Energy (also part of Enerco) applied in September for planning permission for a new 110kv substation in the same location. The Gate 3 connection is approved for 60MW.

A representative of Enerco Energy responded to queries this week, saying that the new substation Enerco says will replace that already permitted, fulfilling new EirGrid requirements regarding size, spacing and orientation.

The change in turbine number and size is down to economics with newer, more efficient machines suited to particular sites, they say. 'The new application and the new wind farm layout will give us a more efficient investment'.

Two companies are involved Enerco, he says, because the Barnadivane development, ongoing for 20 years, was originally owned by a number of farmers and Michael Murnane of Enerco. Enerco has more recently secured ownership of the entire project.

The proposed wind farm if built will be connected to the grid via the existing 110kv Clashavoon to Dunmanway power line which crosses the site. Enerco says they have no plans for further phases at the site. The 60MW Gate 3 connection (6 x 2.3MW yielding max 13.8MW) will, Enerco says, facilitate the connection of other potential developments within 25km of Barnadivane, via underground roadside cables.

On proximity, noise and visual intrusion Enerco says they design a project to show compliance with guidelines and leave it to the public and the planning authorities to assess, grant or refuse permission. If guidelines change, 'it would come down to whether the application was granted or not,' the spokesperson said.

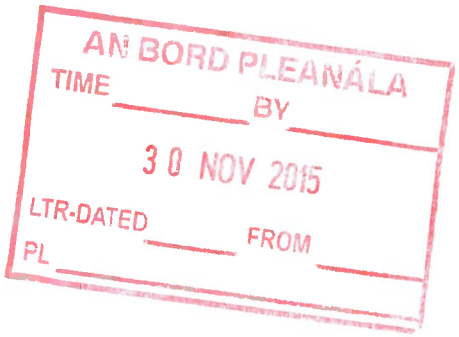
Addressing concerns why a public meeting was held after submissions closed for the new substation Enerco said it would be normal to have public information meetings for wind farms, but not for substations.

In operation for over ten years and producing 230MW of generating capacity equal to 10% of Ireland's total, Enerco stresses they are a Macroom company, employing 20 locally, plus similar in the field.

They are currently accepting proposals for a community fund; €100,000 during the construction period, with €20,000 per annum during operation.

Patrick Manning and Stephanie Hawkins pictured at a recent public meeting about new plans for the Barnadivane Wind Farm at the Riverside Park Hotel, Macroom.
(Photo: Catherine Ketch)

The Secretary,
Planning Department,
Cork County Council,
County Hall,
Cork.



2nd February 2015
Our ref: 26310-14/JN/PW

RE: Planning Register Reference 14/6760
The construction of six wind turbines, with a maximum tip height of up to 131m and associated turbine foundations and hardstanding areas, 1 no. permanent meteorological mast up to 90m in height, upgrade of existing and provision of new site tracks and associated drainage, new access junction and improvements to public road to facilitate turbine delivery, 1 no. borrow pit, underground electrical and communications cables, permanent signage and other associated ancillary infrastructure. This application is said to be *'intended to replace'* development already granted permission under PL04.219620 (05/5907) and subsequently extended under 11/6605. This application is seeking a 10-year planning permission.
Development Address – Lackareagh and Garranereagh, Lissarda, and Barnadivane (Kneeves) Terelton, County Cork
Applicants – Barna Wind Energy (BWE) Ltd
Our clients – Denis Buckley and others known as Barna Wind Action Group, c/o Denis Buckley, Moneygoff East, Castletown, Enniskeane, Co Cork

---

Dear Sir/Madam,

We act on behalf of Denis Buckley and others, known collectively as Barna Wind Action Group, c/o Denis Buckley, Moneygoff East, Castletown, Enniskeane, County Cork. Our clients wish to make an observation in relation to this planning application. We **enclose** the appropriate observation fee of €20. Please acknowledge safe receipt.

We also **enclose** a number of petition forms signed by local residents who are part of the community and who wish to be associated with this observation. We would ask you to note the extent of the concern in the locality as evident from the number of people signalling opposition to the planning application.

This is directly relevant to the claim made on behalf of the applicant that this development is in some way a *'community partnership model'*. This claim is put forward at page 1 of the EIS Non-Technical

Summary. Contrary to that claim, the reality is that the community is not in partnership with the developer. Some individual property owners may well be in a form of commercial partnership with the developer, which would be an entirely different relationship.

1. The application is invalid

Remarkably the application is one of a series of at least three applications all dealing with individual elements of the same project. Based on public statements attributed to the developer, the project is designed to facilitate still more developments, the details of which are not yet disclosed to the public.

The developer applied on 26 September 2014 for permission for a large substation on the site – see your file PA Reg. Ref 14/00557. This was subject of an Order to grant permission made by Cork County Council on 13 January 2015, and that decision will be the subject of an appeal to An Bord Pleanála.

The developer is also seeking permission for a private road joining the R585 to the L6008 intended to facilitate the present application.

Finally the developer's parent company is quoted in the Southern Star (January 10. 2015) as stating that the greatly enlarged substation is designed to facilitate connections from other potential windfarms up to 25km distant. No further details are known to the public at this time however.

It is self-evident and undeniable that this is a classic case of project splitting.

The EIA Directive as implemented under domestic legislation obliges a planning authority to assess the likely significant environmental impacts (including impacts on local residents) of a project. In these circumstances, no assessment of the project is possible as the extent of the project is unknown. The project has been split to an exceptional degree: elements of it are spread across multiple planning applications, three of which are in the public domain so far, and other elements are as yet a mystery. Those unknown elements involve future windfarm developments and connection works over a huge area, up to a distance of 25 kilometres in all directions from this site.

Project splitting in the context of wind farm planning applications has been recently considered by the High Court.

In *Ó Grianna and others v An Bord Pleanála* [2014] IEHC 632 the Court quashed a permission granted in the absence of an EIA of the project in its entirety. Only impacts arising at the site of the proposed windfarm had been considered. The Board and developer claimed they were not obliged to consider impacts of the connection route running from the site of the windfarm development to the national grid, because that was not yet finalised and because the exact nature of the connection was not yet known. The Court rejected that defence. Both the windfarm and the connection to the grid were a single project. The entirety of the project had to be assessed at the earliest possible stage. If the developer had to wait to gather more information on the other element of the project, that was what he had to do. To do otherwise would be unlawful.

The present application is for a part of a larger project. It is not accompanied by an EIS for the entire project. The application before the Council is therefore invalid. It thus cannot be considered by the County Council. Everything that follows in this observation is submitted without prejudice to that overriding objection.

In conclusion on this point we refer to the Planner's Reports on the Council file regarding the sub[illegible]ation application. We made a written observation dated 29 October 2014 on our clients' behalf alerting the Council to the project splitting issue. Nowhere is that issue mentioned, much less addressed, in the Planner's reports, the last of which is dated 12 January 2015, one day before the Council order approving the application was made.

Project splitting is not just a breach of the EIA Directive. It also poses practical problems. This approach makes it more difficult and more expensive for members of the public to participate in the assessment of the overall project. Apart from that, there is a serious difficulty for the local authority, as it is expected to make a decision on this application and on associated applications in a very short time frame, working with limited resources and in circumstances where it simply may not be possible for it to assess the accuracy and reliability of the claims put forward by or on behalf of the developer.

We acknowledge those constraints but they cannot be used as a reason for the mandatory legal rules that govern the assessment of the project to be set aside, lost in the blizzard of technical material or simply bypassed. The Council has to conduct and publish an EIA, identifying, describing and assessing the likely significant environmental impacts (including impacts on the people of the area) of the project. It cannot do so in this case.

2. No reliable planning precedent

The developer places considerable stress on the existence of a planning permission for 14 turbines and for a smaller substation on the site, which permission was sought in 2005, issued in 2007 and was extended in 2011.

Subsequent EU Court of Justice and Irish High Court judgements however have found that the assessment system in place at those times was legally unsound. The legal standards for assessment were not met, with the result that the 2005/2011 permission should not now be relied on as a valid planning precedent.

Specifically we refer to the judgement of the Court of Justice of the European Union in *Commission v. Ireland* case C-50/09. In its judgment delivered on 3 March 2011 the CJEU ruled that Ireland had failed properly to transpose the obligations under Article 3 of the EIA Directive. This was because it had failed to make it obligatory for any single body to conduct an EIA. The Court expressly rejected the State's defence that the system then in use was lawful. It was under that system that the site was approved for 14 turbines.

It follows that no lawful EIA was ever conducted in respect of development for which planning permission was granted in 2007. The extension fared no better in this context. No EIA was even claimed to be carried out at the time the Council extended the permission in 2011. Those decisions must therefore be viewed in the light of current awareness of their legal infirmity. They cannot be given planning precedent value.

We also rely in the judgment of the High Court in the case of *Kelly v. An Bord Pleanála* [2014] IEHC 400 delivered by the Court on 25th July 2014. That judgment emphasised (once again) the mandatory nature of the Habitats Directive obligations on planning authorities in relation in particular to the conduct of Appropriate Assessment.

The developer's EIS and AA Screening Report only address one aspect of what is clearly a larger project. As well as rendering the present planning application invalid for the reasons described above, this approach also fails to equip the Council and its Officials to meet the assessment requirements under the Habitats Directive. If the full project is not considered, then no proper Appropriate Assessment is possible. For that reason also the Council is legally prohibited from giving planning permission.

Separately, it is clear from an examination of the planning history that the developer's predecessor had originally sought planning permission for a far greater number of turbines at this location. It first intended to erect 27 turbines in its 2003 application. This was reduced to 23 in an attempt to assuage planner's concerns. See the Inspector's report **enclosed**. That application was refused by the Board.

The next application was for 18 turbines in 2005. The Board's Inspector recommended refusal *inter alia* on visual impact grounds. See report **enclosed**. She believed it would adversely affect local residential amenity. The Board gave permission for 14 turbines, going against that recommendation, saying that it was satisfied that the reduction in number and size of the turbines had addressed its reasons for the previous refusal. The present application is said by the applicant to be *'intended to replace'* the present permission. (That statement of intent is not legally binding of course and could change at any time.)

While the number of turbines proposed this time is reduced from the number sought in all previous applications, their height is dramatically increased from a maximum tip height of 105m to a maximum tip height of 131m. There is a major consequent increase in bulk, weight, footprint and foundation mass of the supporting tower, as can be seen in the **enclosed** illustration. It follows that the visual impact will be far greater at any given distance. It will in fact be overwhelming in the locality. Each one of these six turbines is roughly twice the height of County Hall.

3. Planning policy and related issues

Our clients have had the benefit of reading a submission filed with the Council dated 15th January 2015 by Mr Anthony Cohu, C. Arch, Ecological Planning, Landscape & Design, of Borlin, Bantry, County Cork. We respectfully endorse the content of Mr Cohu's submission and wish it to be adopted and considered as part of our clients' observation to avoid unnecessary repetition here.

The developer places great reliance on selected national policies in relation to renewable energy. He ignores other fundamental national policies supportive of people in rural Ireland, including the rights of citizens to respect for their bodily integrity, their family life and their property. Those policy principles derive from the State's ultimate policy document, Bunreacht na hÉireann. We suggest the Council should not be as selective as the developer in choosing which policy framework it applies. And even if it were only to have regard to renewable energy policy, it would have to take account of the recent step back at EU level from previous policy commitments, as well as considering the inordinate concentration of wind turbines in County Cork, and the growing awareness of the unsound economics underpinning the sector in Ireland.

Ireland's peak electrical power demand at any one time is about 5GW. Installed wind power generation capacity is already about 2GW. There is no need either in terms of EU policy on renewables or in terms of national economic benefit, for increasing the proportion of wind generation connected to the grid. On power station capacity and other sources such as interconnectors, as UCD Economist Colm McCarthy pointed out in Cork in October 2014:

'The new gas units were planned before the bust. There is now 3300 MW of modern gas capacity, plus 880 of peaking plant. Plus 500 MW of new interconnection to Wales. Plus almost 900 MW at coal-fired Moneypoint. Plus hydro at about 500 MW, plus peat at about 340, plus oil - the total dispatchable is 7400 MW. Non-dispatchable, mainly wind, adds 2400, grand total 9800, twice peak demand.'

So notwithstanding the claims made on behalf of the developer, neither Ireland nor Cork actually need this extra plant generating 6 x 3MW of electricity (and more) in order to meet energy policy goals.

4. Noise

Cork County Council is aware of serious unresolved noise nuisance complaints in various parts of the County, which arose despite the Council imposing certain noise conditions on wind turbine operators. Serious noise nuisance issues have arisen in other parts of the country also. The Planning Authority is obliged to have regard to that fact when assessing any such development. The steadily emerging problems of noise nuisance explains in part why the Government felt it necessary to review Windfarm Planning guidelines issued nine years ago at a time when turbines were smaller and less extensively promoted, and when their noise signature and its effect was less well understood. The departmental review is still underway, and is seeking to find new and appropriate measures of balancing competing interests, particularly focussing on separation distances, noise nuisance and nuisance from shadow flicker.

We refer to our submission to that review (copy **enclosed**) and ask you to treat that submission as part of this observation.

There is patently an emerging problem, with some exceptionally serious consequences in certain areas. The Council is bound to have regard to that fact when considering assurance put before it by or on behalf of this developer.

We refer to the **enclosed** Shirley Windfarm Study in this regard. This was unusual in that it was a study prepared on an agreed co-operative basis by a team of four independent acousticians, some of whom had mainly worked for wind turbine promoters, some of whom had worked more often for residents reporting adverse affects from turbine operation. The study found that noise limits in vogue currently do not adequately protect the public.

5. Other EIS issues

The EIS is unreliable as a basis for an informed assessment. It makes reassuring claims which do not stand up to being tested against current scientific knowledge. Noise nuisance is one important example. Residential property values will be adversely affected. We refer to the **enclosed** material from Keane Mahony Smith in this context. That is not acknowledged at all in the EIS but it is a profound immediate interference with third party property rights.

Another example to illustrate the point is its assessment of impact on bats. A more realistic objective picture of the likely impact emerges from the recent scientific study on that topic, by Cryan *et al*, published in the Proceedings of the National Academy of Sciences, a copy of which is **enclosed**.

The 2003 EPA Guidelines on Environmental Impact Statements say that an EIS should identify describe and assess what impacts are likely if all mitigation measures fail. The developer's EIS does not do this.

The Council should view each section of the EIS critically and methodically, rendering its own description and assessment of all relevant environmental effects including effects on residents, visitors, and workers within the area.

We ask the Council to refuse permission.

Yours faithfully,

Joe Noonan,
NOONAN LINEHAN CARROLL COFFEY

List of Enclosures:

1. Cheque in the sum of €20
2. Petition forms signed by local residents
3. Page 1 of EIS Non-Technical Summary
4. Southern Star Newspaper Article "Wind farm a second power-related blow to Lee Valley resident over 50 years on" by Catherine Ketch.
5. High Court Judgment of Mr Justice Michael Peart, O Grianna & Others v An Bord Pleanala, 12th December 2014.
6. Noonan Linehan Carroll Coffey Submission to Cork County Council Planning Department in relation to Planning Register Reference 14/557 dated 29th October 2014.
7. Judgment of Court of Justice of the EU in Commission v Ireland, case C-50/09 dated 3 March 2011.
8. High Court Judgment of Ms Justice Finlay Geoghegan, Kelly v. An Bord Pleanála, 25th July 2014.
9. Illustration showing the difference in size of the proposed turbines.
10. NLCC Submission to Department of Environment, Heritage & Local Government regarding draft Noise Guidelines, dated 21st February 2014.
11. A Cooperative Measurement Survey & Analysis of Low Frequency and Infrasound at the Shirley Wind Farm in Brown County, Wisconsin, 24th December 2012.
12. Letter of Current Market Value from Keane Mahony Smith, 2nd February 2015.
13. Behaviour of Bats at Wind Turbines by Cryan et al, University of New Mexico, 3rd September 2014.
14. An Bord Pleanala Inspector's Report, Appeal Ref No. PL04.204928
15. An Bord Pleanala Inspector's Report, Appeal Ref No. PL04.219620

Neutral Citation: [2014] IEHC 632

THE HIGH COURT

JUDICIAL REVIEW

Record Number: 2014 No. 2014 No.19 JR; 2014 No. 10 COM

IN THE MATTER OF AN APPLICATION UNDER SECTION 50 AND 50A OF THE PLANNING AND DEVELOPMENT ACT, 2000 (AS AMENDED)

BETWEEN:

POL O GRIANNA, GERALDINE UI DHUINNIN, AOIFE NI DHUINNIN, CLIODHNA NI DHUINNIN,BERNADETTE COTTER, TIM O'CONNELL, CAOIMHGHIN O BUACHALLA, PADRAIG D. KELLEHER, ALAN KING, XAK AROO

APPLICANTS

AND

AN BORD PLEANALA

RESPONDENT

AND

CORK COUNTY COUNCIL

FIRST NAMED NOTICE PARTY

AND

FRAMORE LIMITED

SECOND NAMED NOTICE PARTY

JUDGMENT OF MR JUSTICE MICHAEL PEART DELIVERED ON THE 12th DAY OF DECEMBER 2014:

1. The applicants all live close to an area in County Cork where Framore Limited, the second named notice party are proposing to erect 6 wind turbines and associated buildings and infrastructure for which it obtained a planning permission from An Bord Pleanala ("the Board") subject to 17 conditions on the 14th November 2013.

2. Cork County Council ("the Council") had previously decided to grant permission on 18th June 2013 subject to 28 conditions. The applicants, who had lodged observations with Cork County Council outlining their concerns regarding noise and visual impact in July 2012, appealed that grant of permission to An Bord Pleanala, which on the 14th November 2013 made a decision to grant permission for the development subject to a number of conditions.

3. This application for planning permission is one which had to be accompanied by an Environmental Impact Statement ("EIS"), since the Board was required to carry out an Environmental Impact Assessment ("EIA") under to the provisions of section 172(1) of the Planning and Development Act, 2000, as amended ("the Act of 2000"), the

development being one which fell within the scope of Part 2, Schedule 5 of the Planning and Development Regulations 2001, as amended.

4. In their 'Abridged Statement of Grounds' dated 14th February 2014 the applicants seek a Declaration that in making its decision the respondent failed to carry out a proper EIA in accordance with the provisions of Section 172 of the Planning and Development Act, 2000, as amended ("the Act of 2000"), as interpreted in accordance with the obligations imposed by Article 3 of Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment. A number of different complaints are made, but, essentially, all (except that related to 'project-splitting') are directed towards establishing that the EIA stated by the Board to have been carried out is a flawed assessment which is not in accordance with its obligations under the Act.

5. Section 171A(1) defines "environmental impact assessment" as "*an assessment, which includes an examination, analysis and evaluation, carried out by a planning authority or the Board, as the case may be, in accordance with this Part and regulations made thereunder, that shall identify, describe and assess in an appropriate manner, in the light of each individual case and in accordance with Articles 4 to 11 of the Environmental Impact Assessment Directive, the direct and indirect effects of a proposed development on the following: (a) human beings, flora and fauna, (b) soil, water, air, climate and the landscape, (c) material assets and the cultural heritage, and (d) the interaction between the factors mentioned in paragraphs (a), (b) and (c)*" (emphasis added). The applicants place considerable emphasis on the words "in the light of each individual case".

Section 172 contains a number of subsections dealing with the requirement that certain applicants must provide an EIA to the planning authority or the Board, as the case may be, and that either of the latter may seek further information from an applicant. Of some relevance to the present application is what is provided for in subsections (1G) to (1J) of section 172 which provide as follows:

> *"(1G) in carrying out an environmental impact assessment under this section the planning authority or the Board, as the case may be, shall consider – (a) the environmental impact statement; (b) any further information furnished to the planning authority for the Board pursuant to subsections (1D) or (1E); (c) any submissions observations validly made in relation to the environmental effects of the proposed development; (d) the views, if any, provided by any other Member State under section 174 or Regulations made under that section.*
>
> *(1H) in carrying out an environmental impact assessment under this section the planning authority or the Board, as the case may be, may have regard to and adopt in whole or in part any reports prepared by its officials or by consultants, experts or other advisers.*
>
> *(1I) where the planning authority or the Board, as the case may be, decides to grant consent for the proposed development, it may attach such conditions to the ground as it considers necessary, to avoid, reduce and, if possible, offset the major adverse effects on the environment (if any) of the proposed development.*
>
> *(1J) when the planning authority or the Board, as the case may be, has decided whether to grant or to refuse consent for the proposed development, it shall inform the applicant for consent and the public of the decision and shall make the following information available to the applicant for consent and the public: (a) the content of the decision and*

any conditions attached thereto; (b) the evaluation of the direct and indirect effects of the proposed development on the matters set out in section hundred and 171A; (c) having examined any submission or observations validly made (i) the main reasons and considerations on which the decision is based, and (ii) the main reasons and considerations for the attachment of any conditions, including reasons and considerations arising from or related to submissions observations made by a member of the public; (d) where relevant, a description of the main measures to avoid, reduce and, if possible, offset the major adverse effects; (e) any report referred to in subsection (1H); (f) information for the public on the procedures available to review the substantive and procedural legality of the decision, and (g) the views, if any, furnished by other Member States of the European Union pursuant to section 174."

6. The various grounds upon which the applicants rely for seeking an order of certiorari and a declaration that the Board failed to carry out an EIA in accordance with the requirements of section 172 of the Act of 2000 are set forth in their Abridged Statement of Grounds at paragraph E.1 and its various sub-paragraphs.

Failure to comply with obligations in relation to the Environmental Impact Assessment:

7. The applicants submit that the it is evident from the decision of the Board that in so far as it purports to have carried out an EIA as required by section 172 of the Act of 2000, it failed to do so "in the light of each individual case" as required by both Article 3 of Council Directive 2011/92/EU (the "EIA Directive") and as reflected in the definition of an EIA in section 171A of the Act of 2000 set forth already. It seems to be suggested by the applicants that instead of correctly examining, analysing and evaluating this particular case as far as the effect of noise levels on human beings are concerned, the Board effectively fettered its discretion by simply applying noise limits or other standards recommended under the 2006 Guidelines. In particular they say that the Board in its decision imposed noise limits without carrying out any assessment of the significance of the increase in noise over background noise at this location on human beings living in the vicinity of the proposed turbines.

8. The applicants submit also that in so far as the Board may have relied upon the assessment carried out by the appointed inspector who prepared a report for the Board, and agreed with it for the purpose of its own EIA, the inspector's assessment itself is flawed since he did not carry out an assessment of the significance of the increase in noise over background noise levels at the location of this particular proposed development. They complain that the inspector, and by extension the Board since it "generally adopted" the inspector's report, based his recommendations upon a statement in the 2006 Guidelines to the effect that noise will not "generally" be a problem where the separation distance between turbine and house is greater than 500m, and without having carried out any assessment of the actual anticipated noise impact on existing houses by reference to background noise levels, and that this constitutes a failure to comply with the Board's obligations under section 172 of the Act of 2000 to carry out an EIA in the light of the particular case at hand. In so far as it is argued by the Board that it relied upon the inspector's assessment and generally agreed with it, the applicants submit that that report contains no assessment of the significance of the increase in noise over background noise levels that would affect human beings residing in the vicinity as a result of noise emitted from the turbines, and therefore there has been no conclusion reached by the inspector or the Board as to whether the level of increase in noise would be significant or acceptable, and accordingly there has been no analysis or evaluation by the Board of the direct effects of the proposed development in the context of noise impact on human beings, as is required to be carried out by reference to the

definition of "environmental impact assessment" contained in section 171A of the Act of 00 already referred to.

9. The applicants also maintain that the inspector made a fundamental error in his report, and that this error has carried through to the Board's decision. The error they allege is in relation to what I shall refer to as Location 2. They say that the inspector failed to recognise that Location 2 is a 'low noise environment' according to the noise measurements set forth in the EIS. They state that the background noise levels recorded in relation to Location 2 bring it within the definition of a 'low noise environment' for the purpose of the 2006 Guidelines since the LA90 noise level at that location was measured at less than 30dB(A). That measurement for Location 2 was recorded at 29dB(A). They consider that the Board failed to have regard to the correct noise level measurement (LA90) for the purpose of determining both the background noise levels and the appropriate noise limits to be applied, and instead, erroneously relied upon what are referred to as the LAeq measurements in respect of both Location 1 and Location 2. The LAeq is a measurement which gives an averaged noise level whereas the LA90 measurement gives the noise level found at a location for at least 90% of the period monitored. The 2006 Guidelines recommend that daytime noise levels for a low noise environment should be limited to an absolute level within the range of 35-40 dB(A)LA90, whereas the Board has specified in Condition 12 of the permission that the noise from the wind turbines should not exceed the greater of 43dB(A) LA90, or 5dB(A) above background levels when measured externally.

10. The applicants accordingly submit that, in error, noise levels up to the greater of those two alternatives is permitted, and that either would exceed the 2006 Guidelines level of 29dB(A) LA90 for Location 2 (low noise environment), and therefore that a fundamental error has occurred in relation to the EIA carried out by the Board.

11. Complaint is also made about the failure to apply separate noise limits for day-time and night-time which again is said to be contrary to the Guidelines which state in that regard "*Separate noise limits should apply for day-time and for night-time*". In so far as the inspector has stated in his report that "*in conditions attached to wind farm permissions the Board as a matter of practice uses a fixed night time limit of 43dB(A) or 5 dB(A) above background levels (whichever is the greater)*", the applicants submit that this is contrary to the Guidelines which recommend the 43dB(A) level on its own for night time noise, and they refer to the fact that in relation to day time levels the Guidelines recommend "*a lower fixed limit of 45dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations*" which the applicants say means it is the lower of the two limits which applies.

Board's submissions:

12. In relation to this ground of complaint the Board makes the point that it is an expert body, and that it reached its decision following an assessment of proper planning and sustainable development, and having carried out a proper EIA in accordance with its statutory obligations. In so far as the applicants are saying that the Board failed to carry out an EIA in relation to this "individual case", the Board says that this assertion is manifestly incorrect, and points to the very detailed EIS that was before the Board, as well as the further information that was sought by the Board and which it received, each of which addressed, inter alia, the issue of noise in relation to this particular proposed development. It refers in particular to Request 6 in the Request for Further Information relating to noise which requested further information under six different separate paragraphs (a) to (f), the penultimate of which reads:

> "*(e) the background noise assessments at identified nearest noise sensitive locations should quantify over 10 minute periods the existing background noise levels having due regard to wind speed, wind direction*

and rainfall over the same time periods. Wind speed should be measured at, or derived for, the hub height of the proposed turbines. The applicant should also clarify the periods of noise data that were excluded from analysis due to periods of rainfall. Background noise levels as it varies with hub height wind speed should be quantified separately for daytime, evening time and night-time periods with sufficient data present in a wind direction downwind from the proposed turbines to the identified sensitive locations covering a range of wind speeds from the turbine cut-in speed to its rated power. Hub height wind speed should be converted to standardised 10m height wind speed before comparison with predicted and cumulative noise levels at sensitive locations."

13. Framore's detailed response of April 2013 to this Request includes a response to the above request at (e). Relevant to the question of whether the Inspector in his report, and the Board by generally agreeing with and adopting the inspector's report, failed to carry out an EIA because it failed to take proper account of the fact that Location 2 (otherwise referred to as H13) came within the category of a 'noise sensitive location' is part of the response to (e) which appears at page 24 of 62 of that response. It is there stated:

"The noise impact assessment contained in the EIS concluded that there was no negative operational impact expected from the Derragh Windfarm when assessed against the noise limits contained within the Department of Environment Heritage and Local Government (DoEHLG) 2006 Wind Energy Guidelines. The predicted noise levels at the modelled noise sensitive locations (NSLs) or receivers (all dwellings in this assessment) were less than 40 dB LA90 for fourteen of the eighteen locations, and indeed, as such, were less than the fixed daytime and night-time fixed limits. At the nearest NSLs (H1,H13,H14, and H18) all the predicted noise levels were less than the daytime fixed limit of 45 dB(A) and where baseline monitoring identified periods of 'quiet background noise' i.e. LA90 levels less than 30 dB, the predicted levels were less than the 35–40 dB LA90 fixed limit range. The night-time fixed limit of 43 dB(A) was exceeded at NSLs H13, H14 and H18 for a single modelled wind speed of 8 m/s.

It is worth noting that the exceedance at this wind speed was only 1 dB greater than the 43 dB LA90 limit.

More importantly, these NSLs will never experienced the predicted noise emission of 43dB(A) at 8 m/s or indeed, the other predicted noise levels at the other wind speeds. The noise prediction standard, ISO 9613 Attenuation of Sound during Propagation Outdoors, models all NSLs as if they were downwind of all noise sources at the same time. In reality, the turbine layout requires a range of wind directions from north–north westerly through to easterly for the NSLs to be downwind of all the turbines simultaneously which cannot occur." [emphasis added]

14. This is a point taken up by Tim Cowhig on behalf of the second named notice party (Framore Limited) in his verifying affidavit sworn on 7th March 2014 where at paragraph 18, having referred to certain noise level measurements in relation to Location 1 and Location 2, and in particular the fact that the LA90 noise level at Location 2 was measured at 29dB, he refers to what isstated in the EIS in relation to Location 2, namely:

"the predicted noise levels are compliant except at 8 m/s wind speed of where turbine noise is predicted at 44 dB(A) and the limit is 43 dB(A). While this does indicate that a non-compliance could occur at a wind speed of 8 m/s (standardised to 10m), it is unlikely that such a non-compliance

will occur as the predicted noise level assumes all turbines running a maximum rated power and all upwind of the respective receiver. It is not possible for receiver H13 [i.e. Location 2] to be downwind of all the turbines simultaneously due to its location relative to the turbines, therefore this location will never be subject to the full noise emission at 8 m/s as predicted in the model. Similarly, receivers H14 and H18 will not exceed 44 dB(A) at 8 to 9 m/s for the same reason."

15. The Board has submitted, as has Framore Limited, that it clear from a consideration of all the material which was before the Board including the EIS, the Further Information received, the submissions made and responses thereto, when taken together, that the Board's consideration of this material for the purposes of its EIA was in relation to this individual development, and that no evidence has been adduced to establish that the Board has not carried out an EIA in accordance with its obligations. The Board in its decision has stated that it carried out an EIA. The onus is on the applicants to establish that this is not a correct statement, and in my view they have failed to do so. There is ample evidence from within the materials before the Board and in the Board's own decision that a proper EIA was carried out..

16. The Board has not erred by generally adopting the inspector's report for the purpose of its own EIA. In fact it has not adopted it in its entirety, as can be seen by the variation in a couple of the conditions. There is no evidence to support the contention made that the Board erred in relation to its assessment in relation to Location 2 (H13). Even though the inspector's report refers to the LAeq measurement and not the LA90, as pointed out by the applicant, when addressing the level of background noise, and on the face of it therefore failed to consider Location 2 on the basis that it was a low noise environment (being less than 30 dB(A) LA90, and even though the inspector's report was generally adopted by the Board, it is entirely insufficient to indicate the sort of fundamental error on the part of the Board which should result in the Board's decision being quashed, when all the material is taken into account. The Board was entitled to take into account in its EIA the matters referred to in paragraphs 13 and 14 for example. It cannot in my view be said that the Board failed in its statutory duty in this regard by not slavishly adhering to the Guidelines recommendation in relation to a low noise environment. It was entitled to see the Guidelines as just that, i.e. guidelines. It is entitled to take other matters into account in relation to its consideration of the Guidelines, and how to apply them or not as the case may be, and to agree with what was stated in the EIS, namely that as a matter of actual fact the levels cannot not be exceeded because as Mr Cowhig has averred by reference to the EIS and the Franore response to the request for Further Information: *"it is not possible for receiver H13 [i.e. Location 2] to be downwind of all the turbines simultaneously due to its location relative to the turbines, therefore this location will never be subject to the full noise emission at 8 m/s as predicted in the model."*

Having read and considered the material that was before the Board, and having considered also the affidavits filed by the parties, and considered the legal submissions made in relation to this Ground put forward for quashing the decision of the Board, I am satisfied that the ground does not succeed.

Failure to have regard to the 2006 Guidelines in breach of Section 28 of the Act of 2000:

12. Section 28(1) and (2) of the Act of 2000 provide:

"(1) The Minister may, at any time, issue guidelines to planning authorities regarding any of their functions under this Act and planning authorities shall have regard to those guidelines in the performance of their functions.

(2) where applicable, the Board shall have regard to any guidelines issued to planning authorities under subsection (1) in the performance of its functions." (emphasis added)

The applicants submit that the Board was therefore required to have regard to the 2006 Guidelines when making its decision, and they say that it failed to do so since it either disregarded the Guidelines or misinterpreted them, and in either case cannot be properly said to have had regard to them. They say that the Board failed to have regard to the Guidelines because (a) it failed to have regard to the specific absolute daytime noise limit of 35-40 dB(A) recommended in the Guidelines in respect of a "low noise environment" for the reasons which I have already set forth above, and (b) the Board failed to have regard to the LA90 noise measurements to which the Guidelines refer as the relevant descriptor for the purposes of determining both the background noise levels and the appropriate noise limits to be applied, and instead, relying on the inspector's report, the Board relied upon the LAeq noise measurements for Location 1 and Location 2.

13. It is the LA90 measurements which, according to the 2006 Guidelines, are relevant for determining the existing background noise levels and the existing noise environment. In that regard, the applicants have referred to page 29 of the Guidelines. Having discussed the aerodynamic noise (swish) caused by rotator blades passing through the air, and purely mechanical noise created by the generator, the gear-box and other mechanical elements within a cover or housing (the nacelle), the advances in design and technology which have reduced noise emissions, and the effect of higher and lower wind speeds in masking to a greater or lesser extent (as the case may be) noise caused by the wind turbines, the Guidelines state as follows:

> *"Noise impact should be assessed by reference to the nature and character of noise sensitive locations. In the case of wind energy development, a noise sensitive location includes any occupied dwelling house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational amenity importance. Noise limits should apply only to those areas frequently used for relaxation or activities for which a quiet environment is highly desirable. Noise limits should be applied to external locations, and should reflect the variation in both turbine source noise and background noise with wind speed. The descriptor, which allows reliable measurements to be made without corruption from relatively loud transitory noise events from other sources, should be used for assessing both the wind energy development noise and background noise. Any existing turbines should not be considered as part of the prevailing background noise.*
>
> *In general, a lower fixed limit of 45dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours. However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30dB(A), it is recommended that the daytime level of the LA90, 10min of the wind energy development noise be limited to an absolute level within the range of 35–40dB (A).*
>
> *Separate noise limits should apply for day-time and for night-time. During the night the protection of external amenity becomes less important and*

the emphasis should be on preventing sleep disturbance. A fixed limit of 43 dB(A) will protect sleep inside properties during the night.

In general, noise is unlikely to be a significant problem where the distance from the nearest turbine to any noise sensitive property is more than 500 metres. Planning authorities may seek evidence that the type(s) of turbines proposed will use best current engineering practice in terms of noise creation and suppression"(my emphasis).

14. I note in passing, and as noted by Ellen Morrin in her affidavit in support of the Board's Statement of Opposition, that the first named applicant, Pol O Grianna, in his grounding affidavit sworn on his own behalf and on behalf of all the other applicants and with their authority, has sworn in paragraph 4 thereof that "*the applicants are all residents in the townlands of Derragh, Eachros, Gortnabinne and Rathgaskig, Ballingeary, County Cork whose properties are located at distances between 527m and 1800m from the proposed turbine development ...*" (my emphasis).

15. Finally under this ground, the applicants submit that where the Board departed from the 2006 Guidelines, it was obliged to give its reasons for doing so.

16. The onus is on the applicants to establish that the Board failed to have regard to the 2006 Guidelines. In my view they have failed to discharge that onus. Firstly, the materials before the Board, including the inspector's report were replete with references to the Guidelines. Secondly, The Board's decision itself on page 2 thereof specifically states that it had regard to those Guidelines. I accept of course that a Board cannot simply in some purely formulaic way recite that it had regard to the Guidelines when there is clear evidence from the Decision that it cannot have done so, and still be considered to have complied with its obligations under section 28 of the Act of 2000. But we are not dealing with such an extreme and improbable situation as that. The Board in this case has stated that it had regard to the Guidelines, and it is evident from the materials before it, including the inspector's report relied upon heavily by the Board, and the Decision itself, that it did so. The fact that it has not slavishly followed the Guidelines does not indicate that it has not had regard to them as it is required to do.

17. The second limb of the applicant's ground in relation to section 28 is that the Board has misinterpreted the Guidelines, and in so far as that is so, should be considered to have had regard to them. The applicants say that the inspector in his report used the LAeq measurement for Location 1 and Location 2 instead of the LA90 measurement, and that this led to the Board ignoring the Guidelines in relation to the fixing of a noise limit recommended for a low noise environment in relation to Location 2. In fact it is apparent from the Board's decision that it considered the Guidelines when including Condition 12 in relation to any noise sensitive location, and I note that the limit is set by reference to the LA90 measurement and not the LAeq. I do not regard the fact that the inspector referred to the LAeq measurement rather than the LA90 measurement as indicating such a misinterpretation of the Guidelines as to compel a conclusion that proper regard cannot have been had to the Guidelines. I have dealt with the reality of that issue in relation to the previous ground considered.

18. The parties have referred to the judgment of Quirke J. in *McEvoy v. Meath County Council* [2003] 1 I.R. 208. That was a case where the applicant had sought to quash the respondent's decision to make and adopt a development plan for County Meath on the basis that the council had failed to have due regard to the strategic planning guidelines for the greater Dublin area as required by law. Section 27 of the Act of 2000 at the relevant time required the council to have regard to those strategic planning guidelines when making and adopting its development plan, but Quirke J. held that the phrase "have regard to" did not require it to rigidly follow the Guidelines, and that it could even

depart from them for bona fide reasons consistent with the proper planning and development of its functional area. He also went on to state that "*if it had been the intention of the Oireachtas that section 27(1) should be construed as imposing upon planning authorities an obligation to 'comply' with regional planning guidelines then the enactment rendered subs. (2) of the same section superfluous*". Subs. (2) at the time provided that "*the Minister may, by order, determine that planning authorities shall comply with any regional planning guidelines in force for their area, or any part thereof, when preparing and making a development plan .....*". One can see in relation to the present case that while the Oireachtas had required that Guidelines be had regard to, it has not gone further and required that they be adhered to in every respect. It clearly could have done so if it had so wished. I am satisfied that despite the matters relied upon and argued by the applicants, it is clear from the evidence that the Board had regard to the 2006 Guidelines in accordance with its obligations under section 28.

19. The applicants have also argued that the Board's decision is flawed because neither the inspector nor the Board gave any reason for departing from the 2006 Guidelines, and that the Board was obliged to do so. However, I do not consider the Board's decision departs in any material or significant way from the Guidelines. I have already held that the Board is not obliged to slavishly or rigidly follow and apply the Guidelines, and it follows that it may exercise some discretion in relation to the Guidelines. This is consistent with the requirement that regard be had to them. But secondly, there is no statutory obligation on the Board to give reasons for not following a particular guideline even if it was the situation that they had been departed from. Section 28 imposes no requirement to give any such reasons. Other sections of the same Act do provide that where an authority or the Board is departing from a recommendation of a delegated person such as an inspector, it must include a statement of the main reasons for having done so – see for example section 34(10(b), and also section 37(2) (c) where the main reasons and considerations must be given where the Board decides to grant a permission even though it materially contravenes the development plan. The obligation under section 28 does not go that far.

Project-Splitting:

15. The applicants submit that the Board has failed to carry out an EIA in relation to the overall project of which the construction of the wind turbines is only the first stage, since there is a necessary second phase, namely the works necessary to connect the wind farm to the national grid. It is submitted by the applicants that the cumulative effect of the entire development on the environment should have been the subject of the Board's EIA, and that an impermissible 'project-splitting' has occurred thereby invalidating the decision-making process. They make the point that the connection to the national grid is a fundamental part of the overall development as, without such connection, the wind farm cannot operate, and that the two stages should be considered as a single project and be assessed as such on a cumulative basis before it can be seen as complying with the EIA Directive.

16. The EIS submitted with the planning application by the developer made reference at paragraph 3.1.2 thereof to the fact that a connection to the national grid would in due course be necessary, including the statement that "*it is not possible to determine the line or form (overhead or underground) of the grid connection at this stage as the design will be undertaken by ESB Networks*". The applicants say that whatever form the connection takes, whether overhead or underground, there are inevitable and significant consequences for the environment, and that the Board was required to consider these when considering the first stage of the development, in order to avoid the possibility of 'project-splitting', which in the applicants' submission is contrary to both Irish and EU law. They say that because the EIS did not contain any information as to the environmental impact of the second stage relating to the connection to the national grid,

The Board was prevented from giving any consideration to that factor, or the cumulative effect of both stages of the development, as is required under the Directive.

17. In so far as the Board and Notice Party may argue that the impact of the second stage can be considered at some later stage and that it was unnecessary for its impact to be considered by the Board when considering the present application, the applicants have made the point that it is quite possible that the connection to the national grid would constitute exempted development under Part 1, Schedule 2 of the Planning and Development Regulations 2001, as amended, and therefore there may well be no opportunity available for an EIS to be submitted in relation to the cumulative effects of the development under challenge and its connection to the national grid, as no further planning application would be required. They say that it is not sufficient for the developer in its EIS to simply state that the line and form of the connection is not yet known, and therefore cannot be assessed, and that the Board ought not to be permitted to treat the works related to the grid connection as an entirely separate project, but rather as an integral part of the subject development.

18. The EIS submitted by the developer stated the following regarding the connection of the proposed turbines to the national grid:

> *"The grid connection from the proposed turbines will be via underground cable connections to the on-site substation. The cables will be buried adjacent to the site tracks where possible. The location of the proposed substation is shown on Figure 3.1. The developer has a grid connection offer as part of the Commission for Energy Regulation (CER) Gate 3 processing group. It received a connection offer (DG418 and DG419) on 30th June 2011 from ESB Networks. The connection offer states that the electricity generated at Derragh Wind Farm will connect to the national grid at a 110 kV substation at Coomataggart. The grid connection will operate at 20 kV. It is not possible to determine the line or form (overhead or underground) of the grid connection at this stage as the design will be undertaken by ESB Networks. A 20 kV overhead line is usually constructed with a single wooden pole and does not typically require steel lattice masts. It is of relatively low impact and does not normally require planning permission."*

19. The Inspector merely notes in this regard at para. 9.13.9 of his report:

> *"Having regard to the scale of the project and the need to obtain a connection to the national grid (something that may be beyond the control of the applicant), it would be appropriate to allow a 10-year planning permission as sought by the applicant. This is not unusual in relation to wind farm applications."*

20. In its submissions, the Board refers to the fact that it addressed the issue of the connection to the national grid at Condition 4 of the Board's decision which states: *"This permission shall not be construed as any form of consent or agreement to a connection to the National Grid. Reason: in the interest of clarity."* The second named Notice Party pleads that the precise grid connection that will be available to it is outside its control and will be the subject of further consideration, including with regard to its environmental impact, at some stage in the future when the plans and specifications for that connection have become clear. The Court has not been provided with any evidence of any attempt which may have been made to get a design for the grid connection from ESB Networks, so it can be presumed that there has been no such attempt as yet.

21. The Board accepts that so-called 'project-splitting' must be avoided so as to ensure that objectives of the EIA Directive are not frustrated. But central to the Board's

argument is that in the present case the subject development and the later connection of that development to the national grid do not constitute one project, but rather are separate projects in respect of which their respective environmental impacts may be assessed at the relevant time. It says that when the separate project in relation to the grid connection becomes the subject of a consent application, the cumulative effects of that development will be assessed, including by reference to its cumulative effect with the subject development, and in that way, even if the entire project is considered to be a single project, the effects of both will be assessed. The Board makes the additional point that no development requiring an EIA can be exempted development by virtue of the amendment (by substitution) of section 4 of the Act of 2000 which now provides:

> *"(4) Notwithstanding paragraphs (a), (i), (ia) and (l) of subsection (1) and any regulations under subsection (2), development shall not be exempted development if an environmental impact assessment or an appropriate assessment of the development is required".*

22. Accordingly, it is submitted, any connection to the national grid would have to be assessed so that consideration was given to the direct and indirect effects of the connection to the national grid, both in and of itself as well as cumulatively with the subject development, and where there was likely to be a significant environmental effect an EIA would be required under Part X of the Planning and Development Regulations 2001, as amended. It makes the point that if it was not considered that there would, even cumulatively, be any significant environmental effects from the second phase, then no environmental prejudice would exist. In this way, it is submitted that the objectives and provisions of the EIA Directive will be fulfilled in relation to the future connection of the subject development to the national grid, notwithstanding that at the present time the plans and details relating to the future connection are not yet known, and therefore have not as yet been the subject of an EIA.

23. Notice Party (Framore) supports the submissions made on behalf of the Board. It refers to the fact that where no proposals have yet been formulated by ESB Networks for the grid connection design, it simply was not possible for it to include a consideration of same in its EIS, and consequently it was not possible for the Board to assess the potential environmental impact of the works associated with that phase of the development. Framore also refers to the Planning Guidelines which at para. 4.3 state in this regard that "*the planning authority should note that it may not be possible, due to reasons outside the applicant's control, to provide information on indicative grid connections at the pre-planning consultation or planning application stage of the wind energy development*". One should note, however, the context of that statement which appears from the following paragraph which states: "*It is therefore inappropriate for the planning authority or An Bord Pleanala on appeal to attach conditions to planning permissions for wind energy developments in regard to the location of the connection to the grid. In these instances, a separate application for grid connection will be necessary*" [my emphasis]. It refers to the fact that the inspector in his report noted that the connection to the national grid is a matter outside the control of the developer, and that accordingly by generally adopting the inspector's report, the approach taken by the Board in relation to the environmental impact of the connection to the national grid was appropriate, and in accordance with the Guidelines.

24. Framore have referred to the Opinion of Lord Hodge in the Outer House, Court of Session, Scotland in *Skye Windfarm Action Group Limited v. Highland Council* [2008] C.O.S.H.19 in support of its submission that where there are two phases involved in a development, even where the second is integral to the overall project, it will not always be the case that the EIA must encompass the cumulative environmental effects of the overall project, and that each case must be considered on its own particular facts in order to decide whether those cumulative effects are such that the matters should be

considered together. In Skye, Lord Hodge noted that it was not disputed between the parties that certain 'borrow pits' from which aggregate was to be extracted to provide on-site roads, and for which a separate planning application was lodged, were part of the overall wind farm project, and that normally their cumulative impact should have been considered as part of the EIA. However, he went on to state that he was not satisfied that it was illegal to separate the borrow pits from the assessment of the wind farm, noting that previous assessments carried out in 2002 and 2006 had not identified any significant environmental effects of the borrow pits whether considered alone or cumulatively with the wind farm. In those circumstances he saw "*no practical reason for an environmental impact assessment of the borrow pits other than in the context of the wind farm application.*" He noted that his approach was consistent with the approach taken by Advocate General Gulmann in *Bund Naturschutz in Bayern v. Freistaat Bayern* (Case C-396/92) [1994] ECR 1 – 3717, namely that each case will be fact-sensitive as to whether the case must be considered cumulatively with a related application.

25. It is worth noting that in Skye the initial wind farm application had included within its scope certain proposals to excavate stone but that the developer at that point had made no decision as to the source of material for the construction of the site words. The initial planning permission granted contained a condition which required the developer, before the development commenced, to submit detailed proposals for the sourcing of materials including any necessary planning applications. Thereafter, two separate planning applications for the borrow pits were lodged, but the developers asked for what is referred to as a "screening opinion" as to whether the applications for the borrow pits would require an EIA. The developer was informed that the planning authority "*opined that such an assessment would not be required*". Lord Hodge noted that no challenge had been taken to that screening opinion. Three years later, a second amended proposal was lodged by the developer which included an assessment of the cumulative impact of the wind farm and the borrow pits. In their amended proposal, the developer give a summary of the cumulative impacts of the wind farm and the borrow pits and concluded by stating that they had not identified any likely significant cumulative environmental effects over and above the assessed environmental effects of the wind farm. That conclusion was not challenged by the petitioners in the case. Lord Hodge in those circumstances indicated that there had been no breach of the Regulations in relation to the borrow pits as anybody entitled to do so, had not been deprived of an opportunity to comment on the environmental assessment in relation to the borrow pits, and he concluded also that "*because of the screening opinion, the borrow pits were not EIA applications".* But one should note that at paragraph 76 of his opinion, Lord Hodge stated:

> *"[76] It is undisputed that the borrow pits formed an integral part of the wind farm development and Swale Borough Council and BAA plc support the view that part of a development in such circumstances should not normally be considered in isolation. But I am not satisfied that it was illegal to separate the borrow pits from the assessment of the wind farm. The initial assessment end 2002 and the August 2006 assessment did not identify any significant environmental effects of the borrow pits whether considered alone or cumulatively with the wind farm. It is consistent with Advocate General Gulmann's approach in Bund Naturschutz that the court should look at the particular circumstances of each case in deciding whether a cumulative assessment is needed to fulfil the purposes of the Directive. While, as Mr Campbell argued, the cumulative effects of the wind farm and the borrow pits are cumulative, I see no practical reason for an environmental impact assessment of the borrow pits other than in the context of the wind farm application.*

[77] In any event the problem, if such it was, was remedied. Having received legal advice and reconsidered to the matter, the respondents appear to have encouraged AMEC to present a cumulative assessment in the second amended proposal. AMEC presented that assessment. The respondents were able therefore to consider the cumulative impact of the wind farm and the borrow pits before the grant of planning permission to the wind farm.

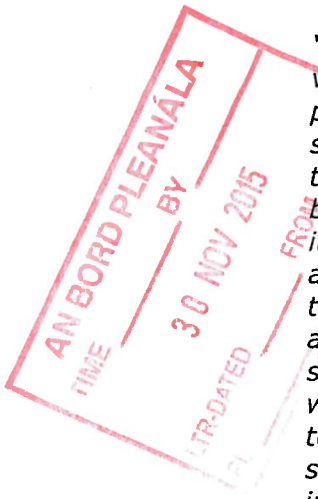
.....

[79] The 1999 Regulations are concerned with achieving a proper environmental assessment in which the public have the opportunity to participate. In this case, in contrast with the circumstances in BAA plc, the unchallenged conclusion of the cumulative impact assessment was that the borrow pits would not give rise to any significant environmental effects beyond those identified in the assessment of the wind farm. I am not satisfied that there has been any failure to assess cumulative environmental effects or that democratic participation in the assessment has been thwarted in any way. The challenge appears to be a technical one rather than one with substantive content and I am not persuaded that the technical challenge is justified. The 1999 regulations are not designed to create an obstacle course for a developer or a planning authority. This ground of challenge fails."

26. I consider that the decision in Skye is distinguishable from the present case in so far as there was in fact an assessment made at an earlier screening stage that there were no significant environmental impacts deriving from the borrow pits such that a cumulative assessment was required, and that opinion was not challenged. But Lord Hodge was able to take comfort also from the fact that the authority requested the developer to provide a cumulative assessment, and that was provided and considered. I do not think it is authority for any general proposition that even though one development is integral to a second there is nothing illegal about separating one from the other, and thereby avoid a cumulative assessment of significant environmental effects of both. Each case will have to be considered in the light of its own specific facts, and as I have said, the Skye facts are very different from the facts in the present case where it has been stated by the developer, and apparently accepted by the inspector and the Board, that it was not possible at the time the application was being considered for the potential environmental effects of the works required in order to make the connection to the national grid to be included in an EIS and then assessed, as the route/design for that connection was not known precisely at the time, and in any event it was a matter outside the control and knowledge of the developer at the time, being a matter for ESB Networks to determine. Therefore, unlike the Skye case, there has not been any assessment of the potential environmental impact of that second phase of the wind farm development at all. There have been some views expressed that it is unlikely that there would be any significant impact to the environment by the works required for the connection to the national grid, but it cannot be said that there has been an assessment as such, since the details have not yet been made available.

27. I am satisfied that the second phase of the development in the present case, namely the connection to the national grid, is an integral part of the overall development of which the construction of the turbines is the first part. This is not a case such as in *R (Littlewood) v. Bassetlaw District Council* [2008]'s E.W.H. C. 1812 where the development in question was a stand-alone project within a larger Master Plan development, the full details of which had not yet been finalised. In that case it was held that phase 1 was not dependent or reliant upon the completion of any other part of the master plan, and therefore the cumulative effects of the entire master plan did not need

to be assessed. The present case is different. The wind turbine development on its own serves no function if it cannot be connected to the national grid. In that way, the connection to the national grid is fundamental to the entire project, and in principle at least the cumulative effect of both must be assessed in order to comply with the Directive. In this regard the applicants have referred to the judgment of Clarke J. in *Arklow Holidays Limited v. An Bord Pleanala and others* [2006] IESC 15, albeit a judgment on the question only as to whether the applicants had established substantial grounds for their challenge to a decision to grant permission for the development of a waste water treatment plant, inter alia on the ground that "*the environmental impact statement submitted by the Urban District Council in support of its application for planning permission omitted from its considerations any potential impact on the environment of all aspects of the project other than those directly connected with the waste water treatment plant itself*". What had been omitted was any assessment of the environmental impact of certain aspects of the project which were outside the waste water treatment plant itself, the inspector taking the view in his report that by virtue of the fact that the rising mains and pumping stations were not located in environmentally sensitive areas, they were unlikely to have a significant environmental impact and therefore did not consider that the Board should require a new E.I.S. In deciding that a substantial ground had been raised in this regard by the applicants, Clarke J. stated:



> "*It may well have been within the competence of the Board to take the view that the potential environmental impacts of those aspects of the project outside the waste water treatment plant itself were much less significant than those from the plant. It may well also have been within the competence of the Board to take the view that the impacts that might be associated with those aspects outside the waste water treatment plant itself were not, of themselves, significant. However, what is required to be assessed is the totality of the impact of the project taken as a whole. It is, therefore, at least arguable sufficient for the purposes of leave, that aspects of a project which might not have impacts which would be significant in themselves might, when taken on a cumulative basis, and when added to the impacts of other aspects of the same project, give rise to an overall view that the environmental impacts taken as a whole were such as should lead to a refusal of development consent or, indeed, the imposition of more stringent conditions.*"

28. It seems to me that the fact that the developer is at the mercy of ESB Networks as far as the details of the plans for that connection to the grid is concerned, cannot absolve the developer from compliance with the Directive in every respect. Presumably at some future date all of the grid connection details will be ascertained, so that a decision can be made as to whether there will or will not be any significant environmental impact either on its own, or cumulatively with the wind turbine development itself. The question is whether that cumulative assessment, or even a decision as to whether any such cumulative assessment is required at all, should be made prior to permission being granted for the first stage of the development (i.e. the construction of the turbines), or whether the construction of the turbines can be allowed to proceed, and then in due course when the details of the connection to the national grid are known, a cumulative assessment of the environment mental impact of both can be carried out – running the risk from the developer's point of view, that in the event that he proceeds with the construction of the turbines, it would be all in vain should there be a negative cumulative assessment when it comes to considering the connection to the national grid.

29. If, in the latter event, where a decision is made by the authority to refuse permission for the connection to the national grid in view of a perceived significant environmental impact cumulatively, and the first phase had at that stage already been completed and was ready to be operated once the connection to the national grid was completed, there

would be a significant prejudice to the developer such that it would probably make no commercial sense to proceed with the completion of the turbines until such time as a connection to the national grid was guaranteed by a relevant permission. For that reason, Framore submits that in reality there is nothing to prevent a cumulative assessment of the environmental impact of the connection to the national grid being carried out later when the details are known. They point also to the fact that the planning permission itself, which they have already obtained, makes it clear that the granting of that planning permission is not to be taken as any assurance that a connection to the national grid will be permitted. But, it must be borne in mind that Condition 4 is not a condition which makes the construction of the turbines conditional upon the consent being given for the connection to the national grid.

30. The applicants on the other hand fear that if the turbines are erected pursuant to the present permission, it would be more difficult for the authority to refuse permission in respect of the connection to the grid. In other words, the fear is that Framore would be seen to have "*a foot in the door*" such that any objections that the applicants might raise in relation to the second phase would be less likely to succeed than if the project was assessed cumulatively now before the developer has invested heavily in phase 1. In this regard, the applicants also refer to the fact that in the EIA Directive at recital 2 thereof that is stated:

> *"pursuant to Article 191 of the Treaty on the Functioning of the European Union, Union policy on the environment is based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should, as a priority, be rectified at source and that the polluter should pay. Effects on the environment should be taken into account at the earliest stage in all the technical planning and decision-making processes" [Emphasis added].*

The applicants submit that the "earliest stage" is now, and prior to permission being granted for phase 1, and that otherwise there a risk that the requirements of the Directive will be avoided by no cumulative assessment of the overall project being carried out, particularly where it is probable that phase 2 on its own will be seen as exempted development requiring no planning consent.

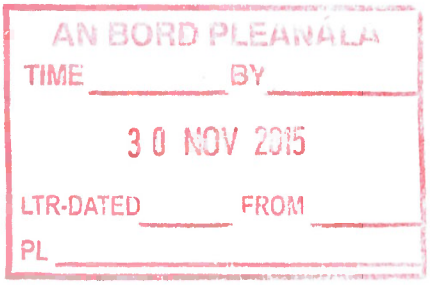
31. The respondent in its written submission has stated:

> *"57. For the Applicants" case to have any merit, it must be on the basis that the development and the national grid connection constitute the one "project" and thus, that such a project has been granted development consent in defiance of the EIA Directive because such has arisen prior to a complete EIA.*
>
> *58. If, of course, the subject matter development and the future connection to the national grid are viewed as one project, then it stands to absolute reason that development consent has not been given for that project. Indeed, Condition 4 is clear on this."*

32. In that regard, I have already concluded that in reality the wind farm and its connection in due course to the national grid is one project, neither being independent of the other as was the case on *R (Littlewood) v. Bassetlaw District Council* [supra] for example. The Board's submissions are very much predicated on the contrary argument, and on the fact as submitted also by Framore that at this point in time there have been no proposals formulated by ESB Networks for the design and route of the connection to the national grid. That argument does not, it seems to me, justify treating phase 1 as a stand-alone project when in truth it is not. Rather, it points to a prematurity in the seeking of permission for the construction of the wind farm ahead of the detailed

proposals for its connection to the national grid from ESB Networks. I appreciate that Tamore have indicated that it simply is not possessed of the necessary information in this regard and could not include it in its EIS. But that does not mean that given more time and further contact with ESB Networks it could not be achieved so that it could be included in an EIS which addressed the impact of the environment of the total project "at the earliest stage". It may mean that the developer must wait longer before submitting its application for planning permission. But it seems to me likely at least that even if a phase 1 permission is granted with a condition such as Condition 4 contained therein, no sensible developer would complete phase 1 of the development without having been granted permission for the connection to the national grid, or without having been assured that the connection phase is exempted development. In that way, it is difficult to see any real prejudice to the developer by having to wait until the necessary proposals are finalised by ESB Networks so that an EIS for the entire project can be completed and submitted, and so that a cumulative assessment of the likely impact on the environment can be carried out in order to comply with both the letter and spirit of the Directive.

33. I will therefore grant the reliefs at D1 and D2 of the Abridged Statement of Grounds dated 14th February 2014.



THE HIGH COURT

[2013 No. 802 J.R.]

BETWEEN

EAMON (TED) KELLY

APPLICANT

AND

AN BORD PLEANÁLA

RESPONDENT

AND

ROSCOMMON COUNTY COUNCIL, GALETECH ENERGY DEVELOPMENTS LIMITED, SKY VALLEY CONCERNED RESIDENTS GROUP, WIND TURBINE ACTION GROUP SOUTH ROSCOMMON, THE DEPARTMENT OF ARTS, HERITAGE AND THE GAELTACHT, SKY VALLEY WIND COMPANY, THE HERITAGE COUNCIL AND THE COMMISSION FOR ENERGY REGULATION, PAUL DONOHUE, JAMES FRANCIS FALLON, THOMAS BURKE, MARIA DONNELLY, TOM AND FIONA FARRELL, LIAM KILDEA SKY VALLEY CONCERNED RESIDENTS GROUP, THE HERITAGE COUNCIL AND THE COMMISSION FOR ENERGY REGULATION

NOTICE PARTIES

JUDGMENT of Ms. Justice Finlay Geoghegan delivered on the 25th day of July 2014.

1. The applicant, supported by one notice party, namely, the Department of Arts, Heritage and the Gaeltacht ("the Department") in this judicial review, seeks, by way of primary relief orders of *certiorari,* to quash two decisions of the respondent to grant planning permission for wind turbine developments in County Roscommon. The challenged decisions are:

> "(1) A decision made on the 9th of September, 2013, to grant permission for a development comprising sixteen wind turbines with a hub height of 85m,

rotor diameter of 100m at Croan, Gortaphuill, Mullaghardagh, Dysart, County Roscommon (Appeal Reference PL20.239759 Planning Register Ref. 10/541) ("Phase 1 Decision").

(2) A decision made on the 13th of September, 2013, to grant planning permission for a development comprising nineteen wind turbines with a hub height of 85m, rotor diameter of 100m and overall height of 135m and 85m anemometer mass and 110kv substation a Milltown, Skeavally, Tawnagh, Tobermacloghlin, County Roscommon (Appeal ref. PL20.241069 Planning Register Ref. 11/273) ("Phase 2 Decision").

2. Galetech Energy Developments Ltd. ("Galetech"), a notice party, is the applicant for the planning permissions that are the subject of the Phase 1 and Phase 2 Decisions. It supports the respondent, An Bord Pleanála ("the Board") in opposing the present application.

3. As appears, the applications for planning permission relate to two developments of wind turbines in County Roscommon. The applicant is resident in Dysart, County Roscommon, is the Chairman of a group o f local residents called the Wind Turbine Action Group South Roscommonand w as an appdlant before the Board in relation to each appeal

Background

4. In 2010, Galetech applied for planningpermission for a development comprising 16 wind turbine at Dysart, County Roscommon. In 2011, it applied for permission for the development of 19 wind turbines at Milltown, Skeavalley, County Roscommon. The two developments are in the same vicinity and are contended by the applicant to comprise two phases of the same development. They will be referred

to as Phase 1 and Phase 2 in this judgment. Roscommon County Council granted permissions for the two developments and appeals were made to the Board.

5. The proposed developments are in the vicinity of a number of European sites, both Special Areas of Conservation (SAC) and Special Protection Areas (SPA). There are ten conservation sites within 10km of the Phase 1 site. These include three Natura 2000 sites, Loghcroan SAC, Four Road Turlough CSAC and the River Suck Callows SPA. Those sites have important numbers of wetland and water birds, including Whooper Swan, Golden Plover and Greenland White Fronted Geese, all Annexe 1 species. Within 15km of the Phase 2 site, there are 14 Natura sites including the three Natura 2000 sites already mentioned.

6. The Board appointed a Planning Inspector to prepare a report on the appeal in relation to Phase 1, Ms. Kelly. Ms. Kelly reported on 11th March, 2012. She recommended refusal of planning permission.

7. The Board appointed Ms. MacGabhann as Inspector in relation to the Phase 2 appeal. Ms. MacGabhann reported on 6th February, 2013. She also recommended refusal of planning permission.

8. The Board considered each of the appeals at a meeting of the Board held on 8th August, 2013, and decided by a majority of 4:1 to grant permission for each of the proposed developments in accordance with reasons, considerations and decisions set out in the respective written decisions. It is those decisions, and the procedure leading to them, that are the subject matter of the present application for judicial review.

Grounds of Challenge

9. The applicant has delivered a lengthy and detailed statement of grounds. Pursuant to directions of the Court, it summarised the legal grounds upon which relief is sought as follows:

> "(1) The Environmental Impact Statements (EIS) accompanying the applications for planning permission were inadequate and did not meet the requirements of national and European law. The Board erred in law in considering the statements to be adequate and proceeding to grant permission.
>
> (2) The Natura Impact Statements (NIS) accompanying the applications for permission were inadequate and did not meet the requirements of national and European law. The Board erred in law in considering the statements to be adequate and proceeding to grant permission.
>
> (3) The Board failed to carry out a proper environmental impact assessment of the proposed development as is required under Irish and European law.
>
> (4) The Board failed to carry out a proper appropriate assessment of the proposed development as is required under Irish and European law.
>
> (5) The Inspectors in each appeal recommended a refusal of permission for the proposed development, the Board erred in failing to have any or any proper regard to these recommendations and in particular the scientific doubt expressed in these recommendation.
>
> (6) The Board failed to properly or at all record its conclusions or to give any or any proper statement of its reasons or considerations contrary to national and European law.

(7) The Board erred in applying an incorrect test in its purported appropriate assessment.

(8) The Board's decision was irrational."

10. At the hearing, counsel indicated that the applicant was not pursuing grounds (1) and (2).

11. The Department supports the applicant on his grounds of challenge which relate to compliance with the requirements of the Council Directive 92/43/EEC (as amended) (the "Habitats Directive") and the relevant implementing national legislation identified in grounds (4), (5), (6) and (7) above.

12. As appears, the primary ground relied upon by both the applicant and the Department is that the decisions of the Board to grant each planning permission were made in breach of the requirements of Article 6(3) of the Habitats Directive as transposed into national law by Part XAB of the Planning and Development Act 2000 (as amended) ("the PDA"). The main contention is that the Board, as competent authority, failed to carry out an appropriate assessment in either appeal in accordance with Article 6(3) and the decisions of the Court of Justice of the European Union (CJEU), or to give reasons for the determination made in the course of the purported appropriate assessments.

13. The applicant pursued ground (3) in relation to the alleged failure by the Board to carry out an environmental impact assessment as required by Directive 2011/92/EU ("EIA Directive") as implemented by the PDA.

14. Whilst I propose, initially, considering the grounds which relate to the alleged breach of the requirements of Article 6(3) of the Habitats Directive, as transposed into Irish law, it is necessary to set out in summary all relevant parts of the Statutory

Scheme which applied to the challenged decisions taken by the Board to consider appropriately the Board decisions.

Statutory Framework

15. The ultimate decisions taken by the Board on the appeals were whether or not to grant planning permission for the developments that were the subject of each of the appeals pursuant to s. 37 of the PDA. In taking those decisions, by reason of the nature and location of the proposed developments, there were three separately identifiable requirements deriving from Statute (in part enacted to give effect to EU obligations) with which the Board had to comply:

(i) Consideration of what might be termed normal or general planning requirements under the PDA and compliance with its procedural requirements; and

(ii) The carrying out of an environmental impact assessment required by the EIA Directive as implemented by Part X of the PDA; and

(iii) The carrying out of an appropriate assessment as required by Article 6(3) of the Habitats Directive implemented by Part XAB of the PDA including making a determination.

Planning Requirements

16. The Board assigned an Inspector to report to it on each appeal pursuant to s. 146(1) of the PDA. The Inspector's Report must include a recommendation to the Board, which it is obliged to consider before determining the appeal (s. 146(2)).

17. In accordance with s. 34(10) of the PDA, the Board must state the main reasons and considerations on which the decision is based. Also, as where, in this case, the decision on the appeal is different to the recommendation in the Inspector's

Report, the decision of the Board must "indicate the main reasons for not accepting the recommendation in the report or reports to grant or refuse permission".

Environmental Impact Assessment

18. Where, as on the facts of these appeals, the Board is also obliged to carry out an environmental impact assessment (EIA), the obligations imposed on it by the EIA Directive, as implemented, are set out in Part X of the PDA. Section 171A(1) defines an environment impact assessment, for the purposes of Part X, as:

> "An assessment which includes an examination, analysis and evaluation carried out by . . . the Board . . . in accordance with this Part and Regulations made thereunder, that shall identify, describe and assess in an appropriate manner, in light of each individual case and in accordance with Articles 4 to 11 of the Environmental Impact Assessment Directive, the direct and indirect effects of a proposed development on the following:
>
> (a) human beings, flora and fauna;
>
> (b) soil, water, air, climate and the landscape;
>
> (c) material assets and the cultural heritage and
>
> (d) the interaction between the factors mentioned in paragraphs (a), (b) and (c)."

19. Section 172(1H) permits the Board, in carrying out an EIA, to "have regard to and adopt in whole or in part any reports prepared by its officials or by consultants, experts or other advisers". This includes its Inspector's Reports.

20. Section 172(1J) obliges the Board, when it has decided whether to grant or refuse consent for the proposed development, to inform the applicant and the public of the decision and to make the following information available to them:

> "(a) The contents of the decision and any conditions attaching thereto;

(b) an evaluation of the direct and indirect effects of the proposed development on the matters set out in section 171A;

(c) having examined any submission or observation validly made:

(i) the main reasons and considerations on which the decision is based and

(ii) the main reasons and considerations for the attachment of any conditions, including reasons and considerations arising from or related to submissions or observations made by members of the public;

(d) where relevant, description of the main measures to avoid, reduce and, if possible, offset the major adverse effects;

(e) any report referred to in sub-section (1H);

(f) information for the public on the procedures available to review the substantive and procedural legality of the decision, and

(g) the views, if any, furnished by other Member States of the European Union pursuant to s. 174."

21. The definition of an EIA as being "an examination, analysis and evaluation" carried out by the Board and the obligation of the Board pursuant to s. 172(1J)(b) to make available to the public its evaluation of the direct and indirect effects of the proposed development on the matters set out in s. 171A are of particular relevance to the matters in dispute.

Appropriate Assessment

22. In these appeals, the third statutory requirement impo sed on the Bœrd relates to its obligations and in particular the carrying out of an appropriate assessment

pursuant to Article 6 of the Habitats Directive as implemented by Part XAB of the PDA. There is some dispute as to the extent of the obligations imposed and in particular the nature of the reasons which must be given by the Board.

23. Whilst the provisions of Part XAB are more detailed than Article 6 of the Habitats Directive, it was common case between the parties at the hearing that they are intended to and do impose similar obligations on the Board to those imposed by Article 6(3) of the Habitats Directive as construed by reference to the case law of the CJEU.

24. Article 6 of the Habitats Directive, insofar as relevant, provides:

> "2. Member States shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive.
>
> 3. Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.

4. If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted."

25. As appears Article 6(3) envisages a two-stage process which is implemented in greater detail by ss. 177U and 177V of the PDA:

(i) a screening for appropriate assessment in accordance with s. 177U;

(ii) if, on a screening, the Board determines that an appropriate assessment is required then it must carry out an appropriate assessment in accordance with s. 177V.

26. There is a dispute between the parties as to the precise obligations imposed on the Board in relation to the stage 1 screening by s.1777U but its resolution is not strictly necessary in these proceedings. There is agreement on the nature and purpose of the screening process which is well explained by Advocate General Sharpston in Case C-258/11 *Sweetman* at paras 47-49:

"47. It follows that the *possibility* of there being a signi ficanteffect on the site will generate the need for an appropriate assessment forthe purposes of Article 6(3). The requirement at this stage that the plan or project be likely to have a significant effect is thus a trigger for the obligation to carry out an appropriate assessment. There is no need to *establish* such an effect; it is, as Ireland observes, merely necessary to determine that there *may be* such an effect.

48. The requirement that the effect in question be 'significant' exists in order to lay down a *de minimis* threshold. Plans or projects that have no appreciable effect on the site are thereby excluded. If all plans or projects capable of having *any* effect whatsoever on the site were to be caught by Article 6(3), activities on or near the site would risk being impossible by reason of legislative overkill.

49. The threshold at the first stage of Article 6(3) is thus a very low one. It operates merely as a trigger, in order to determine whether an appropriate assessment must be undertaken on the implications of the plan or project for the conservation objectives of the site [. . .]"

27. The applicant submitted that s. 177U is mandatory and obliges the Board to carry out a screening and make a formal determination as to whether or not an appropriate assessment is required in all cases, and that it did not do so in the appeals, the subject matter of these proceedings. The Board in response does not assert that it conducted a stage 1 formal screening but disputes that it was under an obligation to carry out a screening and issue a formal determination in circumstances where the planning applications were accompanied by a Natura impact statement. It referred to s. 177U(6)(c) and submitted that this is intended to reflect the practical reality of the situation which pertains in these appeals where the requirement to carry out a full appropriate assessment had been established before the planning authority.

28. Sub-sections 177U(1) and (2), in their terms, impose a mandatory obligation on a competent authority, such as the Board, to carry out screening for appropriate assessment before consent is given for a proposed development. These sub-sections, insofar as relevant, provide:

"177U. - (1) A screening for appropriate assessment of . . . [an] application for consent for proposed development shall be carried out by the competent authority to assess, in view of best scientific knowledge, if that . . . proposed development, individually or in combination with another plan or project is likely to have a significant effect on the European site.

(2) A competent authority shall carry out a screening for appropriate assessment under subsection (1) before-

(a) . . ."

Sub-section (3) permits the competent authority to request information from the applicant to enable it carry out the screening. Sub-sections (4) and (5) set out the determinations which may be made by the Board in that screening process in the following terms:

"(4) The competent authority shall determine that an appropriate assessment . . . of a proposed development, . . . is required if it cannot be excluded, on the basis of objective information, that the . . . proposed development, individually or in combination with other plans or projects, will have a significant effect on a European site.

(5) The competent authority shall determine that an appropriate assessment of . . . a proposed development, . . . is not required if it can be excluded, on the basis of objective information, that the . . . proposed development, individually or in combination with other plans or projects, will have a significant effect on a European site."

29. Sub-section (6) then provides for the notification of a determination made by a competent authority. However, it only expressly requires notification to be given where a competent authority makes a determination that an appropriate assessment is

required. When it does so, it must give notice of the determination, including reasons for the determination to the applicant, persons who have made submissions or observations and a party to an appeal. However, sub-section (c) then provides "paragraph (a) shall not apply in a case where the application for consent for the proposed development was accompanied by a Natura impact statement".

30. Whilst the above statutory scheme appears in its express terms to impose a mandatory obligation under sub-sections (1) and (2) on the Board to carry out a screening for appropriate assessment prior to giving consent for a all proposed developments, sub-section (6), in its express terms, only appears to require notice of its determination with reasons to be given to certain persons where it reaches a positive conclusion that an appropriate assessment is required and then relieves the Board of giving notice of its determination in circumstances where the application for consent was accompanied by a Natura impact statement. As I have already observed, it is not necessary, for the determination of this judicial review application, to decide the proper construction of these provisions as the Board accepted an appropriate assessment was required. It is, however, relevant to the subsequent issues in dispute in relation to the nature of the full appropriate assessment which must be carried out and the reasons which must be given therefor, to note that an appropriate assessment is the second stage of a two-stage process and only arises where the first stage or screening process has either determined (or it was at least implicitly accepted) that the proposed development, alone or in combination with other plans or projects, is likely to have a significant effect on a European site within the meaning of the low threshold set out by Advocate General Sharpston in *Sweetman*.

31. Unlike, in the case of an environmental impact assessment, s. 177V does not contain a stand alone definition of an "appropriate assessment". Sub-section 177V(1)

provides that "An appropriate assessment carried out under this Part shall include a determination by the competent authority under Article 6.3 of the Habitats Directive as to whether or not a . . . proposed development would adversely affect the integrity of a European site". The Board is the competent authority for the purposes of Part XAB in relation to a planning appeal. If as expressly required by s.177V(1) the determination to be made as part of the appropriate assessment is to meet the requirements of Article 6.3 of the Habitats Directive, it follows that the full appropriate assessment must meet the requirements of Article 6.3 of the Habitats Directive as construed in CJEU case law.

32. Sub-section 177V(1) also expressly requires the appropriate assessment to be carried out before consent is given for a proposed development. Further Sub-section (3) provides that "Notwithstanding any other provision in this Act [and other named Acts] the Board shall give consent to a proposed development"only after having determined that the . . .or proposed development shall not adversely affect the integrity of a European site". Sub-section (4) then "subject to the other provisions of the Act" permits consent to be given where modifications or conditions are attached and the Board has determined that "the proposed development would not adversely affect the integrity of the European site if it is carried out in accordance with the consent and the modifications or conditions attaching thereto. On the facts hereinno such determination was made in either appeal and s.177V(4) is not rdevan tto the issues to be determined.

33. As appears, the respective effects on the decision making process of the Board of the environmental impact assessment and the appropriate assessment (where both have to be carried out by the Board prior to taking its planning decision) are quite different. In carrying out an environmental impact assessment, the Board is required

to conduct an examination, analysis and evaluation of and identify the direct and indirect effects of the proposed developments on the matters specified in section 171A(1). However, the outcome of that examination, analysis, evaluation and identification informs rather than determines the planning decision which should or may be made. The Board has jurisdiction in its discretion to grant consent regardless of the outcome of the EIA though of course it impacts on how it should exercise its discretion.

34. In contrast, the Board, in carrying out an appropriate assessment under Article 6(3) and s.177V, is obliged, as part of same, to make a determination as to whether or not the proposed development would adversely affect the integrity of the relevant European site or sites in view of its conservation objectives. The determination which the Board makes on that issue in the appropriate assessment determines its jurisdiction to take the planning decision. Unless the appropriate assessment determination is that the proposed development will not adversely affect the integrity of any relevant European site, the Board may not take a decision giving consent for the proposed development unless it does so pursuant to Article 6(4) of the Habitats Directive. It is agreed that the decisions made by the Board herein were not taken pursuant to Article 6(4) of the Habitats Directive. Hence, for the purposes of these appeals, the Board was precluded from granting consent for the proposed developments unless, having conducted an appropriate assessment in accordance with Article 6(3), as construed by the CJEU, it reached a determination that the proposed development will not adversely affect the integrity of the European sites.

Nature of Appropriate Assessment

35. The requirements of an appropriate assessment and of the legal test that the proposed development "will not adversely affect the integrity of a European site"

have been considered by the CJEU in a number of cases. In *Waddenzee (Case C-127/02)* [2004] E.C.R. I-7405, at para. 61 of its judgment, it stated:

> ". . . under Article 6(3) of the Habitats Directive, an appropriate assessment of the implications for the site concerned of the plan or project implies that, prior to its approval, all the aspects of the plan or project which can, by themselves or in combination with other plans or projects, affect the site's conservation objectives must be identified in the light of the best scientific knowledge in the field. The competent national authorities, taking account of the appropriate assessment of the implications of mechanical cockle fishing for the site concerned in the light of the site's conservation objectives, are to authorise such an activity only if they have made certain that it will not adversely affect the integrity of that site. That is the case where no reasonable scientific doubt remains as to the absence of such effects."

36. This formulation as to the nature of the obligations imposed under Article 6(3) of the Habitats Directive has been affirmed and expanded upon in subsequent decisions of the CJEU. In *Commission v. Spain (Case C-404/09)* [2011] E.C.R. I-11853, the CJEU referred again to the obligation to identify the affects of the proposed development on the European sites conservation objectives "in the light of the best scientific knowledge in the field" and referred again to the test that "no reasonable scientific doubt remains as to the absence of such effects". At paras 99 and 100, the CJEU stated:

> "99. Under Article 6(3) of the Habitats Directive, an appropriate assessment of the implications for the site concerned of the plan or project implies that, prior to its approval, all aspects of the plan or project which

can, by themselves or in combination with other plans or projects, affect the site's conservation objectives must be identified in the light of the best scientific knowledge in the field. The competent national authorities are to authorise an activity on the protected site only if they have made certain that it will not adversely affect the integrity of that site. That is the case where no reasonable scientific doubt remains as to the absence of such effects (see, in particular, *Commission v Ireland*, at paragraph 243).

100. An assessment made under Article 6(3) of the Habitats Directive cannot be regarded as appropriate if it contains gaps and lacks complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the works proposed on the SPA concerned (see, to that effect, Case C-304/05 *Commission v Italy* [2007] ECR1-7495, paragraph 69."

37. More recently, the CJEU, in *Sweetman (Case C-258/11)*, provided further guidance as to what is required of an appropriate assessment at para. 44 where it stated:

"44. So far as concerns the assessment carried out under Article 6(3) of the Habitats Directive, it should be pointed out that it cannot have lacunae and must contain complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the works proposed on the protected site concerned (see, to this effect, Case C-404/09 *Commission v Spain*, paragraph 100 and the case-law cited). It is for the national court to establish whether the assessment of the implications for the site meets these requirements."

38. Whilst all parties accepted for an appropriate assessment to be lawful it must comply with the requirements set out by the CJEU, as summarised in the above extracts from the relevant judgments, there was some dispute as to what was required by reason, in particular, of the wording of s. 177V(1) which only provides that it shall "include" a determination by the competent authority under Article 6.3 of the Habitats Directive as to whether or not ". . . a proposed development would adversely the integrity of a European site" and the absence of any provision analogous to the definition of an environmental impact assessment as contained in section 171A(1) that such an assessment must include "an examination, analysis and evaluation carried out by . . . the Board".

39. Section 177V(1) must be construed so as to give effect to Article 6(3) of the Habitats Directive, and hence, an appropriate assessment carried out under the section must meet the requirements of Article 6(3) as set out in the CJEU case law. If an appropriate assessment is to comply with the criteria set out by the CJEU in the cases referred to, then it must, in my judgment, include an examination, analysis, evaluation, findings, conclusions and a final determinatio n.

40. It must be recalled that the appropriate assessment, ora stage two asses sment, will only arise where, in the stage one screening process, it hasbeen determined (or it has been implicitly accepted) that the proposed development meets the threshold of being considered likely to have significant effects on a European site. Where that is the position, then, in accordance with the preceding case law, the appropriate assessment to be lawfully conducted in summary:

(i) Must identify, in the light of the best scientific knowledge in the field, all aspects of the development project which can, by itself or in combination with other plans or projects, affect the European site in the

light of its conservation objectives. This clearly requires both examination and analysis.

(ii) Must contain complete, precise and definitive findings and conclusions and may not have lacunae or gaps. The requirement for precise and definitive findings and conclusions appears to require analysis, evaluation and decisions. Further, the reference to findings and conclusions in a scientific context requires both findings following analysis and conclusions following an evaluation each in the light of the best scientific knowledge in the field.

(iii)May only include a determination that the proposed development will not adversely affect the integrity of any relevant European site where upon the basis of complete, precise and definitive findings and conclusions made the Board decides that no reasonable scientific doubt remains as to the absence of the identified potential effects.

41. Hence in my judgment the full appropriate assessment required by s.177V(1) must include all of the above elements and not just the determination expressly referred to in the sub-section.

42. In *Sweetman (Case C-258/11)*, the CJEU also gave guidance as to the scope of the expression "adversely affect the integrity of the site". It is unnecessary to consider this in detail save to note that the Board is legally constrained as to how it should address the issue. The Court at para. 39 of its judgment, stated:

> "Consequently, it should be inferred that in order for the integrity of a site as a natural habitat not to be adversely affected for the purposes of the second sentence of Article 6(3) of the Habitats Directive, the site needs to be preserved at a favourable conservation status; this entails, as the

Advocate General has observed in points 54 to 56 of her Opinion, the lasting preservation of the constitutive characteristics of the site concerned that are connected to the presence of a natural habitat type whose preservation was the objective justifying the designation of that site in the list of SCIs in accordance with the Directive."

43. At para56, the Advocate General had stated:

"56. It follows that the constructive characteristics of the site that will be relevant are those in respect of which the site was designated and their associated conservation objectives. Thus, in determining whether the integrity of the site is affected, the essential question the decision-maker must ask is 'why was *this particular site* designated and what are its conservation objectives?' . . ."

Appropriate Assessment and Reasons

44. It is agreed that the Board is under an express obligation pursuant to s. 177V(5) of the PDA to give reasons for the determination made under Article 6(3) of the Habitats Directive as to whether or not the proposed development would adversely affect the integrity of a European site. The dispute relates to the extent or nature of the reasons which must be given. The applicant and the Department submit that where as in these appeals, the determination is that the proposed development would not adversely affect the integrity of any European site in view of the conversation objectives of those sites that the reasons must include complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the proposed development on the European sites in the light of the conservation objectives of the sites. It submits that such reasons are required in order

that the court may, in an application for judicial review, be able to ascertain whether or not an appropriate assessment has been conducted in accordance with the requirements of Article 6(3) of the Habitats Directive, as explained in the case law of the CJEU. They refer by analogy to the purpose of the requirement to state reasons as explained by the CJEU in *Mellor (Case C-75/08)* [2009] E.C.R. I-3799 in relation to an implied duty to give reasons for a negative screening decision under the Environmental Impact Assessment Directive. In that judgment, at paras. 57 to 60, the CJEU stated:-

> "57. It is apparent, however, that third parties, as well as the administrative authorities concerned, must be able to satisfy themselves that the competent authority has actually determined, in accordance with the rules laid down by national law, that an EIA was or was not necessary.
>
> 58. Furthermore, interested parties, as well as other national authorities concerned, must be able to ensure, if necessary through legal action, compliance with the competent authority's screening obligation. That requirement may be met, as in the main proceedings, by the possibility of bringing an action directly against the determination not to carry out an EIA.
>
> 59. In that regard, effective judicial review, which must be able to cover the legality of the reasons for the contested decision, presupposes in general, that the court to which the matter is referred may require the competent authority to notify its reasons. However where it is more particularly a question of securing the effective protection of a right conferred by Community law, interested parties must also be able to defend that right under the best possible conditions and have the possibility of deciding, with a full knowledge of the relevant facts, whether there is any point in applying to the courts.

Consequently, in such circumstances, the competent national authority is under a duty to inform them of the reasons on which its refusal is based, either in the decision itself or in a subsequent communication made at their request (see Case 222/86 *Heylens and Others* [1987] ECR 4097, paragraph 15).

60. That subsequent communication may take the form, not only of an express statement of the reasons, but also of information and relevant documents being made available in response to the request made."

45. They also relied upon the principles stated by Clarke J. in the High Court in *Christian v. Dublin City Council* [2012] 2 I.R. 506, in relation to the extent of the obligation to give reasons in Irish law. The underlying rationale and extent of the obligation as explained by Clarke J. appears to me to be similar if not identical to that explained by the CJEU in *Mellor*. In that judgment at p. 540, para. 78, Clarke J. explained it in the following terms:-

"The underlying rationale of cases such as *Meadows v. Minister for Justice* [2010] IESC 3 (in that respect) and *Mulhol land v An Bord Pleanála (No 2)* [2005] IEHC 306 is that decisions which affect a person's rights and obligations must be lawfully made. In order to assess whether a relevant decision is lawful, a party considering a challenge, and the court in the event of a challenge being brought, must have access to a sufficient amount of information to enable an assessment as to lawfulness to be made. What that information may be, may vary enormously depending on the facts under consideration or the nature of the decision under challenge. However, the broad and underlying principle is that the court must have access to sufficient information to enable the lawfulness of the relevant measure to be assessed."

46. I note that similar statement s of principle have been repeated by Clarke J in the Supreme Court in judgments with which other members of the Court agreed in relation to the extent or type of reasons which must be given in *Rawson v Minister for Defence* [1012] IESC 26 at para 6.8 , and *EMI Records (Ireland)& Ors v Data Protection Commissioner* 2013 IESC 34 at paras 6.3-6.5.

47. The Board, supported by Galetech, did not dispute the above principles or their applicability to its obligation to give reasons for its determination in the appropriate assessment. It referred, however, to the Irish case law, and in particular, that relating to s. 34 of the PDA and the obligation on the Board where it departs from its inspectors' recommendations to state "the main reasons" for the departure. In particular, the Board noted case law establishing not only the position that the reasons need not be discursive but also that they should be read from the perspective of an intelligent person who has participated in the proceedings and should give sufficient information to enable an appeal of the decision while demonstrating that the decision maker adequately turned his/her mind to the matters in issue (*O'Neill v. An Bord Pleanála* [2009] IEHC 202 at paras. 27 to 34). Also Counsel for the Board tied the interpretative approach urged by the respondent to the judgment of Kelly J. in *Mulholland v. An Bord Pleanála (No.2)* [2005] IEHC 306, [2006] 1 I.R. 453. In particular, he noted the comments of Kelly J. at p. 464, paras. 30 to 32, that while new obligations in respect of when reasons are given were introduced by s. 34 of the PDA, the jurisprudence in respect of the content of reasons given by a planning authority had been left unchanged by the legislature. Counsel submitted this position is indicative of a continuing legal position in Irish law on the content of reasons required to be given by a planning authority and, as such, requires that the same interpretation

should be given to the statutory obligations in respect of reasons arising under s. 177V(5) of the PDA.

48. On this issue I have concluded that the submission made on behalf of the applicant and Department is correct. First, the essential principle is that the reasons must be such as to enable an interested party assess the lawfulness of the decision and in the event of a challenge being brought, the court must have access to sufficient information to enable an assessment as to lawfulness to be made On the facts of this judicial review, the challenged decisions are those to grant planning permissions. However, the grounds of challenge include the failure of the Board to carry out a proper or lawful appropriate assessment under Article 6(3) as implemented in Ireland. For the reasons already stated in this judgment the Board could not make a lawful decision to grant planning permission unless it had reached a lawful determination, in an appropriate assessment lawfully conducted, that the proposed development would not adversely impact on the European sites in question. In accordance with the CJEU decision in *Sweetman*, it is for the national court to determine whether the appropriate assessment (including the determination) was lawfully carried out or reached, and to do so, it appears to me that the reasons given for the Board's determination in an appropriate assessment must include the complete, precise and definitive findings and conclusions relied upon by the Board as the basis for its determination. They must also include the main rationale or reason for which the Board considered those findings and conclusions capable of removing all scientific doubt as to the effects of the proposed development on the European site concerned in the light of the its conservation objectives. In the absence of such reasons, it would not be possible for a court to decide whether the appropriate assessment was lawfully concluded or whether the determination meets the legal test required by the judgments of the CJEU.

49. Secondly it appears to me that whilst the requirement for an appropriate assessment has been implemented in Ireland by amendment of the Planning Acts and requires to be carried out *inter alia* as part of the planning process the determination which must be made by the Board as competent authority it is not a "planning decision" in the sense used in the judgments relating to reasons relied upon by the Board. In such a planning decision the Board is exercising a jurisdiction with a very wide discretion. By contrast the determination it must make as part of an appropriate assessment is significantly narrower and legally constrained as explained in the CJEU cases cited. It also determines the Board's continuing jurisdiction to grant planning consent and therefore a decision which goes to its jurisdiction. The application of the principles set out by Clarke J in *Christian, Rawson* and *EMI* to the different types of decision results as envisaged therein in a requirement for reasons of a different order in relation to the different types of decison.

50. In reaching that conclusion I am not deciding that the findings and conclusions always have to be ones made by the Board itself. Where the Board appoints an inspector to prepare a report and the inspector carries out an appropriate assessment as part of his or her report, it may be that if the Board on consideration accepts the relevant findings made and conclusions reached by its Inspector in his or her report that the production of the report may satisfy some or all of the obligation of the Board to give reasons for its determination. This would depend upon the relevant facts.

51. It is now intended to apply the above principles and consider the lawfulness of the appropriate assessment including the determination made conducted by the Board in relation to each of the challenged decisions and the adequacy of the reasons given for its determinations. It is necessary to consider each decision separately.

Phase 1 Decision and Appropriate Assessment

52. The evidence adduced by the Board in relation to its phase 1 decision and the appropriate assessment conducted in that appeal is primarily the Board decision (PL 20.239759), the Board direction relating to that decision and the Inspector's Report and the documents referred to therein. The Board direction states that the submissions on this file and on the file relating to the phase 2 decision were considered at the same Board meeting of 8th August, 2013. I accept that fact.

53. The structure of the Board's decision is that it commences by stating its planning decision; it then identifies the matters considered; it then appears to include a number of paragraphs relating to the environmental impact assessment, it carried out; and then in two paragraphs identifies the appropriate assessment conducted and its reasons for the determination reached therein before returning to its final planning assessment and then sets out the conditions to be attached to the grant of permisson. Counsel on behalf of the Board submitted that this was the structure of the deci sion. The two paragraphs expressly referring to the appro priate assessmentare in the following terms:-

> "The Board completed an Appropriate Asses sment in relation to potential impacts on Natura 2000 sites and having regar d to the Natura Impact Statement submitted including mitigation measures proposed and the reports of the Inspector in relation [to] the current file and to file register reference number PL20.241069, the further information submitted to An Bord Pleanála and to other submissions on file the Board concluded that on the basis of the information available that the proposed development either individually or in

combination with other plans or projects would not adversely affect the integrity of any European site in view of the conservation objectives of this sites.

The Board did not agree with the Inspector's conclusions set out in section 32.3.6 of her report regarding the adverse effects of the proposed development on feeding/roosting/commuting area and natural flight lines of certain water birds in the light of the comprehensive additional data in this regard submitted as further information to the Board on the 6th day of June 2013. The Board did not agree with the further conclusion of the Inspector in relation to the adverse effects of the proposed development on the integrity of European sites at Lough Croan SAC (Site No. 000610) and Lough Croan SPA (Site No. 004139). The Board considered that it could not reasonably be concluded on the basis of the information on ground conditions and other material submitted; the nature of the proposed development and the use of normal good construction practice, that the integrity of these sites would be adversely affected by the proposed development."

54. Earlier in its decision, the Board had stated in relation to the Inspector's Report:-

"The Board generally adopted the report of the Inspector except in relation to the following items (see section 44E of the Inspector's Report):

- landscape and visual impacts
- hydrology and groundwater quality and flows, and
- bird movements in the area,

for the reasons set out below."

55. Section 44E of the Inspector's Report forms part of the environmental impact assessment conducted by the Inspector. It is not expressly part of the appropriate assessment conducted by her. The landscape and visual impacts are of no relevance to the appropriate assessment. Both hydrology and groundwater quality and flow and bird movements in the area are of direct relevance. The reasons included by the Board in its decision in the context of the environmental impact assessment as to why it did not adopt the report of the inspector in relation to these items are explained in the following terms:-

> "The Board considered the subject of hydrology and the potential for adverse impact by the proposed development on groundwater quality and flow in this karst area. The Board is satisfied taking into account the information supplied by the applicant including the resistivity test date submitted to the planning authority at further information stage that subject to normal good construction practice turbine foundations can be developed at this location without significant impacts on the hydrology or h ydrogeology of the area. The Board is satisfied on the basis of the survey inf ormation sub mitted to the planning authority (Chapter 8, EIS) and the further information submitted on 6th day of June 2013 to An Bord Pleanála in relation to bird movements in the area that the proposed development is unlikely to have any significant impacts on avifauna including species of water birds of conservation interest. While the Board reached this view independently of the applicant's proposed use of a radar detection system as an additional mitigant it is of the view that this system may be of valued as an aid to minimising impacts on specific bird species in the area."

56. I accept the submission made on behalf of the Board that those two paragraphs in the decision should not be considered as part of the appropriate assessment conducted by the Board but rather form part of the environmental impact assessment. However, that does not assist the Board in relation to the validity of the appropriate assessment conducted, save that it should not be considered as evidence of the application of an incorrect legal test as was submitted by the applicant.

57. The two paragraphs included by the Board in its decision in relation to the appropriate assessment must be considered in the context of that part of the Inspector's Report, which includes the appropriate assessment conducted by her and her findings and conclusion. It assists in identifying the relevant sites, their conservation objectives and potential impacts of the proposed developments.

58. The Inspector set out the appropriate assessment conducted by her at section 32 of her report. It commences by identifying ten Natura 2000 sites in the area of the proposed development. She then gives a short summary of the five nearest conservation sites, their objectives and the impacts on them in the following terms:-

> "32.1.2 The following is a short summary of the five conservation sites nearest the appeal site based on the site synopses.
>
> 1. Lough Croan - part turlough / part floating fen; supports multitude of highly diverse vegetation, including Red Data - Northern Yellow Cress; important ornithological site; species using site include Whooper Swan, Golden Plover, Greenland White-Fronted Goose (River Suck population), Shoveler, Bewick Swan, Wigeon, Gadwall, Teal, Mallard, Pintail, Lapwing, Curlew, Blackheaded Gull; wintering water fowl numbers are large and site is especially useful to dabbling

duck; important site due to its overall size, birdlife and rare plant communities and the species it supports;

2. Four Roads Turlough - very important site as refuge and feeding area for wildfowl and waders; bird numbers variable; can be very large; extensively used by Greenland White-Fronted Goose (River Suck population); other species include Wigeon, Teal, Shoveler; Bewicks Swan, Golden Plover, Lapwing, Curlew; occasional use by Whooper Swan;

3. River Suck Callows - extensive linear site (70km) that floods each winter; important for Greenland White-Fronted Geese (flock of international importance), Whooper Swan, Golden Plover, Wigeon, Lapwing, Mute Swan, Teal, Pintail, Curlew, Black-headed Gull as well as Otter and Hare. There is a wild fowl sanctuary north of Ballyforan;

4. Lough Funshinagh - classified as turlough; water levels fluctuate significantly; important for wintering waterfowl including Whooper Swan, Bewicks Swan, Golden Plover, Wigeon, Teal, Mallard, Shoveler, Pochard, Tufted Duck, Coot, Lapwing and Curlew and also used by River Suck, Greenland White-Fronted Geese;

5. Lisduff Turlough - important for waders and wintering wildfowl; Bewick Swan, Golden Plover, Dunlin, Pintail, Pochard, Lapwing, Curlew, Snipe.

The conservation objectives for these sites are:

- Lough Croan - (i) maintain Annex I habitat - Turlough; (ii) maintain or restore favourable conservation conditions for Shoveler, Golden

Plover and Greenland White-Fronted Geese; (iii) additional conservation interest for Wetlands and Water birds;

- Four Roads - (i) maintain Annex I habitat - Turlough; (ii) maintain or restore favourable conservation conditions for Golden Plover and Greenland White-Fronted Geese; (iii) additional conservation interest for wetlands and water birds;
- River Suck - (i) maintain special conservation interest for Whooper Swan, Greenland White-Fronted Geese, Wigeon, Lapwing, Wetlands and Water birds;
- Louth Funshinagh - (i) maintain Annex I habitat - Turlough;
- Lisduff Turlough - (i) maintain Annex I habitat - Turlough;

32.2 Direct and Indirect Impacts

32.2.1 I consider the main direct impacts will be from

- Displacement of Golden Plover and Lapwing in the short term due to construction noise and loss of habitat and in the long term due to the sight, noise and vibration of turbines;
- Disturbance of feeding/ roosting/ commuting area and interference with natural flight lines of Whooper Swans, Greenland White-Fronted Geese and Golden Plover;
- Bird strikes due to collision with wind turbines;

32.2.2 I consider the main indirect impact in the short and long term will be from

- Change in turlough habitat."

59. The Inspector then assessed the direct and indirect impacts under each of the above headings as follows:-

"32.3 Assessment

32.3.1 Displacement of Golden Plover and Lapwing within and in the vicinity of the site

32.3.2 Both the notes from the Bird Survey and the NIS state that Golden Plover were regularly observed near the site but not in the immediate area of the proposed development. Some 3,000 were observed in a flock at Lough Croan during the winter surveys and Lapwing were observed during the winter surveys including on wet grassland in the region surrounding Lough Croan. Table 8.5.4.1, (Ornithology Section, EIS) lists both species as being observed in and around the survey area but considered that neither species to be at risk. They are not discussed in the NIS. In view of the extensive, alternative habitat available in the area to this species, I consider that there is unlikely to be a significant long-term impact.

32.3.3 Disturbance of feeding/ roosting/ commuting area and natural flight lines of Whooper Swan, Greenland White- FrontedG eese, Golden Plover and Water birds

32.3.4 The conservation areas in the vicinity of the site support a large population of wintering birds, including Whooper Swan; Greenland White-Fronted Geese, Golden Plover and Water birds. All five are noted as using the River Suck, Four Roads Turlough, Lough Croan and Lough Funshinagh, whilst Lisduff Turlough supports Golden Plover and water birds. Greenland White-Fronted Goose are known to be highly faithful to a site. The Synopses describe them as based on the River Suck, but also note that they regularly utilise Four Roads Turlough, Lough Croan and Lough Funshinagh.

32.3.5 The conservation areas provide a cluster of wetland areas. They are supported by the non-conservation wetland sites in the area, including Thomas Street Turlough, Lough Feacle Loughs Cuilleenirwan and Coolagarry and the Ballyglass Canal, as well as the smaller flooded area adjoining the site. The data submitted refers to the large number of Whooper Swans at Lough Feacle and along the Ballyglass Canal. I am satisfied from my inspection and other appeal submissions that Whooper Swan also use Thomas Street Turlough and the flooded lands east of the site. Together, these wetlands provide an extensive network of feeding and roosting areas for the Whooper Swan and Greenland White-Fronted Goose.

32.3.6 The surveys do not address the interconnections between the conservation sites and provide no information on the movement of Greenland White-Fronted Geese in the area. The 2007/2008 census indicates that there are still significant numbers on the River Suck, notwithstanding a decline in numbers. Overall, I would be concerned that the level of information provided is lacking in detail, is unduly focussed at Lough Feacle, due to the separate application in this area and does not provide a definitive picture of the flight paths of protected species in the area of the site, as they move between the different wetlands in the area. Furthermore, I do not consider the applicant has provided adequate information to prove beyond reasonable scientific doubt that the wind farm will not impact on the feeding/ roosting/ commuting area and natural flight lines of Whooper Swan, Greenland White-Fronted Geese, Golden Plover and Water birds, and would not have an adverse impact on these protected species and on the integrity of the three conservation sites,

River Suck, Lough Croan and Four Roads Turlough, nearest the proposed wind farm.

32.3.7 Bird strikes due to collision with wind turbines

32.3.8 The applicant proposes to install a Merlin Avian Radar System that once trained, will provide constant monitoring of bird movements in the area of the site and eliminate potential bird strike by providing advance warning and allowing necessary turbine shut down. Information submitted (30/01/12) shows that the system is in use at a number of coastal wind farm sites including six in Europe. None of these sites would be similar to the area of the appeal site, which is an inland, moderately undulating site with a-network of wetland systems within a relatively small area, that support important populations of wintering birds. They would also not be similar in terms of weather patterns and topography. A report submitted by Appellant l, which reviews use of the radar system at a site in Sweden, also indicates problems of blind spots, echoes and ground clutter that can mask bird activity. DAHG have also expressed concerns as to the efficacy of the system. . I consider the information provided to date has not demonstr ated that the useof a radar system can effectively mitigate bird strikes at the site

32.3.9 It is argued that Whooper Swan generally fly athei ghts well below the minimum rotor sweep of 35m proposed and that the risk of collisionis therefore very small. A reduction in turbine height and concomitant reduction in rotor sweep will increase the risk of bird strike. I do not consider the proposed turbine height is acceptable in the mixed hilly, flat farmland, where the development is located and consider, therefore that this argument is not acceptable. Overall, I consider the applicant has not proven beyond reasonable

scientific doubt that adverse effects on the integrity of the site with respect to its impact on conservation species in terms of bird strike will not occur.

32.3.10 Changes in turlough habitat

32.3.11 Four of the conservation sites nearest to the appeal site are turloughs. Turloughs are seasonal lakes found in karstified limestone areas where rainfall disappears directly underground through the fissures and conduits in the rock. They fill when the groundwater rises in the autumn and empty as water levels fall in the spring and some are also fed by rivers and streams flowing into them. The water flow rate through karstified rock can be quite rapid and water from a turlough may flow underground to a spring at a rate of l 00m per hour or more. They have a unique flora and can be important bird haunts, in particular Greenland White-Fronted Geese, Whooper Swan, Widgeon, Teal and many waders. Turloughs are priority Annex I habitat (3180) and the habitat is almost unique to Ireland.

32.3.12 There are a number of turloughs on the lower lands immediately below the site as well as the cluster of conservation sites in the wider area. The nearest turlough conservation site is Lough Croan. It is an extensive, linear wetland about l.1k n from the nearest turbine. The turlough habitat, which underpins the conservation species in the area, and the potential impact of the development on the habitat is not discussed in the NIS.

32.3.13 The site is located on karst limestone and all rainwater falling on the site recharges directly to groundwater through the fissures and conduits in the underlying bedrock. The results of 2-D resistivity testing indicate that further investigations are required to determine the depth to competent rock and inform the design of the base, at ten of the turbine sites. At a number of sites,

excavation may extend below groundwater level. The potential to alter the pattern of recharge within the site as a result of the depth of excavation into the karstic layer or by the proposals to discharge surface water throughout the site is not addressed in the application. It is stated that these matters will be addressed following further investigations necessary to determine the detailed design of the turbine base. Turloughs are a relatively shallow habitat. A small alteration in the pattern of recharge has the potential to have a significant impact on the ecology of the area. Furthermore, given that turloughs generally occur in an area with an extensive groundwater system and where water can flow rapidly over significant distances, I consider that a higher burden of proof is required to demonstrate that the development will not have adverse impacts on Lough Croan the nearest conservation site to the proposed development. I consider that the development raises significant concerns. and it has notbeen established beyond reasonable scientific doubt that adverseeffe cts on the integrity of Lough Croan will not occur.

32.3.14 On the basis of the Appropriate Asse ssment, I consider it reasonable to conclude, on the basis of the information available, that the proposed development would adversely affect the integrity of the European sites Lough Croan Turlough SAC, Site No. 000610 and Lough Croan Turlough SPA, Site No. 004139 in view of these sites' conservation objectives."

60. As appears from the above, the appropriate assessment conducted by the Inspector cannot be considered as one which includes complete, precise and definitive findings and conclusions that are capable of removing all scientific doubt as to the effects of the proposed development on at least the five closest European conservation sites concerned. On the contrary, her assessments under the headings of:

(i) disturbance of feeding/roosting/commuting area and natural flight lines of Whooper Swan, Greenland White Fronted Geese, Golden Plover and water birds;

(ii) bird strikes due to collision with wind turbines; and

(iii) changes in turlough, habitat,

either identify *lacunae* in the information provided in the NIS or reach negative conclusions.

61. Subsequent to the Inspector's Report, the Board obtained further information. That information was a wintering bird survey undertaken between January and March 2013. It was furnished in response to a letter seeking further information from the Board dated 7th December 2012. The survey related to Whooper swans and Greenland white-fronted geese. Whilst, in the course of the hearing, there were submissions made by counsel for the Department and the Board for and against the adequacy of the survey as a response to the request dated 7th December, 2012, and in particular, the absence of any survey of Golden Plover, that issue need not be decided as part of the present consideration of the lawfulness or otherwise of the appropriate assessment conducted by the Board.

62. Returning to the evidence before the Court of the appropriate assessment conducted by the Board, taking into account the appropriate assessment conducted by the Inspector, it consists only of the four sentences in the two paragraphs in the Board Decision, together with what is stated by the Inspector in section 32 of her report, insofar as the Board has not disagreed with same. There is uncertainty as to how much of the appropriate assessment conducted by the Inspector or the findings made or conclusions reached by her is accepted by the Board in its decision by reason of the

general statement of acceptance save in relation to matters the matters specified but not by reference to the appropriate assessment part of the Inspector's report.

63. In the Board's own appropriate assessment, set out in its Decision, the first sentence is simply the statement of its determination and the identification of the material upon which the determination was based. Of the material identified, the only part which may constitute evidence of an assessment made by or on behalf of the Board, as distinct from information which the Board might have taken into account in making its assessment, is the Inspector's Report.

64. One of the consequences of the absence of any formal screening for an appropriate assessment pursuant to s. 177U as to whether the proposed development is likely to have a significant effect on the European site is that there is no identification, in advance of carrying out the appropriate assessment, of the reasons for which it is has been determined that the proposed developments meet the, admittedly low, threshold of being likely to have a significant effect on the European sites, having regard to their conservation objectives and require an appropriate assessment. On the facts herein, the Inspector, in her report, identified the potential direct and indirect effects in relation to wintering waterfowl and wadersunder the headings of 'Displacement', 'Disturbance of Feeding/Roosting/Commuting Areas and Interference with Natural Flight Lines and Bird Strikes', and in addition, a change in turlough habitat, the latter being by reason, principally, of the karst limestone underlying the site of the proposed development, the extensive ground water system and potential to alter the pattern of recharge.

65. In relation to the potential impact on the water fowl and waders by reason of disturbance of feeding/roosting/commuting area and interference with natural flight lines and potential bird strikes, the only evidence of any assessment conducted by the

Board itself is its statement in its decision that it "did not agree with the Inspector's conclusions set out in s. 32.3.6 of her report regarding the adverse effects of the proposed development on feeding/roosting/commuting area and natural flight lines of certain water birds in the light of the comprehensive additional data in this regard submitted as further information to the Board on the 6th day of June 2013". There is no evidence of any analysis or evaluation conducted by the Board of the further information or findings made by it.

66. In relation to the effects of potential changes in the turlough habitat identified by the Inspector in paras. 32.3.11 to 32.3.13 of her report, the Board does not, in its Decision, provide any evidence of any further or different assessment conducted by it and simply states it did not agree with the conclusion reached by the Inspector at para. 32.3.14 of her report that the proposed development would adversely affect the integrity of three of the named sites in the light of those sites' conservation objectives and then adds its conclusion "that it could not reasonably be concluded on the basis of the information on ground conditions and other material submitted; the nature of the proposed development and the use of normal good construction practice, that the integrity of these sites would be adversely affected by the proposed development".

Conclusion on Phase 1 Appropriate Assessment

67. My conclusion is that, on the evidence before the Court, the Board has failed to carry out an appropriate assessment which meets the requirements of Article 6(3) of the Habitats Directive, as explained by the CJEU. There is no evidence before the Court of an assessment conducted by the Board (or through its Inspector) which meets the criteria set out at paragraph 40 of this judgment and identifies, in the light of the best scientific knowledge in the field, all aspects of the proposed development which,

by itself, or in combination with other plans or projects which affect the European sites and contains complete, precise and definitive findings and conclusions which the Board considers capable of removing all reasonable scientific doubt as to the effects of the proposed development on the integrity of a number of Natura 2000 sites close to the site of the proposed development.

68. For the reasons set out earlier in this judgment, the determination made by the Board that the proposed development, individually or in combination with other plans or projects, would not adversely affect the integrity of any European site in view of the conservation objectives of those sites cannot be considered lawful unless such determination is made as part of an appropriate assessment which is lawfully conducted. Further, in the absence of such a lawful determination, the Board did not have jurisdiction to grant planning permission for the proposed development pursuant to s. 177V(3) of the PDA. It follows that the applicant is entitled to an order of *certiorari* of the Phase 1 decision.

69. I have also concluded on the same evidence that the Board failed to give reasons for its determination in the appropriate assessment which meetsth e requirements set out earlier in this judgment.

Phase 2 Decision and Appropriate Assessment

70. The evidence adduced by the Board in relation to the Phase 2 Decision is primarily the Board Decision (PL20.241069), the Board Direction relating to that Decision, and the Inspector's Report of Ms. Deirdre MacGabhann, which, whilst dated 6th February, 2012, it is agreed was, in fact, finalised on 6th February, 2013 and the documents referred to therein.

71. The Board Decision follows the same format as that in Phase 1. The Department and applicant laid emphasis upon the fact that, unlike the Decision in relation to Phase 1, there is no reference to the additional information by way of bird survey furnished to the Board on 6th June, 2013, either in the list of matters to which the Board had regard or in those paragraphs of the Decision which appear to constitute the appropriate assessment. I will return to this.

72. In relation to the appropriate assessment, the Board stated, in its Decision:

> "The Board completed an Appropriate Assessment in relation to potential impacts on Natura 2000 sites and, having regard to the Natura Impact Statement submitted, including mitigation measures proposed and the reports of the Inspector in relation [to] the current file and to file register reference number PL20.239759, the further information submitted to the planning authority on the 8th day of June, 2012 and to other submissions on file, the Board concluded, on the basis of the information available, that the proposed development, either individually, or in combination with other plans or projects, would not adversely affect the integrity of any European site in view of the conservation objectives of those sites. The Board did not agree with the Inspector's conclusions, as set out in section 11 of her report, regarding the adverse effects of the proposed development on bird species utilising the site in the light of the comprehensive data in this regard submitted with the application as referenced above. With regard to impacts on karst limestone bedrock the Board considered that it could not reasonably be concluded, on the basis of the information on ground conditions and other material submitted, the nature of the proposed development and the use of normal good

construction practice, that the integrity of these sites would be adversely affected by the proposed development. Finally, with regard to the impact of the proposed development on bats, the Board noted the substantial survey work completed prior to the application as well as the further information submitted to the planning authority on the 8th day of June, 2012 and considered that, subject to the implementation of the proposed mitigation measures, the residual impacts of the proposed development on bats would be minimal."

73. Firstly, in so far as relevant to dispose of the question as to whether the Board indicated that it did have regard to the bird survey furnished in relation to the Phase 1 appeal in June 2013, it appears to me that whilst there is no reference to this in the first paragraph above, it may be that it is being referred to in the first sentence of the second paragraph. The further information was provided to the Board in connection with the Appeal Reference No. PL. 20.239759, and this appeal appears to be referred to in the first sentence of the second paragraph as "the application as referenced above". I am accepting, for the purposes of this jud gment, that the Board did have regard to that additional data.

74. Similar to Phase 1, there is no formal screening determination. However,also similarly, the Inspector (who was a different Inspector to that appointed in respect of the Phase 1 appeal) conducted an appropriate assessment from paras. 10.124 to 10.163 of her report. The Inspector states at para. 10.128 that she followed the Department of Environment's guidance document on appropriate assessment and the European Commission's advice on appropriate assessment. She also refers to the earlier part of her report which, she states, sets out much of the information required for the appropriate assessment and then summarises the key aspects of the

development as it relates to the appropriate assessment. The Inspector considers in some detail the short and long-term, indirect and cumulative impacts which are likely to arise from the construction and operational phases of the development from paras. 10.136 to 10.153. She then considers certain mitigation issues. It is unnecessary to set these out in full. She identifies the residual impacts and states her appropriate assessment conclusion at paras. 10.160 to 10.163 in the following terms:

"10.160 Based on my assessment above, I consider that two key residual impacts remain. Firstly, in the absence of:

a. Detailed geo-technical investigations regarding the construction of the proposed turbine bases and sub-station in areas of karstified limestone and

b. Detailed design solutions for the site specific disposal of surface water arising on site,

10.161 There is a risk that the construction of the wind farm will impact on groundwater flow paths within the karst landscape which may in turn affect the hydrology/hydrogeology of the network of designated wetland systems (notably turloughs) in the vicinity of the site and their associated habitats and species.

10.162 Secondly, in the absence of detailed survey information on the use of the appeal site by bird species listed of Conservation Interest in the surrounding network of SPA's there is a risk that the proposed development will adversely impact on these species by virtue of disturbance, barrier effects to movement and collision risk arising from the construction and operation of the wind farm. These impacts could disrupt factors which maintain the favourable conditions for the species in the wider environment and in the network of SPAs in particular.

10.163 In view of the above, I consider that it is not reasonable to conclude on the basis of the information available that the proposed development would not individually, and in combination with other projects, adversely affect the integrity of the European sites in the vicinity of the appeal site (Lough Croan Turlough SPA, site code 004139; Four Roads Turlough SPA, site code 004140; River Suck Callows SPA, site code 004097) in view of the site's conservation objectives."

75. The Inspector, finally, in s. 11 of her report, sets out her overall summary and conclusions which, obviously, go beyond the ap propriate assessment. Paras. 11 .1 to 11.3 and 11.6 relate to the appropriate assessment:

"**11 SUMMARY AND CONCLUSION**

11.1 International and national policies actively support and encourage the growth of renewable energy sources and wind energy development in particular. However, the government's guidelines on wind energy development state that the implementation of renewable energy policies must have regard for the environment, specifically the legally binding requirements of the EU Directives on Birds and Habitats.

11.2 The appeal site lies within 15km of 14 statutorily designated European sites as part of the European Natura 2000 network and the site itself hosts bird species of national Importance and bird species which are listed of Special Conservation Interest in the 3 no. Special Protection Areas in the vicinity of the site. On the basis of the information provided by the applicant, I am not satisfied that the applicant has demonstrated that the proposed development will not adversely impact on bird species

utilising the site, by way of disturbance, barrier effects to movement and collision risk arising from the construction and operation of the wind farm. In particular, these impacts could disrupt factors which maintain the favourable conditions for the species in the wider environment and in the network of SPA's in particular.

11.3 The appeal site is underlain by karstified limestone bedrock and within the same groundwater bodies as the network of designated wetland habitats within 15km of the site. I do not consider that the applicant has adequately demonstrated that the proposed development will not adversely impact on groundwater flowpaths within the karst landscape or indirectly therefore the groundwater regime of the designated wetland habitats in the vicinity of the site.

. . .

11.6 In summary, I consider that the proposed development should be refused for the two above substantive reasons set out above, impact on hydrology/hydrogeology of related designated wetland systems and impact on bird species of Special Conservation Interest occurring on the site and in the surrounding network of Special Protection Areas."

76. The Board, in the Phase 2 Decision, also expressly stated that it:

". . generally adopted the report of the Inspector except in relation to the following items (see section 11):-

(1) hydrology and groundwater quality and flow, and

(2) bird movements in the area,

for the reasons set out below."

77. For the reasons already set out, whilst the Board is entitled to rely upon an appropriate assessment conducted by its Inspector, and whilst it has generally adopted the Inspector's Report, the findings made and conclusions reached by the Inspector in relation to the matters identified as potentially affecting the integrity of the Natura 2000 sites concerned, are such that the appropriate assessment in the Inspector's Report could not support a determination that the proposed development would not adversely affect the European sites concerned, having regard to their conservation objectives when considered by the Court in accordance with established judicial review principles.

78. Again, the first paragraph of the Board's Decision relating to the appropriate assessment is no more than its determination or conclusion that the proposed development, either individually or in combination with other plans or projects, would not adversely affect the integrity of any European site in view of the conservation objectives.

79. In the first sentence of the second paragraph, the Board again simply disagrees with the Inspector's conclusions regarding the adverse effects of the proposed development on the bird species using the conservation sites. There is no evidence of any assessment conducted by the Board which includes complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the proposed development on the Natura 2000 sites concerned, having regard to their conservation objective of supporting the wintering wild fowl and waders identified.

80. In relation to the potential hydrological/hydrogeological impacts of the construction of the proposed development on Natura 2000 wetlands systems in the vicinity of the site, and in particular, certain turloughs, the Board has not conducted

any assessment which includes complete and precise findings and conclusions capable of removing all reasonable scientific doubt as to the effect of the works proposed on the habitat of the Natura 2000 sites in the light of its conservation objectives, having regard, in particular, to the potential indirect effects and *lacunae* in the information supplied identified by its own Inspector.

Conclusion on Phase 2 Decision

81. My conclusion is that on the evidence before the Court the Board has not lawfully conducted an appropriate assessment in accordance with Article 6(3) of the Habitat Directive capable of supporting its determination. It follows, for the reasons already set out, that by reason of its failure to do so, it did not have jurisdiction to grant permission for the proposed development and the applicant is entitled to an order of *certiorari* of the Phase 2 Decision.

82. I have also concluded that it failed to give reasons for its determination in the appropriate assessment in the Phase 2 Decision in accordance with the principles set out in this judgment.

Other Issues

83. By reason of the conclusions reached on the principal issues in dispute, it is unnecessary to consider the further issues raised by the applicant.

Relief

84. There will be orders of *certiorari* of each of the decisions of the Board set out in paragraph 1 of this judgment.

Proposed Revisions to

Wind Energy Development Guidelines 2006

Targeted Review in relation to Noise, Proximity and Shadow Flicker – December 11th 2013

Comhshaol, Pobal agus Rialtas Áitiúil
Environment, Community and Local Government

Contents **Page**

Introduction

The Department of the Environment, Community and Local Government is currently conducting a targeted review of its Wind Energy Development Guidelines in relation to noise, proximity and shadow flicker. It is proposed to update the relevant sections of the existing Guidelines on these specific issues with the text set out in this document. There will also be a number of technical appendices developed to assist planning authorities in relation to noise assessment, monitoring and the setting of planning conditions.

As this is a targeted review focusing on specific issues, all the other sections of the Wind Energy Development Guidelines 2006 (including existing appendices) will remain in place. Concerns of possible health impacts in respect of wind energy infrastructure are not matters which fall within the remit of these guidelines as they are more appropriately dealt with by health professionals. However, the Department of Health has been made aware of the on-going review of the Wind Guidelines and any perspectives that they may have, relevant to the planning process, will be taken into account in finalising the revisions to the guidelines.

Written submissions on these proposed revisions to the Guidelines are invited up to February 21st 2014. Submissions on other sections of the Guidelines or additional matters will not be considered as it is not proposed to carry out a full review of the Wind Energy Development Guidelines at this time. Following consideration of the submissions made during this period of consultation, the revisions to the Guidelines will be finalised and issued to planning authorities under Section 28 of the Planning and Development Act 2000 (as amended).

Written submissions in relation to the Guidelines may be e-mailed or posted to:

Wind Submissions
Planning Section
Department of the Environment, Community and Local Government, Custom House, Dublin 1
Email: windsubmissions@environ.ie

In the interests of transparency, all submissions received (including the name of the person making the submission but not their contact details) will be made fully available online on the Department's website (www.environ.ie) and will be subject to the provisions of the Freedom of Information Acts 1997 and 2003. The onus is on persons making submissions not to include material of a private nature in the body of their submission.

Note: replace section 5.6 in the existing Guidelines with the draft text belo v

5.6 Wind Turbine Noise

5.6.1 Key Objective

The approach to the assessment and control of wind turbine noise recommended in these guidelines seeks to achieve a balance between the protection of residential amenity of neighbouring communities in the vicinity of wind energy developments, and facilitating the meeting of national renewable energy targets.

5.6.2 Sound and Noise

Sound can be described in terms of both its loudness [1] and its pitch (or frequency)[1]. Sound level (loudness) and sound frequency (pitch) can both be objectively measured using suitable equipment.

Noise is unwanted sound experienced by a listener, and given the 'unwanted' component it can have a strong subjective aspect.

5.6.3 Wind Turbine Noise

Unlike other sources of sound, a key characteristic of wind turbine sound is that the level of sound changes with wind speed. This distinguishes it from other types of commercially and industrially generated sound which can commonly be assessed in neutral conditions with little or no wind.

Because wind turbine sound varies with wind speed, specific measurement and analysis methods are needed to assess noise from either proposed or operational wind farms.

Sources of wind turbine noise

There are two distinct types of sound sources associated with the operation of wind turbines, namely, aerodynamic noise caused by turbine blades passing through the air and wind moving around the turbine tower, and mechanical noise created by the operation of mechanical elements in the hub and nacelle such as the generator (See Glossary of Terms).

In general, wind turbines produce very little noise when not turning. Some sound is produced from yaw motors, blade pitch actuators, brakes, and hydraulic pumps in the nacelle. (See Glossary of Terms).

The transformer at the base of the turbine is energised and may produce some sound. These sound sources are generally not as loud as aerodynamic noise and so they are rarely the causeof noise complaints.

Aerodynamic noise

[1] See glossary of terms

Aerodynamic noise from the interaction between wind and turbine blades is generally the dominant sound source experienced from wind turbines. Modern wind turbine blades begin to rotate and generate electricity at hub height wind speeds of around 3 to 4 metres per second, a speed referred to as the 'cut-in' wind speed. Maximum power output is generally reached at hub height wind speeds of around 10 metres per second, a speed referred to as 'rated power'.

From cut-in the sound level generally increases with wind speed and power output but differs in level depending on the type of turbine used. The two main types of turbine in use are pitch controlled[2] and stall[3] regulated turbines. The aerodynamic sound from a stall regulated turbine continues to increase with wind speed but a pitch regulated turbine's sound level generally reaches a maximum at rated power and remains constant, or decreases slightly as wind speed continues to increase.

Mechanical noise

Mechanical noise sources associated with wind turbines include the generator, gearbox and other parts of the drive-train. Mechanical noise can be tonal in nature in some cases. Improvements in gearbox design and the use of anti-vibration techniques have resulted in significant reductions in mechanical sound generation. The most recent direct drive machines have no high-speed mechanical components and therefore mechanical noise levels are generally reduced. Mechanical noise in the nacelle can be attenuated by conventional noise control methods. These include measures to reduce vibration forces in moving parts such as improved acoustic and vibration isolation around rotating equipment as well as improved sound insulation design of nacelle and machinery housings.

Special audible characteristics

These are the distinctive characteristics of noise which may be associated with both aerodynamic and mechanical wind turbine noise and which can cause annoyance at lower levels of intensity than a sound without such characteristics. Examples of special audible characteristics are tonality, impulsiveness, amplitude modulation, low frequency noise and infrasound. (See Glossary of Terms).

The assessment of these special audible noise characteristics presents challenges as illustrated in Marshall Day Acoustics report[4] .

---

[2] Pitch controlled turbine means it includes controls to rotate the angle of the blades depending on the wind speed in order to regulate output and rotational forces

[3] Stall regulated turbine means the blades are locked in place and do not adjust during operation. Instead the blades are designed to increasingly "stall" as wind speeds increase to control power output and protect the turbine from excessive wind speeds

[4] "Examination of the Significance of Noise in Relation to Onshore Wind Farms" Marshall Day Acoustics. (November 2013).

Note. It is intended to address the assessment of wind turbine noise in detail (including the potential for special audible characteristics) in the form of Best Practise Guidance to be contained in Appendix 1

5.6.4 Setbacks as a noise control method

The relationship between distance from a wind turbine or wind farm and noise effects is significantly variable and a direct correlation between separation distance and wind turbine generated sound levels is not clear . This is due to a variety of factors which are not directly related to distance but which can affect the transmission of sound, including:

- topography (hills have a major impact on sound propagation);
- ground cover types; and
- wind speed and direction.

Because of the lack of correlation between se paration distance and windturbine sound levels, the use of a defined setback of turbines from nois esensitive propertiesto control noise impacts is not considered appropriate.

Note - there should be a minimum separation of 500m between any commercial scale wind turbine and the nearest point of the curtilage of any property in the vicinity in order to provide for other amenity considerations e.g. visual obtrusion

This separation distance does not apply to small scale wind energy developments generating energy primarily for onsite usage.

5.6.5 Absolute Noise Limits as a control method

The use of an absolute noise limit is considered the most appropriate method to control noise impacts from wind energy development in proximity to noise sensitive properties and in areas of special amenity value. (See definition at 5.6.6 below). An absolute limit is easier to understand and apply than some other noise control methods while still providing an assessment that is based on expected and/or measured levels of noise from a wind farm. It offers the following advantages:

- It will provide a consistent level of protection for noise sensitive properties as wind turbine sound emission levels and site topography can be directly accounted for during a compliance assessment.
- It will take account of the number of turbines proposed for a particular project and the reduction in noise level as sound travels from the wind farm to noise sensitive properties.
- It will promote technological advances for reduction of turbine noise as it provides an incentive to manufacturers to design quieter turbines.

Wind turbine technology development has brought about continuous improvement in reducing noise and more recently provided the option of control interventions to fine tune the noise envelope through occasional power production reduction. The noise emissions of more recent wind turbine

odels are therefore generally less than those of equivalent older wind turbines and the trend of noise reduction with technology advancement is expected to continue, driven by planning regulation that controls the noise measured at adjacent noise sensitive properties.

5.6.6 What is a Noise Sensitive Property?

For the purposes of these draft guidelines, noise sensitive properties are defined as dwelling houses, including those which have planning permission but are not yet built, and other buildings for long term residential use such as nursing/retirement homes.

The definition also includes hospitals, schools and places of worship.

It may also include areas of special amenity value (and for which a quiet environment is desirable) the preservation of which is included as an objective in a development or local area plan.

5.6.7 What limit should apply?

A noise limit of 40dBA[5] attributable to one or more wind turbines, should be applied in order to restrict noise from wind turbines at noise sensitive properties.

This limit is an outdoor limit, which should not be exceeded at noise sensitive properties at any wind speed within the operational range of any turbine (i.e. from cut-in until maximum rated power level is reached). The limit applies to the combined sound level of all turbines in the area, irrespective of which wind farm development they may be associated with.

The limit will apply irrespective of time of day or night.

The outdoor limit of 40dBA takes into account World Health Organisation findings in relation to night time noise [6] and the review of international practice undertaken by Marshall Day Acoustics. The Marshall Day review indicates that 40dBA is commonly used in different countries as an absolute limit. Furthermore it may be considered to be in the lower end of the range of limits applied internationally, thus indicating a somewhat more stringent limit on wind energy development sound production than is generally the case.[7]

Generally the reduction in noise levels between the outside of a dwelling and the inside would be approximately 10dBA or more. Consequently an outdoors limit set at this level would generally

---

[5] Noise limits are expressed in terms of dB $L_{A90\ 10min}$ as determined in accordance with the Best Practice Technical Appendixes (to be developed). Refer to the Glossary of Terms for a definition of LA90 and to the Best Practice Technical Appendices for a description of how to apply the limits to either proposed or operational wind farms.

[6] "Night Noise Guidelines for Europe" World Health Organisation (2009)

[7] "Examination of the Significance of Noise in Relation to Onshore Wind Farms" Marshall Day Acoustics. (November 2013).

result in a noise level of about 30dBA or less inside a dwelling. This is based on the dwelling facad e and roof being of reasonable construction and assumes one window is ajar for ventilation.

5.6.8 Where does the limit apply?

The 40dBA noise limit applies to outdoors locations within the curtilage[8] of noise sensitive properties. For areas of special amenity value the 40dBA limit applies at the boundaries of such areas identified in a development/ loc al area plan.

5.6.9 Possible exceptions

Exception to Noise limit

Where there are a limited number of noise sensitive properties within thearea between the wind energy development and where the 4 0dBA no se limit applies, it may be possible for the development to proceed provided the owner(s) of the relevant properties are supportive of the development. Under these circumstances the owner of the property or properties must provide written confirmation to the satisfaction of the planning authority that they understand that their property may experience noise levels higher than the 40dBA noise limit and that they have no objection to the proposed wind energy development. In such circumstances the planning authority may consider departing from the 40dBA limit.

Exception to Setback

An exception may also be provided to the minimum 500m setback for amenity purposes, where the owner(s) of the relevant property or properties are content for the proximity of turbines to be less than the minimum setback. As with noise limits above they must provide written confirmation to the satisfaction of the planning authority that they have agreed to a reduced setback and have no objection to the proposed wind energy development.

5.6.10 Noise assessment methodology: Pre construction

Computer based noise prediction models can be used to estimate sound levels in the vicinity of a proposed wind energy development. The models can take account of various factors including the sound emission levels of the proposed turbines, wind speeds and directions, other climatic conditions, topography and ground conditions. Computed sound level predictions can also take account of the locations of all the turbines within a single wind energy development and the cumulative effect of all the turbines in a number of developments.

[8] The curtilage of a domestic dwelling house for the purposes of these draft guidelines is defined as the land immediately surrounding a dwelling house which is used for purposes incidental to the enjoyment of the dwelling house as such and excludes any open fields beyond the immediate surrounds of the dwelling. In the case of buildings associated with other noise sensitive properties the curtilage would be the area in the immediate surrounds of the relevant buildings.

rther details on noise assessment and an appropriate methodology for modelling noise to suit the application of the proposed absolute limit will be included as a Best Practice Technical Appendix within the final guidelines

5.6.11 Noise assessment methodology: Post construction

Once a wind farm is built and operating, noise levels can be measured at locations around the wind farm to confirm whether the facility complies with the applicable noise limit at noise sensitive properties.

The specific location of the measurements will vary from project to project. However, the measurements can often be carried out directly at noise sensitive properties. In cases where this is not practical because of the influence of extraneous noise, other monitoring locations may need to be chosen.

Further details on appropriate measurement methodologies will be included as a Best Practice Technical Appendix within the final guidelines.

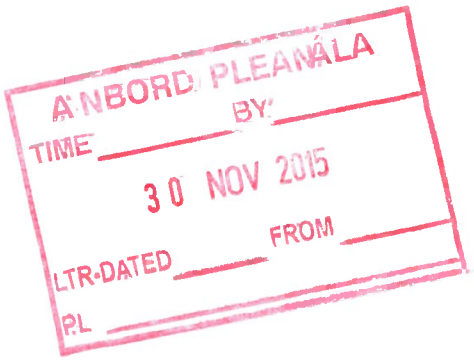
Note: replace section 7.5 in the existing Guidelines with the draft text be low

Para 7.5 Noise, including Construction Noise amended as follows

Conditions relating to the control and management of sound emissions from wind turbines are attached to planning permissions for wind energy development so as to protect the amenity of noise sensitive properties. Appropriate conditions in this context are set out in broad terms in Appendix 3[9]

Note: additional text *(in italics)* to para 1 section 7.7 in the existing Guidelines.

General environmental monitoring conditions should be avoided, apart from where specific requirements in relation to environmental matters are part of the planning permission. Effective monitoring is necessary to provide evidence of compliance with environmental conditions, such as noise limits or wildlife considerations. *It is recommended that planning applications make clear who the appropriate contact person would be to deal with any complaints or issues that might arise during both the construction and operation stages of a wind energy development. Further details on Monitoring and Appropriate Noise Control Post Construction will be contained in Appendix 2*



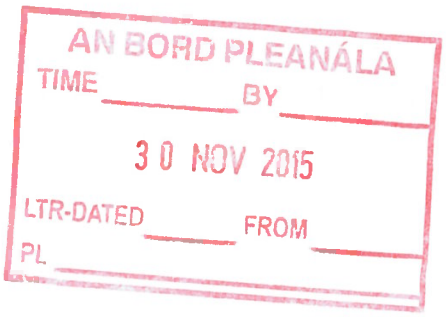
[9] Note. More detailed guidance regarding conditions will be provided as part of the final guidelines which will be adopted in 2014. This more detailed guidance will contain a model set of conditions.

Appendix 1 Best Practice in regard to Noise Assessment

This Appendix will outline the data and modelling requirements for wind turbine noise assessment. This is a work in progress and the final guidelines will provide an Appendix which contains a Best Practice Guide to the assessment and modelling of wind turbine noise (including special audible characteristics)

Matters to be referenced in Appendix 1 will relate to:

- Wind farm noise prediction methods;
- Special Audible Characteristics;
- Commissioning Requirements;
- Cumulative Noise.



Appendix 2 Monitoring and Appropriate Noise Control Post Construction

This is an indicative list of the matters to be examined in this Appendix in order to provide a robust monitoring and compliance regime post construction.

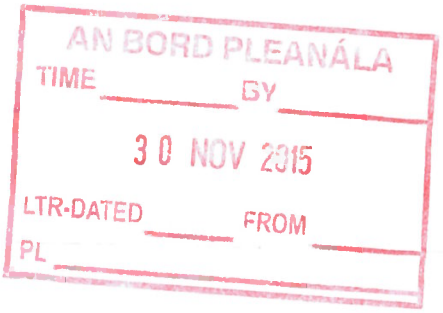
- Noise sensitive locations and representative locations.
- Noise survey methodology.
- Complaints (How to deal with under RMCEI[10]).
- Monitoring post commissioning (To be agreed with LA and time frame).
- Monitoring on foot of complaints (To be agreed with LA and time frame).
- Remedial actions (Time frame and measures needed).

[10] "Recommendations for Minimum Criteria for Environmental Inspection" – European Council Recommendation (2001/331/EC)

Appendix 3 Planning Conditions

The following is an indicative list of the matters which are to be reviewed in the context of appropriate conditions on a planning permission. It is intended to consider the provision of a number of model conditions for use by planning authorities.

- Limits on noise levels.
- Commissioning report on noise levels.
- Compliance noise surveys during life of wind farm.
- Remediation measures to be implemented if non- compliance is found.



Glossary of terms

LA90

LA90 is the A-weighted sound level that is exceeded for 90% of the measurement interval during a single measurement period. For example, during a measurement interval of 10 minutes, it is the level that is exceeded for nine minutes, thus excluding the highest level sounds which occur during the period. In practice the higher level sounds which are excluded would for example include a car passing, a dog barking or such other short-duration sounds unrelated to wind turbine-generated sound.

Sound Pressure

Sound pressure is measured in terms of decibels, which are generally denoted as dBA. The audible range of sound levels for humans is commonly considered to span from 0dBA, the hearing threshold, to about 120dBA, where sound levels can cause pain.

The decibel scale is logarithmic and not linear in nature. This means that if, for example, two instances of the same sound level occur at the same time and each has a sound level of 30dBA, their combined level will be 33dBA, and not 60dBA.

Average sound levels in city street traffic would typically be about 65 - 80dBA, while a conversation between a small number of people would be about 60dBA. A quiet office would be in the range 50-65dBA, while the humming of a refrigerator when running would be around 40dBA.

Sound Frequency

Sound comprises a range of frequencies extending from the very low, such as a rumble of thunder, to high frequencies, such as those generated by a clash of cymbals. Allowing for individual variation, the audible range of frequencies for the human ear is generally in the region of 20Hz to 20,000Hz.

Frequency weighting is the process by which sound levels are corrected to account for the non-linear frequency response of the human ear.

An A-weighted decibel measurement scale is frequently used as the basis for measurement and regulation as this scale is designed to approximate the response of the human ear over a range of frequencies.

Sound Impulsiveness

An impulsive sound has been described as "Transient sound having a peak level of short duration, typically less than 100 milliseconds". Impulsive sound s may typicaly take theform of bangs and thumps.

ıund Types:

Amplitude modulation

If a sound has a noticeable change in sound level which is of a regular and repeating nature, this sound pattern can in some cases be described as displaying amplitude modulation. An example would be the sound of waves crashing on the shore.

Low frequency noise

The definition of low frequency noise can vary, but it is generally accepted to be within the range of 10Hz to 200Hz. Traffic noise would be considered to have low frequency content.

Infrasound

Infrasound occurs naturally in the environment (e.g. wind sound effects) and is generated by many human activities and the operation of many types of machines (e.g. motor cars, washing machines etc.). Infrasound generally occurs at frequencies below the normal range of human hearing, namely less than about 20Hz.

Tonality

Tonal noise has been described as containing a discrete frequency component, most often of a mechanical origin. Examples can include the hum from an electrical transformer located at the base of a wind turbine, which can exhibit low frequency tones, the dial tone on a phone, a mid-frequency tone, and whistling which tends to comprise higher frequency tones.

Wind Turbines:

Anemometer

The anemometer measures the wind speed and transmits wind speed data to the Controller.

Blades

Blades lift and rotate when wind is blown over them, causing the rotor to spin. They are most commonly made of glass, reinforced plastic or wood epoxy, but can be made of aluminium or steel. Modern turbines typically have three blades. These may vary in rotor diameter from 35 metres upwards.

Blade Pitch

The pitch motor turns (or pitches) blades out of the wind to control the rotor speed, and to keep the rotor from turning in winds that are too high or too low to produce electricity.

Blade Pitch Actuator

Adjusts the pitch angle of a rotor blade.

Brake

The brake stops the rotor mechanically, electrically, or hydraulically, in cases of emergency.

Controller

The controller starts up the machine at wind speeds of about 8 to 16 miles per hour (mph) and shuts off the machine at about 55 mph. Turbines do not operate at wind speeds above about 55 mph because they can be damaged by the high winds.

Gear box

The gearbox connects the low-speed shaft to the high-speed shaft and increases the rotational speeds from about 30-60 rotations per minute (rpm), to about 1,000-1,800 rpm; this is the rotational speed required by most generators to produce electricity. The gear box is a costly (and heavy) part of the wind turbine and engineers are exploring "direct-drive" generators that operate at lower rotational speeds and don't need gear boxes.

Generator

The generator produces AC electricity. Off-the-shelf induction generators are generally used.

Nacelle

The nacelle sits atop the tower and contains the key mechanical components of the wind turbine including the gearbox, generator, controller, and brake. A yaw mechanism is employed to turn the nacelle so that the rotor blades face the prevailing wind

Pitch controlled turbine controls are included to rotate the angle of the blades depending on the wind speed in order to regulate output and rotational forces

Rotor

Blades and hub together form the rotor.

Stall regulated turbines have blades locked in place which do not adjust during operation. Instead the blades are designed to increasingly "stall" as wind speeds increase to control power output and protect the turbine from excessive wind speeds

Tower

Made from tubular steel, concrete, or steel lattice, the tower supports the structure of the turbine. Because wind speed increases with height, taller towers enable turbines to capture more energy and generate more electricity.

Transformer

This is a device for changing the voltage of the alternating current. Electricity is typically generated at less than 1000 volts by the wind turbine and the transformer "steps up" this voltage to match that of the national grid. This may be housed either inside or alongside the tower.

'ind direction determines the design of the turbine. Upwind turbines face into the wind while downwind turbines face away.

Wind vane

This measures wind direction and communicates with the yaw drive to orient the turbine properly with respect to the wind.

Yaw drive

Orients upwind turbines to keep them facing the wind when the direction changes. Downwind turbines don't require a yaw drive because the wind manually blows the rotor away from it.

Yaw motor

The yaw drive is powered by the yaw motor.

Note: replace section 5.12 in the existing Guidelines on Shadow Flicker with the draft text below.

5.12 Shadow Flicker

5.12.1 Background

Wind turbines, like other tall structures, can cast long shadows when the sun is low in the sky. The effect known as "shadow flicker" occurs where the rotating blades of a wind turbine cast a moving shadow which, if it passes over a window in a nearby house or other property results in a rapid change or flicker in the incoming sunlight. The effect will occur only for a short period during a given day and only under specific concurrent circumstances, namely when:

- The sun is shining and is at a low angle (after dawn and before sunset), and
- There is sufficient direct sunlight to cause shadows (cloud, mist, fog or air pollution could limit solar energy levels), and
- A turbine is directly between the sun and the affected property, and within a distance that the shadow has not diminished below perceptible levels, and
- There is enough wind energy to ensure that the turbine blades are moving.

The time period in which a neighbouring property may be affected by shadow flicker is completely predictable from the relative locations of the wind turbine and the property. Modern wind turbines have the facility to measure sunlight levels and to reduce or stop turbine rotation if the conditions that would lead to shadow flicker at any neighbouring property occur. Thus in practice with careful site design and appropriate mitigation, and most critica llythe useof appro priate equipment and software, no existing dwelling or other affected property (e.g. existing workplaces or schools) should experience shadow flicker.

5.12.2 Shadow Flicker Control

At distances greater than 10 rotor diameters, the potential for shadow flicker is extremely low, and accordingly this distance should determine a studyare a for the purposes ofmod dling the impact of potential shadow flicker. Every dwelling or other affected property within the 10 rotor diameter radius from each individual turbine should be included in the flicker study area.

Computational models can be used to accurately predict the strength and duration of potential shadow flicker during daylight hours for every day of the year. If a suitable shadow flicker prediction model indicates that there is potential for shadow flicker to occur at any particular dwelling or other potentially affected property, then a review of site design should take place involving the possible relocation of one or more turbines to explore the possibility of eliminating or substantially reducing the occurrence of potential flicker. Following such a review, if shadow flicker is not eliminated for any dwelling or other potentially affected property then measures which provide for turbine shut down to eliminate shadow flicker should be clearly specified. A Shadow Flicker Study for the purposes of modelling the impact of potential shadow flicker should accompany all planning applications for wind energy development

Note: replace section 7.14 in the existing Guidelines with the draft text below.

7.14 Shadow Flicker Planning Conditions

A condition should be attached to all planning permissions for wind farms to ensure that there will be no shadow flicker at any existing dwelling or other existing affected property, within 10 rotor diameters of any wind turbine. A further condition should be included which states that if shadow flicker does occur, then the necessary measures, such as turbine shut down during the associated time periods, will be taken by the wind energy developer or operator to eliminate the shadow flicker.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
IAN O' SULLIVAN	BARNADIVANE TEIRELTON
Miriam O'Sullivan	BARNADIVANE TEIRELTON
Caoimhe O'Sullivan	BARNADIVANE TEIRELTON
MICHAEL O SULLIVAN	GREENVILLE TEIRELTON
James Aherne	Tanelton
Linda Hayman	LISNACUDDY TEIRELTON.

AN BORD PLEANÁLA
TIME ______ BY ______
30 NOV 2015
LTR-DATED ______ FROM ______
PL ______

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Peter Kelleher	TOAMES WEST, MACROOM Land at Knockane 300 Metres From Turbine
Michael Kelleher	Knockane, Teerelton MACROOM Co. CORK
Deirdre Kenny.	Carrigboy Heights, Kilmichael. Macroom, Co Cork.
John M Sweeney	Gurraneraugh Lissarda Co Cork
Adam Chappell	TEERELTON MACROOM CO CORK.
Louise Chappell	Teerelton Macroom Co Cork.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Mary Healy	Dromleigh NS, Kilmichael
Linda Wiseman	Dromleigh N.S. Kilmichael
[illegible]	Dromleigh N.S.
Richard McSweeney	Coolcorrihy, Kilmichael
Geraldine Cotter	Carrigbey Kilmichael
Tadhg Cotter	Carrigbey Kilmichael

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Edmond Neville	Dunmarklin Lissarda
Margaret Neville	Dunmarklin, Lissarda Co Cork
Stephen Neville	Dunmarklin, Lissarda
Ken Neville	Clearagh Lissarda
Ian Neville	" "
Celina Hurley	Clearagh Lissarda

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Tim Delaney.	Lackenaigh Lissarda.
[illegible]	Dunmaklum Lissarda.
[illegible]	poulanargid
Eleanor O' Leary.	Clearagh, Lissarda.
Gerard O'Leary	Clearagh Lissarda.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Paddy Healy	Bengour West, Newcestown
Mathew Healy	Bengour West Newcestown.
Liam Healy	Bengour West, Newcestown
Shane Healy	Bengour Newcestown

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Orla Dorney	Manuday West, Kilmichael, Macroom, Co. Cork
Pat Dorney	Manuday West, Kilmichael, Macroom, Co. Cork.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Michéal Mastens	Carrigboy Kilmichil Macroom
Sean Cowen	
Julie Murray	Macroom Co. Cork.
Jerry Mastens	Carrigboy Kilmichil Macroom
Conchubhar Murray	Macroom Co. Cork.
Shane Mastens	Carrigboy Kilmichil Macroom

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Carol Hayes	Coppeen East Enniskean Co. Cork.
Michelle Hayes	Coppeen East Enniskean Co. Cork.
[illegible]	Lackinashinnagh
Stephanie Hayes	Coppeen East.
Terence McSweeney	Cladagh, Crookstown Co. Cork

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
[signature]	CARRAGGO/ HEIGHTS, KILMICHAEL, MACROOM, CO. CORK.
Catriona O'Leary	Cooldereihy South Kilmichael. Macroom, Co Cork
Gearóid O' Leary	Cooldereihy South Kilmichael Macroom Co. Cork
Joan Masters	Carrigboy Kilmichael Macroom
[signature]	Postmon Kilmichael
Gráinne Masters	Carrigboy Kilmichael Macroom

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
John Wood	Knockane Terelton Macroom
Karen Wood	Knockane Terelton Macroom
Noreen Wood	Knockane Terelton Macroom.
Michael Bradley	Coolderrihy Ki/Michael Macroom
Christy O'Callaghan	Cooldaw Lisheen
Jim McCarthy	Knockane Terelton

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Noelle Sheehan.	Moneygave. Coppeen, Enniskeane Co Cork.
Tessie Galvin	Gurranreigh Lissarda Co Cork.
Dan Galvin	Gurranreigh Lissarda Co Cork
Carmel O'Sullivan	Moneygave Coppeen Enniskeane Co. Cork.
Michael O'Callaghan	Moneygave, Coppeen Enniskeane Co. Cork.
Annette O Sullivan	Farranmareen Enniskeane Co Cork.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
[illegible]	[illegible]
[illegible]	[illegible]
Paidi Cahalan	Ballinbeema ballinhassig Co Cork
Terry Curtin	Bela Vista, LACKINASHINAGH ENNISKEANE Co CORK
Philip Curtin	Bela Vista Lackinashinagh Enniskeane.
Gearoid O Donovan	Farrannareen, enniskeane Cork

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Man O'Donovan	FARRANMAREEN ENNISKEANE
Kevin O' Donovan	Farranmareen, Enniskeane.
John O'Donovan	FARRANMAREEN Enniskeane.
Michael O'Donovan	Farranmareen Enniskeane
Rebecca O'Donovan	Farranmareen, Enniskeane, Co Cork.
Tim Corcoran	Dunmarkham Lissarda Co, Cork.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Mrs P Sliney	moneynacha Enniskeane Co. Cork
Ian Rymer	Monaynacreha Enniskeane Co Cork
Kathleen Hurley	Lackinashinagh Enniskeane, Co. Cork.
John Hurley	Lackinashinagh ENNISKEANE Co CORK
John GALVIN	COPPEEN ENNISKEANE Co CORK
Anne Bradley	Coolderrihy. Kilmichael. Macroom.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

AN BORD PLEANÁLA
TIME ______ BY ______
30 NOV 2015
LTR-DATED ______ FROM ______
PL ______

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Michael Goulding	Clonacow, Crookstown
Bridget Goulding	Clonacow, Crookstown
Marie O'Sullivan	Bordeview, Gurranereigh Lissarda, Co. Cork.
Pat Sheehan	Moneygave Coppeen Enniskane Co. Cork
Peggie Bradley	Cooldorrihy, Kilmichael Macroom
Peter Bosman	Knockane Teerelton Macroom

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
PAT GALVIN	DESHURE TERELTON MACROOM CO CORK
CHRISTOPHER HARLEY	MONEYCROHY ENNISKEANE CO CORK
SHIRLEY HARLEY	MONEYCROHY ENNISKEANE CO CORK
~~PATRICK MANNING~~	~~BARNADIVANE, TERELTON, MACROOM, CO CORK.~~
NOEL MANNING	BARNADIVANE TERELTON MACROOM CO CORK.
HUGH HARRINGTON	GREENVILLE, LISSARDA, MACROOM CO CORK.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Claire Norman.	Lisnacuddy Toorleton.
Oscar Harman	Lisnacuddy Toorleton
Ben Norman	Lisnacuddy Toorleton
Frank Lynch	Tandragee
Tim Cotter	Deshure Tandragee
Eileen Cotter	Deshure Tandragee

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Judith Buttimer	Moneycrohy, Enniskeane, Co Cork
Jimmy Buttimer	Moneycrohy Enniskeane Co Cork
Marie Lynch	AITREAIBH 57 Cork St Macroom. Co Cork
John Lynch	AITREAIBH 57 Cork ST MACROOM. Co Cork
Peter Lynch	129 Eagle Valley WILTON Cork
Conor Lynch	5 The Lawn MOUNTMASSEY MACROOM Co Cork

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
KATHLEEN HARRINGTON	GREENVILLE, LISSARDA, MACROOM, CO CORK.
MICHAEL ALLEN	MONEYCROHY, ENNISHEANE, CO CORK.
Anne Kelleher	Knockane Teerelton. Macroom
Pat Kelleher	Annabella Towers Macroom

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Noel Kelleher	Moneycusker, TOAMES MACROOM, Co CORK
Tony Kelleher	Knockane Terellon Macroom.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Ann Ó Callaghan	Coolduff Lissarda
Christy Ó Callaghan	Coolduff Lissarda.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Michael Cotter	Teshuke Teelton

AN BORD PLEANÁLA
TIME ______ BY ______
30 NOV 2015
LTR-DATED ______ FROM ______
PL ______

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Martina French	Hornhill Lissarda Kilmurry Co. Cork.
S French	HORNHILL LISSARDA
Denis Buckley	Moneygaff East Coppeen Enniskeane
Daniel Buckley	Bengour West, Enniskeane.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
DR. KATHY O' SULLIVAN	GURRANREIGH, LISSARDA, CO. CORK.
Mary O' Sullivan	Gurranreigh, Lissarda. Co. Cork.
Aidan Curtin	Gurranreigh Lissarda Co Cork
Marie Curtin	Gurranreigh Lissarda Co. Cork.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Hillary Neville	Dunmarkum Lissarda,
Edmond Neville	Dunmarkum Lissarda
Roan Neville.	Dunmarkum Lissarda,
Mary Dawson	Dunmarkum Cork
Philip Dawson	Dunmarkum Co Cork
Catherine Dawson	Dunmarkum, Co. Cork

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
PADRAIG CONWAY	HILLSIDE HOUSE LISWACUDDY TERELTON
THERESE CONWAY	HILLSIDE HOUSE LISWACUDDY TERELTON
SOPHIA CONWAY	HILLSIDE HOUSE LISWACUDDY TERELTON
PADDY CONWAY	HILLSIDE HOUSE LISWACUDDY TERELTON
KIERAN ~~KIERAN~~ O'LEARY	TOAMES EAST
EILEEN WHITE	KINNATH DUNMANWAY.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Colum Cronin	Munigave, Coppeen. Enniskeane.
Rose Cronin	Munigave, Coppeen.
Shane Cronin.	Munigave, Coppeen.
Denis Cronin	Munigave, Coppeen.
Diarmuid Cronin	Munigave, Coppeen
Marie Cronin	Munigave, Coppeen.

C.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
[redacted]	[redacted]
Richard Harley	Hornhill Lissarda
MARCel Harley	Ashmore House Hornhill Lissarda
Luke Harley	Hornhill Lissarda
Kaelin Harley	Hornhill Lissarda.
James Roche	Cooldaw Kilmurry.

Joe Noonan Solicitor

Noonan, Linehan, Carroll, Coffey Solicitors

54 North Main St

Cork

AN BORD PLEANÁLA
TIME ______ BY ______
30 NOV 2015
LTR-DATED ______ FROM ______
PL ______

WE THE, UNDERSIGNED, SUPPORT ANY APPEAL/OBSERVATION MADE ON OUR BEHALF TO AN BORD PLANALA BY OUR SOLICITOR, JOE NOONAN, RELATING TO, PLANNING REGISTER REFERENCE NUMBER: 14/6760, BARNADIVANE WIND FARM COMPRISING SIX NO. WIND TURBINES AND ALL ASSOCIATED WORKS.

NAME	ADDRESS
Angela McCarthy	[illegible]
Jamie McCarthy	" "
Alan McCarthy	" "
Cian McCarthy	" "
Tommy McCarthy	" "
Charlie McCarthy	" "

Consider solar energy and other green options to windfarms, say councillors in Cork

Thursday, November 26, 2015

Sean O'Riordan and Eoin English

Off-shore windfarms and the use of solar energy should be considered instead of placing large wind turbines near rural communities in Co Cork.

That's according to Cork county councillors, who have written a letter to An Bord Pleanála ahead of a decision it will make on a planning application for a windfarm on the Cork/Kerry border.

The letter is to be inserted into a report on the council's attitude to the windfarm between Ballyvourney, Co Cork, and Kilgarvan, Co Kerry, which is being compiled by its chief executive, Tim Lucey.

The 38-turbine windfarm is being proposed by ESB.

Cllr Andrias Moynihan (FF) got cross-party support when he called for councillors views to be included in Mr Lucey's report.

"It's important to note that increasingly, rural communities are becoming unhappy with the proliferation of windfarms, especially where they are moving off remote hillsides and in among communities.

"A question arises as to whether alternative options, such as solar energy of offshore windfarms should be examined into the future."

Councillors also put other issues into the letter. This included concern that there might be a potential threat to flora and fauna from the development.

Cllr Marcia D'Alton (Ind) said the windfarm may not comply with the habitats directive.

She said that there were three places in Co Cork, which formed part of the development site, which the council's own officials said could be impacted and these had not been properly addressed in the environmental impact statement which has been compiled by the developers.

"If Bord Pleanála is minded to grant planning permission for this application, then a realistic community fund should be put in place so that local communities can share in any potential profits," Cllr Moynihan said.

"This community fund should be realistic and not a token gesture, it should be a substantial amount of money," Cllr Bob Ryan (FF) said, insisting that this was contained in the council's submission to the planning appeals board.

Mr Lucey agreed to put all of the councillors comments in the submission to Bord Pleanála.

Meanwhile, DePuy Synthes will unveil details today of its plans to build a second wind turbine next to its new manufacturing facility at Loughbeg, Ringaskiddy, in Co Cork.

Wind turbine noise
British Medical Journal, 08 March 2012

Christopher D Hanning, honorary consultant in sleep medicine,
Sleep Disorders Service, University Hospitals of Leicester, Leicester General Hospital, Leicester LE5 4PW, UK

Alun Evans, professor emeritus
Centre for Public Health, Queen's University of Belfast, Institute of Clinical Science B, Belfast, UK

Seems to affect health adversely and an independent review of evidence is needed

The evidence for adequate sleep as a prerequisite for human health, particularly child health, is overwhelming. Governments have recently paid much attention to the effects of environmental noise on sleep duration and quality, and to how to reduce such noise.[1] However, governments have also imposed noise from industrial wind turbines on large swathes of peaceful countryside.

The impact of road, rail, and aircraft noise on sleep and daytime functioning (sleepiness and cognitive function) is well established.[1] Shortly after wind turbines began to be erected close to housing, complaints emerged of adverse effects on health. Sleep disturbance was the main complaint.[2] Such reports have been dismissed as being subjective and anecdotal, but experts contend that the quantity, consistency, and ubiquity of the complaints constitute epidemiological evidence of a strong link between wind turbine noise, ill health, and disruption of sleep.[3]

The noise emitted by a typical onshore 2.5 MW wind turbine has two main components. A dynamo mounted on an 80 m tower is driven through a gear train by blades as long as 45 m, and this generates both gear train noise and aerodynamic noise as the blades pass through the air, causing vortices to be shed from the edges. Wind constantly changes its velocity and direction, which means that the inflowing airstream is rarely stable. In addition, wind velocity increases with height (wind shear), especially at night, and there may be inflow turbulence from nearby structures—in particular, other turbines. This results in an impulsive noise, which is variously described as "swishing" and "thumping," and which is much more annoying than other sources of environmental noise and is poorly masked by ambient noise.[4,5]

Permitted external noise levels and setback distances vary between countries. UK guidance, ETSU-R-97, published in 1997 and not reviewed since, permits a night time noise level of 42 dBA, or 5 dBA above ambient noise level, whichever is the greater. This means that turbines must be set back by a minimum distance of 350-500 m, depending on the terrain and the turbines, from human habitation.

The aerodynamic noise generated by wind turbines has a large low frequency and infrasound component that is attenuated less with distance than higher frequency noise. Current noise measurement techniques and metrics tend to obscure the contribution of impulsive low frequency noise and infrasound.[6] A laboratory study has shown that low frequency noise is considerably more annoying than higher frequency noise and is harmful to health—it can cause nausea, headaches, disturbed sleep, and cognitive and psychological impairment.[7] A cochlear mechanism has been proposed that outlines how infrasound, previously disregarded because it is below the auditory threshold, could affect humans and contribute to adverse effects.[8]

Sixteen per cent of surveyed respondents who lived where calculated outdoor turbine noise exposures exceeded 35 dB LAeq (LAeq, the constant sound level that, in a given time period,

would convey the same sound energy as the actual time varying sound level, weighted to approximate the response of the human ear) reported disturbed sleep.[4] A questionnaire survey concluded that turbine noise was more annoying at night, and that interrupted sleep and difficulty in returning to sleep increased with calculated noise level.[9] Even at the lowest noise levels, 20% of respondents reported disturbed sleep at least one night a month. In a meta-analysis of three European datasets (n=1764),[10] sleep disturbance clearly increased with higher calculated noise levels in two of the three studies.

In a survey of people residing in the vicinity of two US wind farms, those living within 375-1400 m reported worse sleep and more daytime sleepiness, in addition to having lower summary scores on the mental component of the short form 36 health survey than those who lived 3-6.6 km from a turbine. Modelled dose-response curves of both sleep and health scores against distance from nearest turbine were significantly related after controlling for sex, age, and household clustering, with a sharp increase in effects between 1 km and 2 km.[11] A New Zealand survey showed lower health related quality of life, especially sleep disturbance, in people who lived less than 2 km from turbines.[12]

A large body of evidence now exists to suggest that wind turbines disturb sleep and impair health at distances and external noise levels that are permitted in most jurisdictions, including the United Kingdom. Sleep disturbance may be a particular problem in children,[1] and it may have important implications for public health. When seeking to generate renewable energy through wind, governments must ensure that the public will not suffer harm from additional ambient noise. Robust independent research into the health effects of existing wind farms is long overdue, as is an independent review of existing evidence and guidance on acceptable noise levels.

Notes

Cite this as: *BMJ* 2012;344:e1527

Footnotes

Competing interests: Both authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; CDH has given expert evidence on the effects of wind turbine noise on sleep and health at wind farm planning inquiries in the UK and Canada but has derived no personal benefit; he is a member of the board of the Society for Wind Vigilance; AE has written letters of objection on health grounds to wind farm planning applications in Ireland.

Provenance and peer review: Not commissioned; externally peer reviewed.

References

1. WHO. *Burden of disease from environmental noise. 2011.* www.euro.who.int/__data/assets/pdf_file/0008/136466/e94888.pdf.

2. Krogh C, Gillis L, Kouwen N, Aramini J. WindVOiCe, *a self-reporting survey: adverse health effects, industrial wind turbines, and the need for vigilance monitoring.* Bull Sci Tech Soc*2011;31:334*-9.

3. Phillips C. *Properly interpreting the epidemiologic evidence about the health effects of industrial wind turbines on nearby residents.* Bull Sci Tech Soc*2011;31:303*-8.

4. Pedersen E, Persson Waye K. *Perception and annoyance due to wind turbine noise—a dose-response relationship.* J Acoust Soc Am*2004;116:3460*-70.

5. Phillips C. *Properly interpreting the epidemiologic evidence about the health effects of industrial wind turbines on nearby residents.* Bull Sci Tech Soc*2011;31:303*-8.

6. Pedersen E, van den Berg F, Bakker R, Bouma J. *Can road traffic mask sound from wind turbines? Response to wind turbine sound at different levels of road traffic sound.* Energy Policy*2010;38:2520*-7.

7. Bray W, James R. *Dynamic measurements of wind turbine acoustic signals, employing sound quality engineering methods considering the time and frequency sensitivities of human perception.* Proceedings of Noise-Con 2011, Portland, Oregon, 25-27 July 2011. Curran Associates, 2011.

8. Møller M, Pedersen C. *Low frequency noise from large wind turbines.* J Acoust Soc Am*2010;129:3727*-44.

9. Salt A, Kaltenbach J. *Infrasound from wind turbines could affect humans.* Bull Sci Tech Soc*2011;31:296*-303.

10. Van den Berg G, Pedersen E, Bouma J, Bakker R. *Project WINDFARMperception. Visual and acoustic impact of wind turbine farms on residents.* FP6-2005-Science-and-Society-20. Specific support action project no 044628, 2008. www.rug.nl/wewi/deWetenschapswinkels/natuurkunde/publicaties/WFp-final-1.pdf.

11. Pedersen E. *Effects of wind turbine noise on humans*. Proceedings of the Third International Meeting on Wind Turbine Noise, Aalborg Denmark 17-19 June 2009. www.confweb.org/wtn2009/.

12. Nissenbaum M, Aramini J, Hanning C. *Adverse health effects of industrial wind turbines: a preliminary report.* Proceedings of 10th International Congress on Noise as a Public Health Problem (ICBEN), 2011, London, UK. Curran Associates, 2011.

13. Shepherd D, McBride D, Welch D, Dirks K, Hill E. *Evaluating the impact of wind turbine noise on health related quality of life.* Noise Health*2011;13:333*-9.

Clinical Review

The Royal Society of Medicine

Journal of the Royal Society of Medicine Open;
5(10) 1–5
DOI: 10.1177/2054270414554048

Diagnostic criteria for adverse health effects in the environs of wind turbines

Robert Y McMurtry[1,2] and Carmen ME Krogh[3]
[1]Schulich School of Medicine and Dentistry, Western University, London, Canada
[2]Prince Edward County, Family Health Team, Picton, Canada
[3]Independent health researcher, Killaloe, Canada
Corresponding author: Robert Y McMurtry. Email: rymcmurtry1@gmail.com

Summary

In an effort to address climate change, governments have pursued policies that seek to reduce greenhouse gases. Alternative energy, including wind power, has been proposed by some as the preferred approach. Few would debate the need to reduce air pollution, but the means of achieving this reduction is important not only for efficiency but also for health protection. The topic of adverse health effects in the environs of industrial wind turbines (AHE/IWT) has proven to be controversial and can present physicians with challenges regarding the management of an exposure to IWT. Rural physicians in particular must be aware of the possibility of people presenting to their practices with a variety of sometimes confusing complaints. An earlier version of the diagnostic criteria for AHE/IWT was published in August 2011. A revised case definition and a model for a study to establish a confirmed diagnosis is proposed.

Keywords

Case definition, clinical diagnosis, wind turbines, adverse health effects, symptoms

Introduction

In an effort to address climate change, governments seek to reduce greenhouse gases. Alternative and/or renewable energy, including wind power, has been proposed by some.[1,2] In 2008, the World Health Organization (WHO) states that governments must 'ensure that economic and social policy responses to climate change and other environmental degradation take into account health equity' while 'addressing the exclusionary policies and processes that lead to rural poverty, landlessness, and displacement of people from their homes'.[3] Have these admonitions been heeded? Evidence from adverse event reports indicates this may not be the case.[4–6] For this reason, rural physicians in particular must be aware of the possibility of people presenting to them with multisystem complaints that may be initially confusing (see 'Third-order criteria' section).[7] In order that reports become systematic, a uniform case definition is recommended.

Methods

A revised case definition was developed through a variety of methods including a review of self-reporting surveys published in the peer-reviewed literature and other sources; interviews and correspondence with neighbours reporting health effects; incident reports posted on the Internet; testimony under oath during judiciary proceedings of neighbours reporting health effects; personal dialogue with physicians; and grey literature. We searched PubMed and Google Scholar for articles published since 2000 that included the terms 'wind turbine health', 'wind turbine survey', 'wind turbine symptoms', 'wind turbine self reports' and 'wind turbine noise'. A PubMed search with the search term 'case definition' obtained additional background relating to case definitions for emerging diagnostic challenges.

Guidelines for deployment of diagnostic criteria

The healthcare practitioner applying the criteria must be licensed to take a medical or health history and to make a diagnosis. Physicians should consider that children are also affected but in ways sufficiently different from adults. This will require a separate discussion.

The most frequent complaints or symptoms are sleep disturbances or difficulty initiating sleep and/or difficulty with sleep disruption and annoyance producing increased levels of stress and/or psychological distress. Another frequent complaint relates to inner ear symptoms.

The variation of terms of complaints should be understood in the context of people using

many different words to describe similar health effects.[8]

Categories of diagnosis

1. Possible: a potential diagnosis is considered in the differential diagnosis.
2. Probable: cause of complaints is more likely than not related to adverse health effects in the environs of industrial wind turbines (AHE/IWT).
3. Presumed: no other explanation for the diagnosis of AHE/IWT can be found by history, physical and after appropriate investigations.
4. Confirmed: other diagnoses are very unlikely i.e. less than one chance in 20.

Probable diagnosis[7]

First-order criteria (all four of the following must be present)

(a) Domicile within up to 10 km from IWT.[9]
(b) Altered health status following the start-up of, or initial exposure to, and during the operation of IWT. There may be a latent period of up to six months.
(c) Amelioration of symptoms when more than 10 km from the environs of IWT.
(d) Recurrence of symptoms upon return to environs of IWT.

Second-order criteria (at least three of the following occur or worsen after the initiation of operation of IWT)

(a) Compromise of quality of life.
(b) Continuing sleep disturbance, difficulty initiating sleep and/or difficulty with sleep disruption.
(c) Annoyance producing increased levels of stress and/or psychological distress.
(d) Preference to leave residence temporarily or permanently for sleep and/or restoration.

Third-order criteria

Three or more of the following frequently occur or worsen following the initiation of IWT. If the symptoms described in second-order criteria (b and c) are present, no further symptoms or complaints are required for the probable diagnosis. Based on the authors' experience,[10] the following list provides an indication of the more common symptoms:

Neurological
- (a) Tinnitus
- (b) Dizziness
- (c) Difficulties with balance
- (d) Ear ache
- (e) Nausea
- (f) Headache

Cognitive
- (a) Difficulty in concentrating
- (b) Problems with recall or difficulties with recall

Cardiovascular
- (a) Hypertension
- (b) Palpitations
- (c) Enlarged heart (cardiomegaly)

Psychological
- (a) Mood disorder, i.e. depression and anxiety
- (b) Frustration
- (c) Feelings of distress
- (d) Anger

Regulatory disorders
- (a) Difficulty in diabetes control
- (b) Onset of thyroid disorders or difficulty controlling hypo- or hyper-thyroidism

Systemic
- (a) Fatigue
- (b) Sleepiness[7]

Presumed diagnosis

If following a fulsome history, physical and completed investigations no alternative explanation is apparent, and the criteria of probable diagnosis have been met, then a presumed diagnosis of AHE/IWT is warranted. AHE/IWT exists until proven otherwise.

Proposed confirmed diagnosis

Sleep disruption

The confirmation of AHE/IWT could be achievable by the following methods:

- Simultaneous monitoring of physiological parameters, i.e. a sleep study as well as noise energy exposure which ideally should be done in the home of both affected and unaffected individuals with simultaneous recording of sound energy inside and outside the home while capturing all frequencies including decibel and infra- and low-frequency noise and sound pressure levels.

- Blinding of the exposed individuals to control for visual impact is accomplished by testing during sleep.
- For sleep disturbance, measurements electrophysiologically[11] and by biomarkers.[12]

The complex physiological monitoring equipment required for a sleep study is not readily mobilised. Alternatively, sleep studies could be carried out in an established clinical sleep laboratory with a source of acoustic energy that accurately reflects the person's exposure to IWT.

Epidemiologic studies would be valuable to establishing the incidence and prevalence of AHE/IWT and have been recommended since 2006.[13] Schomer[14] comments that double-blinded studies could be done if industry co-operated by turning IWT off and on during noise energy and physiological measurements.

Differential diagnosis

An important differentiating point is the timing of the onset, and the impact of being away from home and the environs of IWT.

Significant improvement away from the environs of wind turbines and a revealed preference for sleeping away from home serve to distinguish between AHE/IWT from other conditions. One alternative explanation is a stressful home environment which might lead to restoration being more likely away from home. A history for family discord and other stressors should be elicited and ruled in or out.

Psychological issues and/or mood disorders may be simultaneously or independently present. If the situation appears more complex, then a referral to a clinical psychologist or psychiatrist might be considered.

Another possible consideration is chemical sensitivity or allergic reaction to contents in the home. The key differentiating feature would be the co-relation between the operation of IWT and symptoms. If the home is not a source of complaint or symptoms when IWT are not operating (see 'first-order criteria [b]' section), then chemical sensitivity or allergic response is highly unlikely.

Discussion

An earlier version of a case definition was published in August 2011[7] and has been cited in other publications.[15]

Research and other references have advanced the acknowledgement that symptoms are predictable[16] or can occur in some.[6,13,17–21]

Case definitions are frequently developed to assist with diagnosis of complex emerging issues. In some cases, establishing diagnostic criteria can be challenging[22,23] and can evolve over time.[24]

There are widespread reports of sleep disturbance in environs of IWT.[6,10,18] The WHO states 'Uninterrupted sleep is a prerequisite for good physiological and mental functioning...'[25]

Physiological monitoring employed in sleep studies of persons exposed to IWT are proposed to demonstrate measurable changes.[26] Quality of sleep, a 'prerequisite for good health'[27] can be measured objectively.

International reports of symptoms are consistent, and it is imperative that a systematic approach to diagnosis of AHE/IWT be adopted. The impacts can be significant resulting in many cases of people abandoning their homes temporarily or permanently.[4,5,17,21] Since Gohlke et al.[28] state: 'Wind energy will undoubtedly create noise, which increases stress, which in turn increases the risk of cardiovascular disease and cancer', home abandonment is a reasoned option.

This topic has been surrounded by competing claims and controversy[5,29–32] and has presented health professionals with management challenges. While the need for definitive evidence of the precise mechanism involved remains, with increased prevalence of wind energy facilities physicians can expect to see increasing numbers of rural patients reporting adverse effects.[17]

Conclusions

1. An updated version of the criteria for the diagnosis of AHE/IWT has been presented.
2. A change has been made in the third-order criteria which are commonly present but not necessary for a diagnosis to be made.
3. If the criteria for probable diagnosis are satisfied and investigation reveals no logical alternative to explain the health effects, a presumed diagnosis of AHE/IWT may be made.
4. A model for a study to establish a confirmed diagnosis has been proposed.

Declarations

Competing interests: None declared

Funding: None declared

Ethical approval: Not applicable

Guarantor: RYM

Contributorship: Both authors contributed equally to the research, writing, editing and review of this manuscript.

Acknowledgements: The authors thank those who shared their experiences and the reviewers for their comments during the review process. CMEK is a member of the Board of the Society for Wind Vigilance, an international federation of physicians, acousticians, health and other professionals. The Objects of the Corporation are safe siting of wind turbine facilities based on human health research; education through the dissemination of facts and references on the risk of adverse health effects of human exposure to industrial wind turbines; working constructively with interested parties to ensure that guidelines for wind turbine facilities will protect the health and safety of communities; and to achieve vigilance monitoring and long-term surveillance regarding the risks to health of industrial wind turbines.

Provenance: Not commissioned; peer-reviewed by Christopher Hanning

References

1. Green Energy and Economy Act. Green Energy and Green Economy Act, S.O. 2009, c. 12 - Bill 150, Government of Ontario 2009.
2. CPH 2025. *Climate Plan: A Holistic Plan*. Copenhagen: Denmark. See http://subsite.kk.dk/sitecore/content/Subsites/CityOfCopenhagen/SubsiteFrontpage/Business/Growth_and_partnerships/~/media/F5A7EC91E7AC4B0891F37331642555C4.ashx (last checked 17 March 2014).
3. CSDH. *Closing the Gap in a Generation: Health Equity Through Action on the Social Determinants of Health. Final Report of the Commission on Social Determinants of Health*. Geneva: World Health Organization, 2008: 4. See http://www.who.int/social_determinants/thecommission/finalreport/en/ (last checked 17 March 2014).
4. Krogh CME. Industrial wind turbine development and loss of social justice? *Bull Sci Technol Soc* 2011; 31: 321.
5. Phillips CV. Properly interpreting the epidemiologic evidence about the health effects of industrial wind turbines on nearby residents. *Bull Sci Technol Soc* 2011; 31: 303.
6. Shepherd D, McBride D, Welch D, Dirks KN and Hill EM. Evaluating the impact of wind turbine noise on health related quality of life. *Noise Health* 2011; 13: 333–339.
7. McMurtry RY. Toward a case definition of adverse health effects in the environs of industrial wind turbines: facilitating a clinical diagnosis. *Bull of Sci Technol & Soc* 2011; 31: 316.
8. Council for International Organizations of Medical Sciences (CIOMS). *Reporting Adverse Drug Reactions, Definitions of Terms and Criteria for Their Use*. Editorial Group: Bankowski Z, Bruppacher R, Crusius I, et al. ISBN 92 9036 071 2. See http://cioms.ch/publications/reporting_adverse_drug.pdf (last checked 17 March 2014).
9. Authors' note: The premise of considering effects up to 10 km is the result of adverse event reports up to 10 km and Health Canada's announcement of February 10, 2013 that regarding the Wind Turbine Noise and Health Study, noise measurements at residences will be made at distances up to 10 km from the wind turbines. See http://www.hc-sc.gc.ca/ewh-semt/consult/_2013/wind_turbine-eoliennes/research_recherche-eng.php (last checked 17 March 2014).
10. Krogh CME, Gillis L, Kouwen N and Aramini J. WindVOiCe, a self-reporting survey: adverse health effects, industrial wind turbines, and the need for vigilance monitoring. *Bull Sci Technol Soc* 2011; 31: 334.
11. World Health Organization. *Burden of Disease From Environmental Noise: Executive Summary*. Geneva: World Health Organization, 2011: xv.
12. Möller-Levet CS, Archer SN, Bucca G, Laing EE, Slak A, Kabiljo R, et al. Effects of insufficient sleep on circadian rhythmicity and expression amplitude of the human blood transcriptome. *Proc Natl Acad Sci* 2013; 110: E1132–E1141.
13. Chouard CH, Auquier L, Bounhoure J-P, et al. Académie nationale de médecine. Leretentissement du fonctionnement des éoliennes sur la santé de l'homme. Rapport et recommandations d'un Groupe de Travail March 14, 2006. See http://www.academie-medecine.fr/publication100035507/ (last checked 17 March 2014).
14. Schomer PD. Comments on recently published article "concerns about infrasound from wind turbines". *Acoust Today* 2013; 9: 4.
15. Google Scholar Citations, McMurtry RY, case definition adverse health effects, wind turbines. See https://www.google.ca/search?q=mcmurtry+college&oq=mcmurtry%2C+&aqs=chrome.5.69i57j0l5.10051j0j8&sourceid=chrome&espv=210&es_sm=93&ie=UTF-8#q=mcmurtry%2C+case+definition+adverse+health+effects%2C+wind+turbines (last checked 17 March 2014).
16. Howe B. *Low Frequency Noise and Infrasound Associated With Wind Turbine Generator Systems: A Literature Review. Ontario Ministry of the Environment RFP No. OSS-078696*. Mississauga, ON: Howe Gastmeier Chapnik Limited, 2010.
17. Jeffery RD, Krogh C and Horner B. Industrial wind turbines and adverse health effects. *Can J Rural Med* 2014; 19: 21–26.
18. Nissenbaum MA, Aramini JJ and Hanning CD. Effects of industrial wind turbine noise on sleep and health. *Noise Health* 2012; 14: 237–243.
19. Pierpont N. *Wind Turbine Syndrome: A Report on a Natural Experiment*. K-Selected Books: Santa Fe (NM): K Selected Books, 2009.
20. Harry A. *Wind Turbines, Noise and Health*, 2007. See http://docs.wind-watch.org/wtnoise_health_2007_a_harry.pdf (last checked 17 March 2014).
21. Hansard. Legislative assembly, first session, 39th parliament première session, official report. Standing Committee on Green Energy and Green Economy Act. 2009: G516, G-547. See http://www.ontla.on.ca/web/committee-proceedings/committee_transcripts_details.do?locale=en&Date=2009-04-15&ParlCommID=8856&BillID=2145&Business=&DocumentID=23801#P68_2644 (2009, last checked 24 September 2014).
22. Holmes GP, Kaplan JE, Gantz NM, Komaroff A, Schonberger LB, Straus SE, et al. Chronic fatigue

syndrome: a working case definition. *Ann Int Med* 1988; 108: 387–389.
23. Centers for Disease Control and Prevention. *Diagnosis, Diagnostic Challenges: Austism Spectrum Disorders.* See http://www.cdc.gov/ncbddd/autism/screening.html http://mc.manuscriptcentral.com/jro (last checked 28 January 2014).
24. Reeves WC, Lloyd A, Vernon SD, Klimas N, Jason LA, Bleijenberg G, et al. Identification of ambiguities in the 1994 chronic Fatigue syndrome research case definition and recommendations for resolution, and the International Chronic Fatigue Syndrome Study Group. *BMC Health Serv Res* 2003; 3: 25.
25. World Health Organization. Executive Summary, 3. Adverse health effects of noise. In: Berglund B, Lindvall T and Schwela DH (eds) *Guidelines for Community Noise.* Geneva: World Health Organization, 1999: ix.
26. Michaud D, Feder K, Bower T, et al. *Health Canada Impacts and Exposure to Sound From Wind Turbines: Updated Research Design and Sound Exposure Assessment*, 2013. See http://www.hc-sc.gc.ca/ewh-semt/consult/_2013/wind_turbine-eoliennes/research_recherche-eng.php (last checked 23 July 2014).
27. Hanning C and Evans A. Wind turbine noise. *BMJ* 2012; 344: e1527.
28. Gohlke JM, Hrynkow SH and Portier CJ. Perspectives editorial health, economy, and environment: sustainable energy choices for a nation. The National Institutes of Health (NIH). *Environ Health Perspect* 2008; 116: A236–A237.
29. Enbom H and Enbom IM. Infrasound from wind turbines: an overlooked health hazard. *Läkartidningen* 2013; 110: 1388–1389.
30. Salt AN and Lichtenhan JT. How does wind turbine noise affect people? *Acoust Today* 2014; 10: 20–28.
31. Jeffery RD, Krogh C and Horner B. Adverse health effects of industrial wind turbines. *Can Fam Phys* 2013; 59: 921–925.
32. Canadian Wind Energy Association. *Addressing Concerns with Wind Turbines and Human Health*, 2009. See http://windfacts.ca/your-health (last checked 17 March 2014).

Fran allagher - (DECLG)

From: Colette_Bonner@health.gov.ie
Sent: 11 November 2013 09:44
To: Frank Gallagher - (DECLG)
Subject: public health effects of wind turbines.
Attachments: heath effects of wid turbines.docx

Dear Frank ; This request was sent to me last week by CMO . Due to work commitments I have been only able to do a brief overview of the literature Tis evidence is based on Australian government National Healthand Medical research council (2009). I will update this at a later stage.

Dr Colette Bonner
Deputy C.M.O
Tel: 01 6353035
Fax: 01-6710148
Email: Colette_Bonner@health.irlgov.ie
MCRN03159

Effects of Noise from Wind Turbines on Human Health

The health and well-being effects of noise on people can be classified into three broad categories:

1. subjective effects including annoyance, nuisance and dissatisfaction;
2. interference with activities such as speech, sleep and learning; and
3. physiological effects such as anxiety, tinnitus or hearing loss (Rogers, Manwell & Wright, 2006).

Many factors can influence the way noise from wind turbines is perceived. The aforementioned study also found that being able to see wind turbines from one's residence increased not just the odds of perceiving the sound, but also the odds of being annoyed, suggesting a multimodal effect of the audible and visual exposure from the same source leading to an enhancement of the negative appraisal of the noise by the visual stimuli (Pedersen & Persson Waye, 2007). Another study of residents living in the vicinity of wind farms in the Netherlands found that annoyance was strongly correlated with a negative attitude toward the visual impact of wind turbines on the landscape. The study also concluded that people who benefit economically from wind turbines were less likely to report noise annoyance, despite exposure to similar sound levels as those people who were not economically benefiting (Pedersen et al, 2009).

In addition to audible noise, concerns have been raised about infrasound from wind farms and health effects. It has been noted that the effects of low frequency infrasound (less than 20Hz) on humans are not well understood (NRC, 2007). However, as discussed above, several authors have suggested that low level frequency noise or infrasound emitted by wind turbines is minimal and of no consequence (Leventhall, 2006; Jakobsen, 2005). Further, numerous reports have concluded that there is no evidence of health effects arising from infrasound or low frequency noise generated by wind turbines (DTI, 2006; CanWEA, 2009; Chatham-Kent Public Health Unit, 2008; WHO, 2004; EPHC, 2009; HGC Engineering, 2007). In summary:

- 'There is no reliable evidence that infrasounds below the hearing threshold produce physiological or psychological effects' (Berglund & Lindvall 1995).
- Infrasound associated with modern wind turbines is not a source which will result in noise levels which may be injurious to the health of a wind farm neighbour (DTI, 2006).

- Findings clearly show that there is no peer-reviewed scientific evidence indicating that wind turbines have an adverse impact on human health (CanWEA, 2009).

- Sound from wind turbines does not pose a risk of hearing loss or any other adverse health effects in humans. Subaudible, low frequency sounds and infrasound from wind turbines do not present a risk to human health (Colby, et al 2009).

- The Chatham-Kent Public Health Unit (Ontario, Canada) reviewed the current literature regarding the known health impacts of wind turbines in order to make an evidence-based decision. Their report concluded that current evidence failed to demonstrate a health concern associated with wind turbines. 'In summary, as long as the Ministry of Environment Guidelines for location criteria of wind farms are followed … there will be negligible adverse health impacts on Chatham-Kent citizens. Although opposition to wind farms on aesthetic grounds is a legitimate point of view, opposition to wind farms on the basis of potential adverse health consequences is not justified by the evidence' (Chatham-Kent Public Health Unit, 2008).

- Wind energy is associated with fewer health effects than other forms of traditional energy generation and in fact will have positive health benefits (WHO, 2004).

- 'There are, at present, very few published and scientifically-validated cases of an SACs of wind farm noise emission being problematic … the extent of reliable published material does not, at this stage, warrant inclusion of SACs … into the noise impact assessment planning stage (EPHC, 2009).

- While a great deal of discussion about infrasound in connection with wind turbine generators exists in the media there is no verifiable evidence for infrasound and production by modern turbines (HGC Engineering, 2007).

The opposing view is that noise from wind turbines produces a cluster of symptoms which has been termed Wind Turbine Syndrome (WTS). The main proponent of WTS is a US based paediatrician, Dr Pierpont, who has released a book 'Wind Turbine Syndrome: A report on a Natural Experiment, presents case studies explaining WTS symptoms in relation to infrasound and low frequency noise. Dr Pierpont's assertions are yet to be published in a peer-reviewed journal, and have been heavily criticised by acoustic specialists. Based on current evidence, it can be concluded that wind turbines do not pose a threat to health if planning guidelines are followed.

Effects of Shadow Flicker and Blade Glint on Human Health

Shadow flicker from wind turbines that interrupts sunlight at flash frequencies greater than 3Hz has the potential to provoke photosensitive seizures (Harding, Harding & Wilkins, 2008). As such it is recommended that to circumvent potential health effects of shadow flicker wind turbines should only be installed if flicker frequency remains below 2.5 Hz under all conditions (Harding, Harding & Wilkins, 2008).

According to the EPHC (2009) there is negligible risk of seizures being caused by modern wind turbines for the following reasons:

- less than 0.5% of the population are subject to epilepsy at any one time, and of these, approximately 5% are susceptible to strobing light;
- Most commonly (96% of the time), those that are susceptible to strobe lighting are affected by frequencies in excess of 8 Hz and the remainder are affected by frequencies in excess of 2.5 Hz. Conventional horizontal axis wind turbines cause shadow flicker at frequencies of around 1 Hz or less;
- alignment of three or more conventional horizontal axis wind turbines could cause shadow flicker frequencies in excess of 2.5 Hz; however, this would require a particularly unlikely turbine configuration.

In summary, the evidence on shadow flicker does not support a health concern (Chatham-Kent Public Health Unit, 2008) as the chance of conventional horizontal axis wind turbines causing an epileptic seizure for an individual experiencing shadow flicker is less than 1 in 10 million (EPHC, 2009). As with noise, the main impact associated with shadow flicker from wind turbines is annoyance.

In regards to blade glint, manufacturers of all major wind turbine blades coat their blades with a low reflectivity treatment which prevents reflective glint from the surface of the blade. According to the Environment Protection and Heritage Council (EPHC) the risk of blade glint from modern wind turbines is considered to be very low (EPHC, 2009).

In conclusion, wind turbines do not represent a threat to public health. However there is a consistent cluster of symptoms related to wind turbine syndrome which occurs in a number of people in the vicinity of industrial wind turbines. There are specific risk factors for this

syndrome and people with these risk factors experience symptoms. These people must be treated appropriately and sensitively as these symptoms can be very debilitating.

Dr. Colette Bonner
November 2013

Clinical Protocol for Evaluating Pathology Induced by Low Frequency Noise Exposure

Nuno A. A. Castelo Branco, M.D.
Senior Surgical Pathologist, R. Prof. Dias Amado, No. 5-1B, 1600-612 Lisbon, Portugal

Mariana Alves-Pereira, Ph.D.
Biomedical Engineer, Lusófona University, Campo Grande 376, 1749-024 Lisbon, Portugal

Augusto Martinho Pimenta, M.D.
Senior Neurologist, Julio de Matos Hospital, Av. do Brasil, 53, 1700-063, Lisbon, Portugal

José Reis Ferreira, M.D.
Senior Pneumologist, Clínica Doentes Pulmonares, Campo Grande, 4, 1700-092, Lisbon, Portugal

Summary
Segments of the general population who complain about infrasound & low frequency noise (ILFN) in their homes or in their workplaces continue to increase. These individuals often complain about similar sets of concurrent symptoms, and frequently attribute their ailments directly to ILFN exposure. Oftentimes, however, routine clinical evaluations of these individuals reveal no apparent dysfunction, and patients with persistent complaints are subsequently referred to psychology or psychiatry health professionals. The goal herein is to present an objective clinical protocol that scientifically evaluates these complaints, leading to the elimination of malingerers, and to the proper medical assistance of those developing ILFN-induced lesions.

PACS no. 43.40.Ng, 43.50.Qp, 43.80.Gx

Introduction

Since 1980, this team of scientists has studied the biological response to Infrasound & Low Frequency Noise (ILFN) exposure in both human populations [1-3] and laboratory animal models [4,5]. Over the decades, a valid clinical protocol has been established in order to ascertain a differential diagnosis for ILFN-exposed persons. The goal of this report is to list the medical diagnostic complementary tests relevant for evaluating ILFN-induced pathology. The rationale justifying each diagnostic test included in this ILFN clinical protocol will be but briefly described; extensive details can be found in the references provided.

2. Vibroacoustic Disease

The nosological entity triggered by excessive exposure to ILFN has been termed vibroacoustic disease (VAD) [1-3]. Despite the overwhelming antagonism with this nomenclature [6, for example], this time these authors have opted to use this specific name rather than "ILFN-induced pathology." VAD is a whole-body pathology characterized by proliferation of extra-cellular matrices (collagen and elastin) in the absence of an inflammatory process. VAD is a consequence of the disruption and restructuring of tissue and cellular components in order to maintain functional structural integrity in the presence of a mechanical agent of disease [further refs in 1]. The onset of VAD is insidious and frequently misdiagnosed. Individual ILFN exposure patterns dictate the time-evolution and ultimate severity of lesions, i.e., exposure times vs. recovery periods is of crucial importance, both for a prognostic view and for an appropriately detailed clinical history of ILFN exposure. Generally, ILFN exposure can be occupational or residential. With occupational exposures, recovery periods are usually certain, given the scheduled end of the workshift and the existence of weekends. Residential exposures, however, do not enjoy this type of recovery periods. The onset of VAD among individuals who are exposed to ILFN in their homes has been observed to be more rapid than those who are exposed to occupational ILFN. Over the past decades, there has been much controversy regarding several issues related to human health

and noise exposure, such as, a) the role and range of the human auditory system in ILFN-rich environments; b) the physiological pathways responsible for inadequate quality of sleep, for hypersensibility and intolerance to sound, and for cardiovascular disease; and c) the parameters used for measuring ILFN, and for assessing health impacts on ILFN-exposed populations. These issues have been extensively addressed by this team of researchers, and are currently beyond the scope of this report. The clinical protocol herein defined will provide family physicians and epidemiologists with objective, useful and clinically valid data that could ensure appropriate medical assistance to potential VAD patients.

3. Clinical Protocol for ILFN Exposures

3.1. Fundamentals

Auditory effects of ILFN exposure differ from the classical picture of hearing loss due to acoustic trauma. In VAD, patients report of *hearing too much*, and commonly lower the volume of audio devices (as opposed to increasing the volume to hear better). Whether in occupational or environmental ILFN exposures, early symptoms frequently include mood disorders and sleep disturbances. As overall exposure time accumulates, physicians are often confronted with a myriad of complaints referring to a wide variety of organs and systems. If unfamiliar with VAD, extensive complementary diagnostic tests will be prescribed to confirm or exclude a clinical suspicion. Most of these medical examinations will disclose negative or borderline values in ILFN-exposed patients, i.e. useless for a diagnosis. Generally, at this point, the clinician refers the patient to psychiatric care, with the likely suspicion of malingering or hypochondria. If, however, the physician suspects that ILFN may be playing a role in the patient's condition, the following complementary diagnostic tests are recommended for confirmation or exclusion of that hypothesis.

3.2. Echocardiogram

Thickening of the parietal pericardium was first observed in autopsy [7], then studied through echocardiography [8-10], and then confirmed through surgical pathology [11,12]. Pericardial thickening in the absence of diastolic dysfunction, and in the absence of an inflammatory process, is a hallmark response to ILFN exposure in humans. In VAD, pericardial echogenicity is visible with a GAIN setting of <45. See Fig. 1.

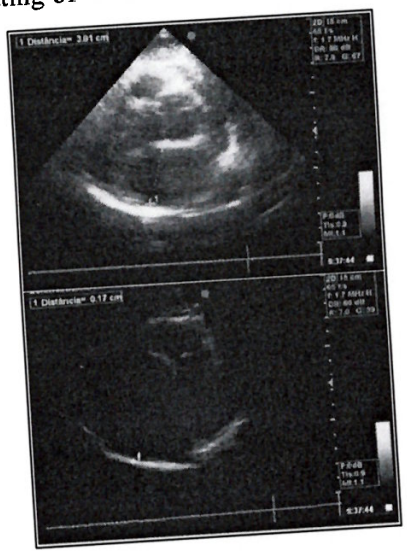


Figure 1 shows echocardiograms of Mr. R [13-15]. *Top image*: Gain set at 67. *Bottom image*: Gain set at 39.

Valve pathology may also be present, particularly in the more severe cases [8-10]. When thickened pericardia are observed through echocardiography, and no accompanying diastolic dysfunction exists, this indicates that significant ILFN exposure has taken place. Echo-imaging alone, however, is insufficient to establish a full VAD diagnosis. Firstly, because this organic manifestation is a *sign* of ILFN exposure, and not a nosological entity in itself. Secondly, no standardized methodology exists to numerically evaluate pericardial thickness. Hence, an undesirable element of subjectivity is introduced with this diagnostic test, making it susceptible to erroneous interpretations [16, for example] and/or deliberate manipulations. With the introduction of GAIN considerations, however, the degree of subjectivity of this imaging technique can be drastically reduced. Echocardiography is, therefore, the diagnostic method of choice for exposure confirmation and patient selection.

3.3. Brain MRI

This imaging test includes the evaluation of structural changes in brain tissues. Albeit non-specific to VAD, brain tissue changes in ILFN-exposed patients include: a) hyperintense foci in T2 of the subcortical and periventricular white

matter, basal ganglia and brain stem, and b) cerebral atrophy and dilation of the perivascular Virchow-Robin spaces. The most frequent locations for these appearances are the sublenticular and periatrial areas, and semioval centers [17]. While these situations may be expected in older populations, they are not desirable among working populations within the 35-55 year age range. VAD patients often exhibit low tolerance to this examination, and frequently remain bed-ridden for the rest of the day.

3.4. P300 Event Related Evoked Potentials

This non-invasive and objective neurological test evaluates nerve conduction times of processes that occur in the cerebral cortex. The P3 and N2 components of Event Related Potentials (ERP) are related to decision processing and stimuli classification, respectively, and increased latencies in these components have been associated with cognitive deterioration [18]. Longer latencies and lower amplitudes of ERP are observed in ILFN-exposed individuals [17]. VAD patients who present with the above described brain MRI lesions, also exhibit significant latencies of the endogenous N2 component, and significantly decreased amplitudes of the P3 component [17]. The presence of cortical lesions, confirmed through brain MRI, is associated with the changes seen in the P300 ERP values. Frontal topography and multipeaked appearances, as observed in these ILFN-exposed individuals, are similar to those found in the elderly and in patients with degenerative processes of the brain.

3.5. Brainstem Auditory Evoked Potentials

This is another non-invasive and objective neurological test. Here, nerve conduction times of processes occurring within the brainstem are evaluated. These can be altered due to demyelinization foci or expansive lesions. In ILFN-exposed individuals, brainstem auditory evoked potentials (BAEP) exhibit increased latencies in wave intervals III, IV and V [19]. Increased BAEP wave V interval latencies were correlated with hyperintense foci in T2 observed in the brainstem through MRI. VAD patients often develop balance disturbances, and these were associated with the existence of asymmetric values for the BAEP wave V interval latency, in both ears [20]. BAEP results suggest that some central dysfunction is occurring at the level of the brainstem. This is further corroborated by the results obtained in ILFN-exposed individuals through the next diagnostic test in this discussion.

3.6. PCO_2 respiratory drive evaluation

This evaluation is performed within the context of lung function tests. The neurological centers of the control of breathing are located in the brainstem. This control system modulates respiratory rate and respiratory (either inspiratory or expiratory) pressure depending on CO_2 concentration: as CO_2 concentration increases, so does the neurologically-controlled respiratory rate and respiratory pressure drive. In VAD patients, this increased respiratory rate and drive in the presence of increased CO_2 is only mildly observed [21]. The significance of this impaired partially autonomic reflex among ILFN-exposed individuals is not yet clearly understood, and raises many (more) questions regarding the pathophysiological mechanisms of this agent of disease. Nevertheless, it further corroborates the existence of brainstem lesions in ILFN-exposed humans. In respiratory functional tests, changes of metacholine sensitivity is common in VAD patients, probably related to the cellular changes in epithelial bronchial cells which present cellular cholinergic degranulation processes [1,4,22].

3.7. Bronchoscopy

This is a highly invasive examination, and is only recommended for forensic purposes within the context of legal proceedings. In VAD patients, vascular-like lesions are observed in both tracheal and bronchial trees, uniformly distributed bilaterally near the spurs [23]. Biopsies of these lesions were taken and studied with light and electron microscopy, revealing the same features observed before in ILFN-exposed human and animal samples, namely, organized proliferation of collagen and elastin in the absence of an inflammatory process [1,2]. Respiratory diseases (specifically, asthma-like conditions, and squamous cell carcinomas, particularly of the right lung) that develop among noise-exposed populations should be carefully considered in light of the morphological impact that ILFN has on respiratory tract structures [22].

3.8. Voice Acoustic Analysis

In a more recent area of study for VAD researchers, this non-invasive test evaluates changes in voice production as a consequence of

physiological changes of the laryngeal anatomical structure system. Morphological changes of the respiratory tract structures, such as those seen in ILFN-exposed human and animal models, can alter several parameters associated with voice acoustics. The fundamental frequency among three vowels significantly increases with increasing ILFN exposure time [24,25]. Changes in other voice acoustic parameters, such as jitter and shimmer perturbation measures, harmonic-to-noise ratio, and maximal phonational frequency range, also exhibited changes but these are not yet fully understood. Bronchoscopy imaging of the vocal folds revealed the same, above-mentioned, vascular-like lesions as observed in the tracheal and bronchial trees [23]. This non-invasive, voice acoustic evaluation that seems to reflect a dose-response pattern for VAD patients is poised to become an invaluable complementary diagnostic tool for ILFN-induced pathology

3.9. Hemostasis and Coagulation Parameters

In extreme stress environments, states of elevated hypercoagulability have been documented [26,27]. In ILFN-exposed individuals, spontaneous platelet aggregation was observed in the most severe cases while platelet aggregation values are abnormally high in all VAD patients. In ILFN-exposed persons the plasminogen activator inhibitor-1 (PAI-1) is significantly increased, even after several days post-ILFN exposure [27]. Increased PAI-1 is an indicator of fibronolysis inhibition and activation of coagulation, leading to situations of hypercoagulability.

3.10. Immunological Parameters

Autoimmune disorders, particularly collagenous diseases, are common among the more extensively ILFN-exposed individuals [1,9]. Lupus-prone animal models exposed to ILFN saw an earlier onset and higher mortality rate than the non-noise-exposed control group [28]. ILFN-exposed Wistar rats saw the pleural immune mechanisms highly impaired, when compared to non-exposed controls [5]. In ILFN-exposed animals, splenic $CD4^+$, $CD8^+$, and IgM^+B lymphocyte populations were decreased when compared to non-exposed controls [29]. In VAD patients, the number of circulating $CD8^+$ and $CD4^+$ T lymphocytes was significantly increased when compared to non-noise-exposed controls [30]. Pericardial fragments of VAD patients observed through electron microscopy revealed remarkable amounts of cellular debris due to non-programmed (non-apoptotic) cellular death [1,11,12]. It is, therefore, unsurprising that VAD patients often develop lupus, vitiligo, and other autoimmune disorders [1]. Hence, complementary examinations should include assays for antinuclear and anti-mitochondrial antibodies, C-reactive protein, and systemic lupus erythematous.

3.11. Exposure Histories

To assess the probability of a patient's symptomatology being associated with excessive ILFN, a comprehensive noise exposure history must be taken. Not only will this aid diagnosis, but it will also provide valuable prognostic information. Noise exposure histories begin with fetal exposure that will depend on the mother's profession and residential conditions. Residential exposures during childhood are of fundamental importance given the cellular processes that occur only during this time of human physical and emotional growth. The relative position of bedrooms in relation to noisy streets, potentially concurrent with occupational exposures, and a variety of different types of recreational noise exposures, must all be taken into account in order to obtain an accurate clinical picture of the patient. The development of ailments in the individual's history should be viewed in light of the chronological exposure to noise. Each type of individual noise source also provides key information for ascertaining the extent of the risk factors for VAD to which the individual has been exposed. Documentation of the time spent away from the ILFN-rich environments (i.e., recovery periods) is crucial for characterizing the evolution of VAD.

4. Health Impact of ILFN Exposure

Over the past decade, the health impact of ILFN exposure has taken on a new life due to the worldwide energy crisis and the urgent implementation of numerous industrial wind turbines (IWT), as decreed by many governments. Since little regard was initially given to the ILFN generated by these devices, it was not long after their installation that families living in their vicinity began having complaints. Recognizing the problematic situation, several agencies and institutions worldwide began conducting studies and publishing papers with titles suggesting that health impacts were being evaluated among these residential populations. However, upon a closer examination, significant design flaws rendered

most of these studies useless [31, for example]. While this may not have been a concerted effort, it is however a consequence of the perpetuation of an historical fact: acousticians, usually with no medical background, are generally greatly involved in noise-impact study designs. Therefore, information on the "health impacts," as rudimentarily obtained through questionnaires or interviews, is often deemed sufficient in order to establish whether or not ILFN is, *de facto*, having an impact on the health of human populations. Objective clinical evaluations of families and animals living in the vicinity of IWT are not commonly performed. ILFN is a physical agent of disease, and infrasound (<20 Hz) is internationally classified as *non-ionizing radiation*. The type of toxicological effect and the evolution and onset of disease caused by ILFN exposure is partially analogous to that caused by radiation. As with radiation exposure, a) the onset of ILFN-induced disease greatly depends on time-exposure patterns; b) different wavelengths of the physical agent affect different organs and tissues; c) the individual need not perceive the agent of disease for a pathological effect to occur within the body; and d) prior exposure histories are a determining factor of key importance. These facts *must* condition the design of studies purporting to evaluate the health impacts of residential ILFN exposure; but currently, they do not. It is recognized that there is an added cost to conducting real clinical studies among ILFN-exposed populations. The next obvious question, though, is: what is the added cost associated with continuing with the *status quo*. While this issue is way beyond the scope of this paper, it is nevertheless pertinent to recall episodes in humanity's recent history, having to do with asbestos, smoking and pesticides.

5. Looking Forward

In the interest of becoming a responsible and mature human society, activities that are deleterious to human health and wellbeing should not be hidden, obfuscated, or otherwise camouflaged. History unequivocally demonstrates the benefits of dealing outright with any potential human-health issue. It is recognized that the production of electrical energy has become the warp and woof of modern societies, and hence the urgency to procure new ways of harvesting energy that can be rapidly (and inexpensively) transformed into electrical energy. There need not be, however, such antagonistic, acrimonious and spiteful endeavors between ILFN disturbed families and *industry*, be it in of the energy, transportation, military, entertainment or manufacturing sectors of society. Having contextualized the issue, it is therefore of paramount importance that the clinical parameters used to evaluate the specific type of pathology caused by excessive ILFN exposure be the most appropriate for the job. Audiometry, electrocardiography, cortisol levels, and number of nighttime arousals are remarkably imprecise measures to clinically evaluate the adverse health impacts of noise exposure. Whether transverse or longitudinal epidemiological studies are planned, the clinical parameters required to ascertain the extent of ILFN-induced pathology have herein been outlined. It is hoped that this report will contribute to a symbiotic relationship between the ILFN-generating industries and world citizens.

Acknowledgement

VAD researchers profoundly and gratefully acknowledge the participation of all voluntary patients and *pro bono* scientists who have, over the decades, greatly contributed to this body of knowledge.

References

[1] M. Alves-Pereira, N.A.A. Castelo Branco: Vibroacoustic disease: Biological effects of infrasound and low frequency noise explained by mechanotransduction cellular signaling. Progress Biophysics & Molecular Biology 93 (2007) 256-279.

[2] N.A.A. Castelo Branco, M. Alves-Pereira: Vibroacoustic disease. Noise & Health 6 (2004) 3-20.

[3] N.A.A Castelo Branco: The clinical stages of vibroacoustic disease. Aviation, Space & Environmental Medicine 70 (1999) A32-9.

[4] N.A.A. Castelo Branco, E. Monteiro, A. Costa e Silva, J. Reis Ferreira, M. Alves-Pereira. Respiratory epithelia in Wistar rats born in low frequency noise plus varying amounts of additional exposure. Revista Portuguesa de Pneumlogia IX (2003) 481-492. europepmc.org/abstract/MED/15190433

[5] M.J.R. Oliveira, A. Sousa Pereira, A.P. Águas, E. Monteiro, N.R. Grande, N.A.A. Castelo Branco. Effects of low frequency noise upon the reaction of pleural milky spots to mycobacterial infection. Aviation, Space & Environmental Medicine 70 (1999) A137-40.

[6] S. Chapman, A. St. George: How the factoid of wind turbines causing 'vibroacoustic disease' came to be 'irrefutably demonstrated'. Australian & New Zealand Journal of Public Health 37 (2013) 244-49.

[7] N.A.A. Castelo Branco: A unique case of vibroacoustic disease. A tribute to an extraordinary patient. Aviation, Space & Environmental Medicine 70 (1999) A27-31.

[8] W. Marciniak, E. Rodriguez, K Olsowska, I. Botvin, A. Arauj, F. Pais, C. Socares Ribeiro, A. Bordalo, J. Loureiro, E. Prazeres de Sá, D. Ferreira, M.S.N. Castelo Branco, N.A.A. Castelo Branco: Echocardiography in 485 aeronautical workers exposed to different noise environments. Aviation, Space & Environmental Medicine 70 (1999) A46-53.

[9] R. Torres, G. Tirado, A. Roman, R. Ramirez, H. Colon, A. Araujo, F. Pais, J.M.C. Lopo Tuna, M.S.N. Castelo Branco, M. Alves-Pereira, N.A.A Castelo Branco: Vibroacoustic disease induced by long-term exposure to sonic booms. Proc. Internoise 2001, 1095-98 (ISBN: 9080655422).

[10] A. Araujo, J. Carranca, M. Alves-Pereira, N.A.A. Castelo Branco: Echocardiography in vibroacoustic disease. Proc. 12th ICSV 2005, No.567 (9 pages).

[11] N.A.A. Castelo Branco, A.P. Águas, A. Sousa Pereira, E. Monteiro, J.I.G Fraggata, F. Tavares, N.R. Grande: The human pericardium un vibroacoustic disease. Aviation, Space & Environmental Medicine 70 (1999) A54-62.

[12] N.A.A. Castelo Branco, J.I. Fragata, A.P.Martins, E. Monteiro, M. Alves-Pereira: The pericardium in vibroacoustic disease I – morphological features. Proc. 12th ICSV 2005, No.568 (9 pages).

[13] M. Alves-Pereira, N.A.A. Castelo Branco: In-home wind turbine noise is conducive to vibroacoustic disease. Proc. 2nd Intl Meet Wind Turbine Noise, 2007, Paper No. 3 (11 pages).

[14] N.A.A. Castelo Branco, T. Costa e Curto, L. Mendes Jorge, J. Cavaco Faísca, L. Amaral Dias, P. Oliveira, J. Martins dos Santos, M. Alves-Pereira: Family with wind turbines in close proximity to home: follow-up of case presented in 2007. Proc. 14th Intl Meet Low Frequency Noise, Vibration and its Control, 2010, 31-40.

[15] N.A.A. Castelo Branco, M. Alves-Pereira, A.J.F. Martinho Pimenta, J. Reis Ferreira: Low frequency noise-induced pathology: Contributions provided by the Portuguese wind turbine case. EuroNoise 2015, paper no. 602.

[16] ATSDR – Agency for Toxic Substance and Disease Registry: Expert review of the Vieques heart study. Summary report for the Vieques heart study expert panel review. (2001) Contract No. 200-2000-10039. www.atsdr.cdc.gov/sites/vieques/heart_study_summary.html.

[17] M.G. Pimenta, A.J.F. Martinho Pimenta, M.S.N. Castelo Branco, N.A.A. Castelo Branco: ERP P300 and brain magnetic resonance imaging in patients with vibroacoustic disease. Aviation, Space & Environmental Medicine 70 (1999) A107-14.

[18] L. Gomes, A.J.F. Martinho Pimenta, N.A.A. Castelo Branco: Effects of occupational exposure to low frequency noise on cognition. Aviation, Space & Environmental Medicine 70 (1999) A115-18.

[19] J. H. Marvão, M.S.N. Castelo Branco, A. Entrudo, N.A.A. Castelo Branco: [Changes of the brainstem auditory evoked potentials induced by occupational vibration]. Jornal da Sociedade das Ciências Médicas 149 (1985) 478-486 (In Portuguese).

[20] A.J.F. Martinho Pimenta, M.S.N. Castelo Branco, N.A.A. Castelo Branco: Balance disturbances in individuals with vibroacoustic disease. Aviation, Space & Environmental Medicine 70 (1999) A100-6.

[21] J. Reis Ferreira, J. Albuquerque e Sousa, P. Foreid, M. Antunes, S. Cardoso, M. Alves-Pereira, N.A.A. Castelo Branco: Abnormal respiratory drive in vibroacoustic disease. Revista Portuguesa de Pneumologia XII (2006) 369-74. www.scielo.oces.mctes.pt/pdf/pne/v12n4/v12n4a03

[22] N.A.A. Castelo Branco, J. Reis Ferreira, M. Alves-Pereira: Respiratory pathology in vibroacoustic disease-25 years of research. Revista Portuguesa de Pneumologia XIII (2007) 129-135. www.scielo.oces.mctes.pt/pdf/pne/v13n1/v13n1a08

[23] J. Reis Ferreira, M. B. Monteiro, F. Tavares, I. Serrano, E. Monteiro, C. P. Mendes, M. Alves-Pereira, N.A.A. Castelo Branco: Involvement of central airways in vibroacoustic disease. Revista Portuguesa de Pneumologia XII (2006) 93-105. www.scielo.oces.mctes.pt/pdf/pne/v12n2/v12n2a01

[24] A. P. Mendes, I. Bonança, A. Jorge, M. Alves-Pereira, N.A.A. Castelo Branco, M. Caetano, N. Oliveira, A. Graça, C. Santos, R. Ferraria: Voice acoustic profile of males exposed to occupational infrasound and low frequency noise. Laryngology & Voice. 4 (2014) 12-20. www.laryngologyandvoice.org/temp/JLaryngolVoice4112-3980982_110329.pdf

[25] A. P. Mendes, A. Graça, A. Jorge, M. Alves-Pereira, N.A.A. Castelo Branco, A. Freitas, M. Laranjeira, I. Bonaça: The effects of ILFN-exposure on voice acoustic parameters of commercial cabin crewmembers. Laryngology & Voice. 2 (2012) 70-80. www.laryngologyandvoice.org/temp/JLaryngolVoice2270-459212_124521.pdf

[26] G. Biondi, S. Farrace, G. Mameli, F. Marongiu: Is there a hypocoagulable state in military fighter pilots Aviation, Space & Environmental Medicine 67 (1996) 568-71.

[27] L. Cunha Ribeiro, F. F.Crespo, I. Freira, H. Afonso, M.S.N. Castelo Branco, M.C. Marques, M. Alves-Pereira, N.A.A. Castelo Branco: Hemostasis and coagulation changes in vibroacoustic disease. Proc. 12th ICSV 2005, No.564 (8 pages).

[28] A.P. Águas, N. Esaguy, A.P. Castro, N.R. Grande, N.A.A. Castelo Branco: Acceleration of lupus erythematosus-like processes by low frequency noise in the hybrid NZB/W mouse model. Aviation, Space & Environmental Medicine 70 (1999) A132-6.

[29] A.P. Águas, N. Esaguy, A.P. Castro, N.R. Grande, N.A.A. Castelo Branco: Effect of low frequency noise exposure on BALB/C mice splenic lymphocytes. Aviation, Space & Environmental Medicine 70 (1999) A128-31.

[30] A.P. Castro, A.P. Águas, N.R. Grande, E. Monteiro, N.A.A. Castelo Branco: Increase in CD8+ and CD4+ T lymphocytes in patients with vibroacoustic disease. Aviation, Space & Environmental Medicine 70 (1999) A141-4.

[31] Executive Office of Energy and Environmental Affairs of the State of Massachusetts, USA: Wind turbine health impact study: Report of an independent expert panel. January 2012. www.mass.gov/eea/docs/dep/energy/wind/turbine-impact-study.pdf

Low Frequency Noise-Induced Pathology: Contributions Provided by the Portuguese Wind Turbine Case

Nuno A. A. Castelo Branco, M.D.
Senior Surgical Pathologist, R. Prof. Dias Amado, No. 5-1B, 1600-612 Lisbon, Portugal

Mariana Alves-Pereira, Ph.D.
Biomedical Engineer, Lusófona University, Campo Grande 376, 1749-024 Lisbon, Portugal

Augusto Martinho Pimenta, M.D.
Senior Neurologist, Julio de Matos Hospital, Av. do Brasil, 53, 1700-063, Lisbon, Portugal

José Reis Ferreira, M.D.
Senior Pneumologist, Clínica Doentes Pulmonares, Campo Grande, 4, 1700-092, Lisbon, Portugal

Summary
In November 2006, 4 Industrial Wind Turbines (IWT) were installed in the vicinity of a residential dwelling in Portugal. In March 2007, this team was contacted by the family requesting assistance in dealing with their Infrasound & Low Frequency Noise (ILFN) problem that they claimed was being generated by the IWT. The family began legal proceedings for the removal of the IWT, and in September 2007, this team's first report was presented at the 2nd International Meeting on Wind Turbine Noise. In June 2010, a follow-up report of this case was presented at the 14th International Meeting on Low Frequency Noise and Vibration and its Control, wherein ILFN-induced pathology was confirmed through histology in this family's thoroughbred horses. The goal of this report is to provide second follow-up to this case, five years later.

PACS no. 43.40.Ng, 43.50.Qp, 43.80.Gx

1. Introduction

(Please see disclaimer notice provided at the end of this report.) Over the past 35 years, this team of scientists has studied the biological response to Infrasound & Low Frequency Noise (ILFN) exposure in both human populations [1-4] and laboratory animal models [5-7]. Initially prompted by the signs and symptoms observed among a population of aeronautical technicians [3], by the mid-1990's, study populations included commercial airline pilots and flight attendants [8,9]. In 2001, the team began receiving complaints from families regarding ILFN in their homes [10], and subsequently the inquiry was widened to include residential exposures [11]. By 2007, this team had already accumulated a vast body of knowledge regarding the biological effects of ILFN exposure, including a clinical protocol for establishing the extent of ILFN-induced pathology [1,2,12]. It is within this context that private citizens worldwide have requested our assistance with their ILFN-related issues.

2. First Contact in March 2007

In November 2006, 4 2-MW Industrial Wind Turbines (IWT) were installed in the vicinity of the farm of Family R. This rural dwelling also housed the family's business: breeding thoroughbred Lusitanian horses and bulls for bullfighting events. The IWT were installed at a distance of 321-642 m from the residential home. Complaints of sleep disturbances were first reported in December 2006. In mid-March, Mr. and Mrs. R received a letter from their 12-year-old son's schoolteacher, expressing concern for the growing difficulties in an otherwise outstanding student, "*particularly in English, Humanities and Physical Education. He progressed in Mathematics, which is a field that naturally attracts his type of intelligence. However, in the above mentioned coursework, it seems that [the child] has lost interest, makes a lesser effort, as if he were permanently tired. In Physical Education,*

an abnormal amount of tiredness is also observed. Is [the child] leading a healthy life? Does he sleep sufficient hours during the night?" This immediately prompted the parents to begin legal proceedings and seek medical assistance, and thus, this team's first contact with Family R. During the month of April 2007, Family R hired an accredited acoustical firm to conduct continuous acoustical monitoring of ILFN both inside and outside their home, for a period of 2 weeks, and that included real time wind speed data. Legally stipulated annoyance levels were exceeded during the day (7am-8pm), evening (8-11pm) and night (11pm-7am) hours. dBA noise levels were also exceeded for a sensitive zone during night hours, but were within legal limits for a mixed zone. Municipal Authorities where Family R.'s property is located had not yet classified the area as sensitive *or* mixed. Numerical data regarding acoustical and wind speed information, independently collected by the accredited firm, was provided to this team for analysis. Figure 1 provides a visual comparison of ILFN levels inside the master bedroom under different conditions.

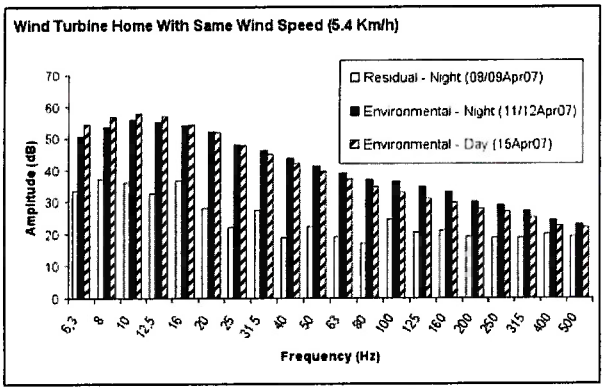


Figure 1. Comparison of ILFN levels in 1/3 octave bands, in dBL, *at the same windspeed*, and recorded inside the master bedroom. Residual (no IWT blade movement); Environmental (with rotating IWT blades) [13].

These ILFN levels were compared to those obtained in other ILFN-rich residences and occupational environments [13], and were deemed to be problematic for the health of this family. In order to obtain relevant clinical data, specific medical examinations were provided. For the rationale justifying the medical examinations reported herein, please see [1-3, 12]. The 12-year-old child received a neurological test assessing cortical nerve conduction times: P300 Event Related Evoked Potentials (ERP). P300 ERP disclosed nerve conduction time to be 352 ms, when expected value should be closer to 300 ms. Brainstem Auditory Evoked Potentials (BAEP) disclosed asymmetries in the right and left nerve conduction times, and the right I-V interval interlatency value was at the threshold of normal (4.44 ms). Mr. and Mrs. R. disclosed slight to moderate pericardial thickening: between 1.7 mm and 2.0 mm (normal for the equipment in use: <1.2mm) [12]. Respiratory drive was below normalized values in both adults (46%-53%, normal: >60%), suggesting the existence of brain lesions in the areas responsible for the neurological control of breathing [14]. Observations made by the family included animal behavioural changes: Horses were seen to lie down and sleep during the day; Dogs were lethargic, and no longer jumped up requesting attention from their owners; Ants simply disappeared. All data was presented at the 2nd International Meeting on Wind Turbine Noise, held in Lyon, France in September 2007, where this team concluded that precautionary measures regarding the placement of IWT near residential dwellings were justified, and that safe distances between IWT rotating blades and inhabited buildings had not yet been determined by the scientific community [13].

3. 2010 Update and Equine Pathology

By 2010, Mrs. R and the children no longer resided in their rural home, having moved to a suburban apartment. For Mr. R, however, this was not an option given the care required by thoroughbred Lusitanian horses and prize bulls that, as his only source of income, he bred and trained for bullfights. After the summer vacation in 2007, spent away from the farm, the 12-year-old child had again received the P300 ERP examination that, this time, disclosed nerve conduction times much closer to normal: 302 ms. In 2010, this child was again an outstanding student, top of his class. Over these 3 years, Mr. R's health and wellbeing had continuously and visibly deteriorated: intolerance to (any) noise had become more severe; situations compatible with an unregulated sympathetic nervous system increased in frequency; and cognitive impairment became more pronounced. As a result of the first phase of the (still ongoing) legal proceedings, IWT were

ordered to be shut down during evening and night hours (8 pm - 7 am), and the IWT closest to the home (322 m) was ordered to be removed. Meanwhile, however, more IWT continued to be installed in the immediate vicinity surrounding the R family home. Legal proceedings underway refer only to the first 4 IWT. The R family was now being confronted with yet another problem that would severely aggravate their already delicate financial situation: a condition was now developing in the horses during the first year of life that was substantially reducing the family's equine income. Between 2000 and 2006, 13 healthy thoroughbred Lusitanian horses were born and raised on Mr. R's property. All horses (N=4) born after 2007 on his farm developed asymmetric flexural limb deformities. Besides the IWT installed in November 2006, no other changes (constructions, industries, etc) were introduced into the area during this time. Detailed results from the tissue study carried out among these equines and their corresponding controls were presented at the 14th International Meeting on Low Frequency Noise and Vibration and its Control, held in Aalborg, Denmark, in June 2010 [15]. One of this team's most consistent findings over the past 30 years of histological and ultrastructural analyses of human and animal ILFN-exposed tissues has been the organized proliferation of collagen and elastin fibers in the absence of an inflammatory process [1,2,5,6]. This same morphological feature appeared in the tissue fragments of the horses that were born, *or raised*, on Mr. R's farm after 2007 [15]. Equine flexural limb deformities developed by Mr. R's horses was the object of a Master's Thesis defended at the School of Veterinary Medicine, Technical University of Lisbon in 2012 [16].

4. 2015 Update

In terms of legal proceedings, in May 2013 the Supreme Court of Justice of Portugal decided that the remaining 3 IWT had to be removed from the vicinity of Mr. R's property [17]. The developer is reportedly appealing to the European Courts. Given the installation of other IWT in the immediate vicinity, the R Family property will still potentially be impacted by ILFN, although new studies to that effect would be required. Mr. R continues to live away from Mrs. R and the children, and his health has further deteriorated. The respiratory drive value that in 2007 was 46% (normal: >60%) is now at 28%. The development of balance disturbances associated with loss of consciousness has apparently caused several falls, requiring medical treatment for facial and rib fractures. This situation is still under clinical study, as late-onset epilepsy is one of the most severe outcomes of excessive ILFN exposure. However, diagnosis of this neurological disorder requires time to be properly established within a clinical context. While disconcerting, this is unsurprising given the already documented cases of balance disturbances and late-onset epilepsy among ILFN-exposed persons [18-20]. To date, the only remarkable element in the severe degradation of Mr. R's health is its rapidity, when compared to the evolution of this pathology seen in workers exposed to occupational ILFN. Ultimately, though, this observation is unsurprising, given the distinct time-exposure patterns of residential vs. occupational exposures.

5. The Scientific Approach

This IWT case is but one of many residential ILFN cases with which this team has been confronted, i.e., IWT are but one in a long list of ILFN-generating industries capable of disturbing citizens' right to a healthy physical environment in their homes. The approach applied to this IWT case is consistent with this team's long-standing methodology: confirmation of the presence of the agent of disease (ILFN), and clinical assessment of the parameters deemed relevant by 30 years of past research. Other agencies and institutions have studied health impacts caused by the proximity of IWT to residential dwellings [21,22 for example]. Apparently, however, all have chosen subjective and clinically unreliable measures to characterize "health impacts," unsurprisingly leading to many inconclusive results. Hypersensitivity to noise or intolerance toward sounds, commonly called *annoyance*, is frequently considered a measure of health. Usually there are large variations in the levels of annoyance assessed among family members living in the same ILFN-rich home, and among families and neighbours living in clusters of homes under the same ILFN exposure conditions. Since no prior noise exposure histories are generally included in these "health impact" studies, the fact that annoyance levels are directly related to prior and overall noise exposure

histories remains, therefore, unaccounted for. The same lack of information occurs for concurrent occupational or recreational exposures – no information of this type is generally collected among these populations. But even if annoyance levels were correctly assessed, their relationship to a proper "health impact" remains a mystery, with the exception of the relatively vague notion of "quality of life". Medical scholars trained in the scientific method know that the measure of annoyance *is not* a clinically objective parameter. Hence, any statement regarding "health impacts" merely based on (incomplete) assessments of annoyance levels is, at best, perplexing. Medical scholars trained in epidemiology will also recognize that transverse studies are quite insufficient to establish causality (or lack thereof) between an agent of disease and a specific pathology. This is particularly true when prior exposures to that same agent of disease under study are not taken in account. Having put forth why annoyance is an improper measure, both in terms of its extraordinary subjectivity and of its clinical uselessness, it is now pertinent to share this team's (long) experience with the medical concept of annoyance, which was termed in 1984 as hypersensitivity to noise or intolerance to sound [23]. Normal Wistar rats, independent of age, react to the sound of a blown kiss by becoming tense and discretely irritated. In rats exposed for extended periods of time to ILFN, the sound of a blown kiss produces a dramatic startle response, some of them losing balance, and falling backwards [24]. Fusion of actin-based, cochlear stereocilia, both amongst themselves as well as with the upper tectorial membrane, was observed in ILFN-exposed rat cochlea. These results were presented at the 8th International Meeting of the Commission on the Biological Effects of Noise, held in Rotterdam, The Netherlands, in 2003, and wherein it was postulated that the fusion of these actin-based structures could be an organic basis for the hypersensitivity to noise and intolerance to sound observed in ILFN-exposed populations, i.e., an organic-based hypothesis for annoyance [24,25]. If so, it would follow that annoyance is the product of cumulative exposures to ILFN, and not necessarily a hereditary trait related to an oversensitive auditory function. If this were indeed the case, however, *the needs of the many outweigh the needs of the few* would justify the exclusion of this "sensitive" segment of the population from the decision-making process.

6. Looking Ahead

Mr. R is not alone when it comes to life disruption due to the installation of IWT in the proximity of a residential home. This problem has become a societal issue compelling an intelligent approach, rather than a crystallized view based on antiquated notions and concepts. It is clear that the great motivation for marshalling energy and effort toward industrial wind farms is legitimately based on a worldwide shortage of electrical energy. It would seem, however, that under the guise of *the needs of the many outweigh the needs of the few*, humans are collectively forgetting their own history that has unequivocally shown the benefits of dealing with adverse health effects outright, rather than later. The dichotomy stipulating that either one accepts the development of adverse health effects among certain segments of the population, *or*, one does not have sufficient electrical energy for all the modern gadgets (including cars), is archaic and fictitious. An effort toward developing and implementing appropriate construction techniques that would minimize the deleterious effects of in-home ILFN could be, perhaps, an excellent beginning. The hindrance to this apparently viable beginning is the *sine qua non* prior recognition that ILFN is, *de facto*, a physical agent of disease.

Acknowledgement

The authors deeply appreciate the participation of Family R. in the development of this study.

References

[1] M. Alves-Pereira, N.A.A. Castelo Branco: Vibroacoustic disease: Biological effects of infrasound and low frequency noise explained by mechanotransduction cellular signaling. Progress Biophysics & Molecular Biology 93 (2007) 256-279. www.academia.edu/10671962/Vibroacoustic_disease_Biological_effects_of_infrasound_and_low-frequency_noise_explained_by_mechanotransduction_cellular_signalling.

[2] N.A.A. Castelo Branco, M. Alves-Pereira: Vibroacoustic disease. Noise & Health 6 (2004) 3-20.

[3] N.A.A Castelo Branco: The clinical stages of vibroacoustic disease. Aviation, Space & Environmental Medicine 70 (1999) A32-9.

[4] N.A.A Castelo Branco: Vibroacoustic disease – An emerging pathology. Aviation, Space & Environmental Medicine 70 (1999) A1-6.

[5] N.A.A. Castelo Branco, J. Reis Ferreira, M. Alves-Pereira: Respiratory pathology in vibroacoustic disease-25 years of research. Revista Portuguesa de

Pneumologia XIII (2007) 129-135. www.scielo.oces.mctes.pt/pdf/pne/v13n1/v13n1a08

[6] N.A.A. Castelo Branco, E. Monteiro, A. Costa e Silva, J. Reis Ferreira, M. Alves-Pereira. Respiratory epithelia in Wistar rats born in low frequency noise plus varying amounts if additional exposure. Revista Portuguesa de Pneumlogia IX (2003) 481-492.

[7] M.J.R. Oliveira, A. Sousa Pereira, A.P. Águas, E. Monteiro, N.R. Grande, N.A.A. Castelo Branco. Effects of low frequency noise upon the reaction of pleural milky spots to mycobacterial infection. Aviation, Space & Environmental Medicine 70 (1999) A137-40.

[8] A. Araujo, F. Pais, J.M.C. Lopo Tuna, M. Alves-Pereira, N.A.A. Castelo Branco: Echocardiography in noise-exposed flight crew. Proc. Internoise 2001, 1007-10 (ISBN: 9080655422).

[9] M. Alves-Pereira, M.S.N. Castelo Branco, J. Motylewski, E. Kotlicka, A. Pedrosa, N.A.A Castelo Branco: Airflow-induced infrasound in commercial aircraft. Proc. Internoise 2001, 1011-14 (ISBN: 9080655422).

[10] R. Torres, G. Tirado, A. Roman, R. Ramirez, H. Colon, A. Araujo, F. Pais, J.M.C. Lopo Tuna, M.S.N. Castelo Branco, M. Alves-Pereira, N.A.A Castelo Branco: Vibroacoustic disease induced by long-term exposure to sonic booms. Proc. Internoise 2001, 1095-98 (ISBN: 9080655422).

[11] A. Araujo, M. Alves-Pereira, J. Joanaz de Melo, N.A.A. Castelo Branco: Vibroacoustic disease in a ten-year-old male. Proc. Internoise 2004, No. 634 (7 pages) (ISBN: 8001030555).

[12] N.A.A. Castelo Branco, M. Alves-Pereira, A.J.F. Martinho Pimenta, J. Reis Ferreira: Clinical protocol for evaluating pathology induced by low frequency noise exposure. Euronoise 2015, paper no. 601.

[13] M. Alves-Pereira, N.A.A. Castelo Branco: In-home wind turbine noise is conducive to vibroacoustic disease. Proc. 2nd Intl Meet Wind Turbine Noise, 2007, Paper No. 3 (11 pages).

[14] J. Reis Ferreira, J. Albuquerque e Sousa, P. Foreid, M. Antunes, S. Cardoso, M. Alves-Pereira, N.A.A. Castelo Branco: Abnormal respiratory drive in vibroacoustic disease. Revista Portuguesa de Pneumologia XII (2006) 369-74. www.scielo.oces.mctes.pt/pdf/pne/v12n4/v12n4a03

[15] N.A.A. Castelo Branco, T. Costa e Curto, L. Mendes Jorge, J. Cavaco Faísca, L. Amaral Dias, P. Oliveira, J. Martins dos Santos, M. Alves-Pereira: Family with wind turbines in close proximity to home: follow-up of case presented in 2007. Proc. 14th Intl Meet Low Frequency Noise, Vibration and its Control 2010, 31-40.

[16] T. Costa e Curto: [Acquired flexural deformity of the distal interphalangic joint in foals]. Masters Thesis. School of Veterinary Medicine, Technical University of Lisbon (2012) (In Portuguese). www.repository.utl.pt/bitstream/10400.5/4847/1/Deformaçao%20flexural%20adquirida%20da%20articulaçao%20interfalangica%20distal%20em%20poldros.pdf

[17] Supreme Court of Justice of Portugal. Decision No. 2209/08.oTBTVD.L1.S1, 30 May 2013 (In Portuguese). www.dgsi.pt/jstj.nsf/954f0ce6ad9dd8b980256b5f003fa814/4559d6d733d1589780257b7b004d464b?OpenDocument

[18] A.J.F. Martinho Pimenta, M.S.N. Castelo Branco, N.A.A. Castelo Branco: Balance disturbances in individuals with vibroacoustic disease. Aviation, Space & Environmental Medicine 70 (1999) A100-6.

[19] A.J.F. Martinho Pimenta, N.A.A. Castelo Branco: Epilepsy in vibroacoustic disease. Aviation, Space & Environmental Medicine 70 (1999) A119-21.

[20] GIMOGMA*: [Epilepsy of vascular etiology, a clinical picture of vibration disease? Revista Portuguesa de Medicina Militar 32 (1984) 5-9.

[21] Executive Office of Energy and Environmental Affairs of the State of Massachusetts, USA: Wind turbine health impact study: Report of an independent expert panel. January 2012. www.mass.gov/eea/docs/dep/energy/wind/turbine-impact-study.pdf

[22] Health Canada: Wind turbine noise and health study – Summary of results. Department of the Government of Canada. 2014. www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php

[23] GIMOGMA*: [Noise and vibration at the origin of hypo- and hyper acoustic sensitivities in an industrial population]. Revista Portuguesa de Medicina Militar 32 (1984) 17-20 (In Portuguese).

[24] N. Lousã, E. Monteiro, M. Alves-Pereira, N.A.A. Castelo Branco: Rat cochlea exposed to low frequency noise. Proc. 8th ICBEN, 2003, 43-5 (ISBN: 9080799017).

[25] M. Alves-Pereira, J. Joanaz de Melo, N.A.A. Castelo Branco: Actin- and tubulin-based structures under low frequency noise stress. In: A. Méndez-Vilas (ed.). Recent Advances in Multidisciplinary Applied Physics. Elesevier, London, 2005, pp. 955-79 (ISBN: 9780080446486).

*Grupo de Investigação Médica das Oficinas Gerias de Mateiral Aeronautico.

Disclaimer

The authors and the research team they represent would like to clarify that:

No member of this team is party to anti-technology sentiments;

Alternative forms of renewable energy, such as industrial wind turbines, are considered welcome additions to our modern technological society, by all members of this team;

The data reported herein have been scrutinized under one, and only one, agenda - that of pure scientific inquiry;

In no way can or should this report be construed as a document arguing for or against the implementation of industrial wind turbines;

No member of this research team is employed by the firm that conducted the acoustical measurements reported in this article, nor are there any commercial, financial or professional agreements (contractual or otherwise) between the aforementioned accredited firm and any member of this team;

The consulting activities provided by these authors to Family R are of a purely academic and scientific nature and hence are *pro bono*.

SUBMISSION

OF

Dr Christopher Hanning
BSc, MB, BS, MRCS, LRCP, FRCA, MD

to the

Australian Senate

SELECT COMMITTEE ON WIND TURBINES

February 2015

Contents

Summary

Recent evidence confirms and strengthens my 2010 conclusions that wind turbine noise at the levels permitted by Australian regulations has unacceptable adverse effects on sleep and health.

The NHMRC statement on wind turbine noise and human health fails in its duty to *"build a healthy Australia"* and to protect the public health by; reversing the burden of proof, applying an inappropriately high burden of proof and failing to properly apply the precautionary principle. They have, instead, applied the "reactionary principle" (Kriebel 2007), which is clearly not in the public interest. Had they correctly applied the precautionary principle, then, even using their present analysis, they would have called for an immediate moratorium on the construction of new wind turbines within at least 1.5km of residences and immediate reductions in noise emissions from existing wind turbines sited within 1.5km of residences. Had they applied a reasonable burden of proof, they would have called for a construction moratorium and noise emission reductions for turbines sited within 10km of residences. In addition, they would have mandated research by independent experts with relevant expertise in acoustics, sleep medicine and other relevant clinical disciplines, funded by the wind industry, as an urgent matter for the protection of public health.

The "nocebo" hypothesis is falsified at many levels. There is overwhelming evidence that the adverse health effects complained of by wind turbine neighbours and reported in the many publications cited in this and my 2010 submission are caused by the noise emissions of wind turbines.

The Australian regulations on wind turbine noise are not fit for purpose. They take no account of relevant earlier research, excessive amplitude modulation and low frequency sound emissions and were formulated to favour the industry rather than the public health.

Introduction

In November 2012, I was privileged to make a lengthy, detailed written submission to the Australian Senate Inquiry into Excessive Noise from Wind Farms and subsequently gave oral evidence on 13th November.

I concluded that: "... there is compelling evidence that wind turbine noise can and does disturb sleep and impair the health of those living too close and that current guidance is inadequate protection."

I see no useful purpose in restating my previous evidence as it is in the public domain and available to the Committee. I shall, therefore, restrict my evidence to three principal areas:

1. New evidence since 2012

2. Commentary on the recent NHMRC statement on wind turbine noise and human health

3. Commentary on the "nocebo" hypothesis

Fourthly, I shall comment on the wind industry and its supporters as "Producers of Doubt".

1. New evidence since 2012

1.1 **Introduction.**

In 2012, I cited a large body of evidence in support of my opinion that there was a significant risk to sleep and health for those living within 1.5km of industrial wind turbines. I note that the NHMRC statement on wind turbine noise and human health quotes a similar distance where they determine there are sufficient concerns to recommend research. I noted also that there was no original research which found that wind turbines were safe at that distance.

I describe below the new evidence published in the last 2½ years.

1.2 Morris (2012) presented a survey of the Waterloo Wind Farm in South Australia to the Parliamentary Select Committee on Wind Power. An anonymous, self reporting survey was sent to all 230 residences within 10km of the 3MW turbines. 93 (40%) were returned, a good response rate for this type of study. 40% reported night-time disturbance and 27 (29%) reported sleep disturbance (Figure 4)

This is not a strong epidemiological study in that it has not been peer-reviewed, has no control group and the survey instrument asked generalised questions to avoid leading respondents. Nevertheless, it had a good response rate and its findings are in accord with other similar studies. It represents strong supporting evidence. I note that it was considered acceptable by the NHMRC in its latest literature review, and that Professor Colin Hansen's acoustic field research at Waterloo (Hansen 2014) has confirmed excessive low frequency noise out to 8.7km, which provides independent acoustic data supporting Morris's findings.

1.3. Schneider (2012) conducted a similar study of the Cullerin Range Wind Farm in New South Wales, Australia. Responses were obtained from 73% of residences within 5km of the turbines of which 78.5% reported sleep disturbance from the development. (Figure 5). A follow-up study was conducted in 2013 (Schneider 2013) to answer allegations by Chapman (2013) in his "nocebo" studies that residents had not complained at Cullerin. A similar response rate was achieved with 91% of respondents living within 8km reporting an impact on their sleep. All had complained to a variety of authorities.

These are not a strong epidemiological studies in that they have not been peer reviewed, have no control group and the survey instruments asked generalised questions. Nevertheless, they had good response rates and the findings in both studies are in accord with each other and with other similar studies. It represents strong supporting evidence.

1.4. Mroczek and colleagues (2012) reported a survey of 1277 adults living near wind farms in Poland. 424 (33.2%) lived >1.5km, 221 (17.3%) 1-1.5km. 279 (21.9%) 700-1000m and 220 (17.2%) <700m from a turbine. The Polish version of the SF36 was administered with a Visual Analogue Scale for Health Assessment.

Taking all subjects together, they concluded that: *"Close proximity of wind farms does not result in the worsening of the quality of life"* and *"Within all scales, the quality of life was assessed highest by residents in areas located closest to wind farms, and the lowest by those living more than 1,500m from wind farms."* These conclusions are at variance with all other studies reported here. The authors offered no mechanism for the apparent benefit of living close to a wind farm. In a personal communication (Mroczek 2013), the lead author stated that not all of the wind farms were operational at the time of the survey, some were under construction or in the planning stage. It would appear also that no allowance was made for any financial interest in the turbines which would be more likely for those living close to the turbines.

This analysis is therefore meaningless as it includes subjects not exposed to turbine noise at all and those living over 1.5km from the turbines. Taking into account also the failure to allow for any financial interest in the turbines, the conclusions can not be regarded as reliable.

1.5. McBride and colleagues (2014) administered the WHO Health Related Quality of Life test instrument to 25 persons living 700-3500m (average 1400m) from wind turbines. The study group had lower scores in all domains when compared to community and hospital inpatients and outpatient groups indicating a significant reduction in quality of life. They conclude: *".., the fact that so many individuals scored so poorly must be a cause for concern."*

1.6. Magari and colleagues (2014) administered a survey questionnaire to a small sample of residents living within a wind farm an average of 586m from the nearest

turbines. 26% reported sleep disturbance from the wind turbines. 8.9% had made noise complaints even though all residents were receiving a substantial property tax reduction and other financial benefits. The authors were clearly surprised at the level of sleep disturbance as they concluded: *"Additional research should include a detailed investigation of sleep patterns and possible disturbance in those living in and near operating wind turbine projects."*

1.7 The Cape Bridgewater Wind Farm in Victoria, Australia has been subject to a recent, detailed, acoustic testing program in response to residents' ongoing complaints of six years of sleep disturbance and other adverse health effects (Cooper, 2015). The study is unique in that it was undertaken by an independent group of acousticians and commissioned by the developer, Pacific Hydro, who co-operated fully in the study, including allowing full access to the wind turbines, and enabling background noise measurements to be taken when the turbines were off for other reasons, and publishing the report in full. Pacific Hydro are to be commended for their actions and stand in contrast to the attitude of other developers.

The survey was based on the six occupants of three houses sited between 650 and 1600 m from the nearest turbines. The full spectrum of acoustic frequencies and vibration inside and outside homes were measured for 8 weeks. Cooper analysed also the complaints of residents and noted that, in addition to sleep disturbance, they comprised "sensations", which included headache, head, ear or chest pressure, tinnitus and heart racing. During the study period, residents were blinded to the acoustic measurements, and contemporaneously recorded detailed diaries of their individual perceptions of noise, vibration, and "sensations". A dose response relationship is suggested by the trend line from the data relating to the occurrence of severe sensations (level 5) at the same time as elevated levels of infrasound, when compared with lesser severity sensations (level 2) and lower SPL's of infrasound but Cooper concluded more data are required in order to properly establish correlation. These results are consistent with the Kelley research from thirty years earlier (Kelley 1985,7).

The residents also documented sleep disturbance when it occurred. No formal assessment of sleep was undertaken. The report states that: *"All of the residents indicated that over time their sensitivity to "noise" from the wind farm has increased and that there is regular occurrence of sleep disturbance to the point that their health has been affected (to varying degrees)"*. One home of the three studied has been abandoned. It should be noted that Thorne has previously studied this wind farm (Thorne 2012 and 2014) (see Section 1.8) and found poor sleep quality and adverse health effects in the residents.

The report concludes that:*"... with respect to sleep disturbance ... where ambient noise levels at night inside dwellings are typically below 15dB(A), then the concept of a 30dB(A) Leq threshold level identified in the New Zealand Standard ..., would appear to be an inappropriate threshold for the assessment of internal noise levels associated with wind farms."*

1.8. Thorne (2012) in a submission to an Australian Senate inquiry into wind farm noise regulations has reported a survey of residents reporting health concerns living within 700 to 3500m of two wind farms, Cape Bridgewater and Waubra. The purpose of the study was to explore sound levels and character to inform future research. Similar health instruments were used to those in the Nissenbaum and Shepherd studies discussed in the 2010 submission. The general health effects were considered by McBride (2014) (Section 1.5)

Predicted sound levels at the residences ranged from 44-<28dBLAeq. Measured sound levels at 5 residences ranged from 61-43dBLAeq and exceeded predicted levels by between 4-25dBA.

Twenty three of 25 (92%) participants reported Pittsburgh Sleep Quality Index scores >5 confirming that sleep disturbance is a major feature of health effects of wind turbine noise. The PSQI is a widely used and well validated measure of sleep quality. Scores >5 indicate poor quality sleep.

Thorne concluded: *"The measures of wind turbine noise exposure that the study has identified as being acoustical markers for excessive noise and known risk of serious harm to health (significant adverse health effects) are:*

1. An LAeq or 'F' sound level of 32 dB(A) or above over any 10 minute interval, outside;

2. An LAeq or 'F' sound level of 22 dB(A) or above over any 10 minute interval inside a dwelling with windows open or closed.

3. Measured sound levels shall not exhibit unreasonable or excessive modulation ('fluctuation').

4. An audible sound level is modulating when measured by the A-weighted LAeq or 'F' time-weighting at 8 to 10 discrete samples/second and (a) the amplitude of peak to trough variation or (b) if the third octave or narrow band characteristics exhibit a peak to trough variation that exceeds the following criteria on a regularly varying basis: 2dB exceedance is negligible, 4dB exceedance is unreasonable and 6dB exceedance is excessive.

5. A low frequency sound and infrasound is modulating when measured by the Z-weighted LZeq or 'F' time-weighting at 8 to 10 discrete samples/second and (a) the amplitude of peak to trough variation or (b) if the third octave or narrow band characteristics exhibit a peak to trough variation that exceeds the following criteria on a regularly varying basis: 2dB exceedance is negligible, 4dB exceedance is unreasonable and 6dB exceedance is excessive.

Definitions: 'LAeq' means the A-weighted equivalent-continuous sound pressure level; 'F' time-weighting has the meaning under IEC 61672-1 and ref. 18; "regularly varying" is where the sound exceeds the criterion for 10% or more of the measurement time interval of 10 minutes; and Z-weighting has the meaning under AS IEC 61672.1 with a lower limit of 0.5Hz.

Approval authorities and regulators should set wind farm noise compliance levels at least 5 dB(A) below the sound levels in criterion (1) and criterion (2) above. The compliance levels then become the criteria for unreasonable noise."

1.9 Paller and colleagues (Paller 2013) presented the results of a survey of nearly 5000 residences in Ontario counties containing 10 or more wind turbines at a conference organised by the Ontario government. Paller subsequently presented a fuller account as a Masters thesis. (Paller 2014). A highly statistically significant relationship was found between ln(distance) from turbines and PSQI and vertigo. Modelled relationships had the same general form as those of Nissenbaum (2011)(See 2010 submission for details). They conclude that: *"..future research should focus on the effects of wind turbine noise on sleep disturbance and symptoms of inner ear problems."* Minimum setback distance in Ontario is 550m and over 80% of respondents lived more than 1km from the turbines. The strength of the relationship between distance and effect is strong evidence for a causal relationship.

1.10. The preliminary findings of a survey conducted under the auspices of Health Canada have just been made available (Health Canada 2014). A range of health and sleep measures were compared to measured and calculated wind turbine noise. The survey did not find a direct association between wind turbine noise and self-reported sleep, illness, stress and quality of life. A statistically significant relationship was found between annoyance and wind turbine noise exposure when calculated noise levels exceeded 35dBA. Wind turbine noise annoyance was statistically related to self reported sleep disturbance (PSQI), migraines, tinnitus, dizziness and objective measures of stress (hair cortisol, blood pressure and resting heart rate). It is reasonable to conclude from the data that adverse health effects occur at external turbine noise levels above 35dBA. ETSU-R-97 permits night time noise levels of 42dBA. Calculated outdoor A weighted wind turbine noise levels reached 46dBA. The authors compare the noise levels to those recommended by WHO from which it can be inferred that most subjects were exposed to lower levels. The WHO noise levels are based upon traffic noise. It is inappropriate to base wind turbine noise levels on traffic research for the reasons given in my previous evidence.

This study, and its interpretation, have been criticised (Krogh and McMurtry 2014) but its findings confirm that wind turbine noise has adverse health effects at noise levels permitted by Australian regulations.

1.11. There has been much misunderstanding over the term "annoyance" with some characterising it as trivial irritation. Annoyance in the context of studies of noise is a degree of disturbance sufficient to cause stress, which is a departure from health and well being. Whether sleep disturbance is mediated by a direct effect of noise or through annoyance, or a combination of both, it remains an adverse health effect. A recent study by van den Berg and colleagues (2014) examined the relationship between annoyance and self reported sleep disturbance from environmental noise and found them to be strongly associated, confirming that annoyance must be regarded as an adverse health effect.

1.12 **Conclusions**

It remains the case that there is no credible research showing that wind turbines have no effect on sleep and health at the set back distances permitted under Australian guidelines. The only study suggesting no effect (Mroczek, 2012) is fatally flawed, not least because many of the subjects were not subjected to turbine noise. The new evidence, detailed above, adds further weight to my original opinion that there is a significant risk to the sleep and health of those residing within 1.5km of industrial wind turbines and indeed extends the adverse effect distance to at least 5km based upon the most recent Australian studies.

2. NHMRC Statement on wind turbine noise and human health

2.1. **Introduction**

The National Health and Medical Research Council (NHMRC) describes itself as: ".. *Australia's leading expert body promoting the development and maintenance of public and individual health standards."* Its mission statement is *"Working to build*

a healthy Australia." It is reasonable, therefore, to expect it to apply the fundamental principles of public health in its activities, including application of the precautionary principle (Martuzzi 2007).

The precautionary principle was characterized in the 1998 Wingspread consensus statement thus (Roffensperger 1999): "when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically." The statement goes on to list four central components of the precautionary principle:

1. taking preventive action in the face of uncertainty

2. shifting the burden of proof to the proponents of an activity

3. exploring a wide range of alternatives to possibly harmful actions; and

4. increasing public participation in decision-making.

Kriebel (2007) in commenting on Martuzzi's editorial, commends the precautionary principle and notes that public health too often works on the reactionary principle whose key components are:

1. requiring incontrovertible evidence of harm for each hazard before taking preventive action

2. placing the burden on the public (or government agencies) to show that each chemical, material or technology is harmful

3. not considering potential health and environmental impacts when designing new materials and technologies, and

4. discouraging public participation in decision-making about control of hazards and introduction of new technologies.

2.2. NHMRC has undertaken a critical review of what it deems to be acceptable literature. Research published after May 2014 has not been considered. They find that: *"There is consistent but poor quality direct evidence that wind farm noise is*

associated with annoyance, as well as less consistent, poor quality direct evidence of an association between sleep disturbance and wind farm noise." They considered evidence on noise emissions from other sources, road, rail and air and concluded that: *"it is unlikely that people would experience significant health effects beyond 1500 metres from wind farms."* The corollary to that statement must be that people **are** likely to experience significant health effects within 1500 m. There is a large body of evidence to show that wind turbine noise can not be equated with road, rail and traffic noise. It is more annoying, less easily masked by background noise, has a greater low frequency noise content, propagates further and is greater at night. The final statement is thus not supported by the evidence.

2.3. NHMRC must have been aware of the many hundreds, if not thousands, of Australians living near wind farms who have complained of sleep disturbance and ill-health. They must also have been aware of the many abandoned homes. People do not abandon their homes because they are disgruntled, they do so for genuine fear for their health and they find their living conditions intolerable. The research review found evidence of adverse effects within 1.5km. Certainty is not necessary before taking action to prevent harm to the public health.

2.4 In considering the evidence, NHMRC adopted inappropriately strict evidential criteria. This is the reactionary approach to public health risks and is clearly not in the public interest. Action in defense of the public health does not require certainty. In addition, in my opinion, they have turned the burden of proof on its head. It is the wind industry's duty to prove the safety of its activities not that of the public.

2.5. It is known that wind turbine noise emissions can disturb sleep and impair health, if this were not so, there would be no need for set back distances. The body which formulated the UK's guidance, ETSU-R-97, which is the basis for the Australian standards, chose noise levels which they "***thought***" would afford the public ***"reasonable"*** protection. No certainty, just assumptions, only "reasonable" protection, with no definition of "reasonable". No margin for error. In addition, the permitted noise levels were raised in order to facilitate the development of the wind industry. In the 17 years since ETSU was published, wind turbines have

increased in size from around 1MW with a hub height of 32m to 2.5-3MW, with a hub height up to four times greater, with a concomitant increase in noise, particularly low frequency noise. These facts, which demonstrate the capacity for harm, should have been known to the acoustician(s) advising the panel and should have provided the basis for an understanding of the potential for harm from wind turbine noise.

2.6. There are no large scale, randomized, double-blind, crossover trials of the effects of wind turbine noise on sleep and health. In the light of the evidence available to date, such trials on human subjects would probably be deemed unethical, assuming that volunteers could be recruited. What does exist is a large body of anecdotal reports, case control studies, observational reports and small controlled studies, **ALL** of which point in the same direction; wind turbine noise adversely effects sleep and health at distances permitted by Australian regulations. This is more than sufficient evidence for action.

2.7. What should NHMRC have done? Having reviewed the evidence, with the precautionary principle and its components in mind, they should have acknowledged that there was and is substance to the complaints. Even had they used their own analysis, they should have called for an immediate, nationwide moratorium on the construction of wind turbines within 1.5km of human habitation until high quality, independent research, funded by the wind industry, has demonstrated the safe setback distance appropriate for different sizes of turbine and topography. They should have called for immediate restriction of power output from existing wind turbines. However, had they applied appropriate and reasonable standards of proof rather than those that were inappropriately high, they would have called for a moratorium on construction and restrictions of power output for wind turbines within 10km of human habitation. They should have mandated that such restrictions not be lifted until high quality research by independent experts with relevant expertise in acoustics, sleep medicine and other relevant clinical disciplines, funded by the wind industry, had demonstrated safe external noise levels and power outputs.

3. The "Nocebo" Hypothesis

3.1. It is universally accepted that psychological factors influence an individual's response to unwanted sound. Individuals vary in their sensitivity to noise just as with many other factors. About 15% of the population are "noise sensitive". A dislike of turbines increases the response and financial gain decreases the response. However, these factors are only contributory and do not explain the entire response. Magari (2014) (Section 1.6) found high levels of sleep disturbance in a population with a considerable financial interest in the turbines. It is clear that physical factors are the main cause of adverse effects of wind turbine noise.

3.2 The "nocebo" hypothesis has been advanced suggesting that the symptoms reported by the thousands of subjects complaining of adverse effects from wind turbine noise are an example of a mass psychogenic illness (MPI) (Chapman 2013, Rubin 2014). Chapman claims that reports of adverse effects do not predate the earliest published papers, particularly the Pierpont case series (Pierpont 2009), and the ensuing publicity, and that the complaints are restricted to those wind farms where opposition groups were active in the planning stage.

3.3 This hypothesis is disproved by the Mroczek study cited above (Section 1.4). By combining data from active wind farms and those in the construction and planning stage, the authors were able to conclude that wind farms had no effect on quality of life measures and may even have been beneficial. However, Poland has a considerable number of groups opposing the installation of wind turbines, active since at least 2010. As a first world nation with good internet access, It is reasonable to suppose that the opposition groups would have been making the same objections as those in Australia, including the effects on sleep and health. It is reasonable to suppose also that opposition groups would have been active at many of the studied wind farms, especially those in the planning or construction phase. If the MPI hypothesis were correct, Mrocezk should have recorded worsened quality of life measures at all wind farms whether active or in the construction or planning stages. She did not.

3.4. This hypothesis is further disproved by the observation that adverse reports predate the Pierpont book by over 20 years (Kelley 1985), many wind farms reporting adverse effects had no opposition groups, and the residents initially welcomed the turbines, including wind turbine hosts (Mortimer 2012). Stigwood and colleagues (2013), acousticians with considerable research experience of UK wind farms, note: "*This* (the "nocebo" hypothesis) *is contrary to our own direct evidence where many communities and individuals either did not object to the development, positively supported the development or moved near to the wind farm in the belief that it would not adversely affect them".*

3.5. The hypothesis is further disproved by the evidence of several experienced acousticians who could reasonably be expected to be immune to such suggestions and have reported adverse effects (Ambrose et al. 2012, Stigwood 2013, Cooper 2015).

3.6. McMurtry (2013), Laurie (2013) and Hartman (2013) have analysed the Chapman papers in depth, detailing their bias and logical fallacies. Hartman concludes that the Chapman papers: *"fail to meet credible standards of professionalism to be taken seriously"*. The author concurs with this conclusion.

3.7. Chapman cites a laboratory based study in support of his hypothesis (Crichton 2013). Punch, an audiologist (Punch 2013), and Swinbanks, an acoustician (Swinbanks 2013), found the experiment itself, and its conclusions, to be seriously flawed, doubting that the volunteers were even exposed to infrasound. Government and industry accepts that adverse symptoms such as those described by Pierpont are due to turbine noise (Colby 2009). Adverse effects are found in children and animals who would not be susceptible to psychological factors.

3.8. In clinical medicine, a psychogenic explanation for reported symptoms is not entertained until possible physical explanations are excluded. To do otherwise would be construed as malpractice. There is a clear physical cause for the

symptoms reported by those exposed to wind turbine noise. Nissenbaum and Paller's studies (Nissenbaum 2012, Paller 2014) show a clear dose-response between distance and effects. Cooper's recent research at Cape Bridgewater, demonstrate a clear trend and dose response relationship of symptoms with concurrently measured levels of wind turbine infrasound inside homes. All of these are clear evidence of a causal relationship between wind turbine noise and effects on humans which would not be present for a psychogenic cause.

3.9 **Conclusions**

The "nocebo" hypothesis singularly fails to stand up to scrutiny as an explanation for the adverse effects of wind turbine noise on sleep and health.

4. Comments

4.1. Michaels (2005), an epidemiologist and former US assistant secretary of energy for environment and chief safety officer of a nuclear weapons complex, described the response of industries to the suggestion that their products or processes were causing harm to humans or the environment. He notes that laboratory and epidemiological studies of the effects of chemicals or drugs on humans have uncertainties and those charged with regulating the public health must extrapolate from the evidence to make causal inferences and recommend protective measures. Absolute proof is rarely present in science. Using examples from the tobacco, chemical and pharmaceutical industries he shows how companies manufacture doubt by producing their own research and seeking to discredit those studies which shows their product or process in a bad light. The latter studies are often characterized as "junk science" and the researchers denigrated.

Industry is assisted by compliant academics, consulting firms and government departments and agencies which can be counted upon to produce papers which undermine the original studies. They may do this by "reanalyzing" the original data and seeking to reduce the statistical significance of any findings, or conducting literature "reviews" which use the "reactionary principle" with inappropriate

burdens of proof to claim that there is "insufficient good evidence". Alternatively, attempts may be made to suggest that the effects on humans or the environment may be due to some other cause, usually a factor that is either impossible to measure or very common, for example, social habits (tobacco, alcohol, living conditions).

Michaels notes also that such industries seek to influence those making regulatory decisions by seeking to exclude independently minded experts and substituting those who are favourably inclined. This process extends from the initial setting up of guidelines for safe limits through to revision of limits in the light of new research.

The industries' aim is simply to muddy the waters, to create sufficient "doubt" so that they will be able to continue their activities unfettered by regulation.

4.2. Were Michaels to revise his paper for 2015, he would find the wind industry to be the perfect exemplar of this thesis. Acousticians regularly employed by the wind industry and compliant civil servants combined to ignore earlier research and produce noise level guidelines unique to the wind industry, permitting higher noise levels than were prudent in order to help the industry and higher still at night, contrary to evidence and common sense.

When the inevitable complaints began to emerge, complainants were ignored or brushed off. Dr Nina Pierpont in the US published a book (2009) detailing a case series of people adversely affected by wind turbine noise, creating the term "wind turbine syndrome". For her pains, she has been vilified in the media with attempts to discredit the research and denigrate her professionalism. Dr Sarah Laurie, of the Waubra Foundation in Australia, has suffered similar attacks on her professionalism and attempts made to hamper her ability to act as a major source of information to the public.

Dr Steven Cooper has been subjected to similar attacks following publication of his Cape Bridgewater studies. Schomer and Hessler, two highly respected US acousticians, the former Standards Director for the Acoustical Society of America, have written two open letters (2015 a and b) endorsing Cooper's work. They note

that it is exactly what it claims to be, a simple, but very detailed, observational study of a small number of affected individuals which, nevertheless, provides a high degree of proof of a causal relationship between wind turbine emissions and symptoms. They further predicted the nature of the attacks, "reanalysis" and criticism of their qualifications, which proved to be well founded. Interestingly, the second letter is entitled: "*Muddying the waters*".

In giving expert evidence (for a list, see section 6) I have been subject to personal attack. When I last gave evidence to the Australian Senate, one Senator asked my views on climate change, clearly hoping to smear me as "denier" and thus imply that my opinions were not to be trusted. In Ontario, consulting epidemiologists, often employed by the wind industry, have "reanalysed" our data in an attempt to reduce its significance and have produced "reviews" of the literature attempting to demonstrate that there is "insufficient" evidence for our assertions. Government agencies have joined in (See Section 2), misapplying the usual processes of protecting the public health.

Finally, distraction "evidence" is advanced, in this case, the "nocebo" hypothesis (Section 3).

4.3. The purpose or effect of these activities is to sow the seeds of doubt and undermine the evidence of harm. To give regulators and decision makers "reasons" for permitting developments and not taking action when complaints are made. In my opinion, it is time this obfuscation was recognised for what it is and the public properly protected from the adverse effects of wind turbine noise on their sleep and health.

5. Conclusions

My evidence and conclusions are fundamentally unchanged from those given in 2012 save that the safe setback distance for larger turbines must be at least 5km and may be as much as 10km in some circumstances. I have absolutely no doubt that wind turbine noise has adverse effects on sleep and health at the distances

permitted by Australian regulations. They are not fit for purpose. The additional evidence that has accrued in the intervening years has served to strengthen my certainty in the validity of that opinion.

Dr Christopher Douglas Hanning

24th February 2015

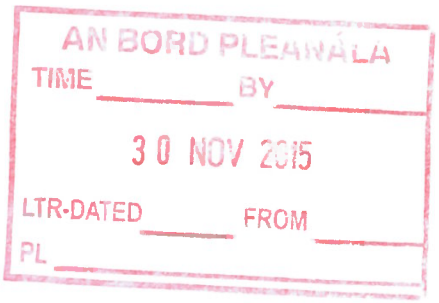
6. About the author:

Dr Christopher Hanning, Honorary Consultant in Sleep Disorders Medicine to the University Hospitals of Leicester NHS Trust, based at Leicester General Hospital, having retired in September 2007 as Consultant in Sleep Disorders Medicine. In 1969, he obtained a First class Honours BSc in Physiology and, in 1972, qualified in medicine, MB, BS, MRCS, LRCP from St Bartholomew's Hospital Medical School. After initial training in anaesthesia, he became a Fellow of the Royal College of Anaesthetists by examination in 1976 and was awarded a doctorate from the University of Leicester in 1996. He was appointed Senior Lecturer in Anaesthesia and Honorary Consultant Anaesthetist to Leicester General Hospital in 1981. In 1996, he was appointed Consultant Anaesthetist with a special interest in Sleep Medicine to Leicester General Hospital and Honorary Senior Lecturer to the University of Leicester.

His interest in sleep and its disorders began over 30 years ago and has grown ever since. He founded and ran the Leicester Sleep Disorders Service, one of the longest standing and largest services in the country, until retirement. The University Hospitals of Leicester NHS Trust named the Sleep Laboratory after him as a mark of its esteem. He was a founder member and President of the British Sleep Society and its honorary secretary for four years and has written and lectured extensively on sleep and its disorders and the effects of wind turbine noise (e.g. Hanning and Evans 2012) and continues to be involved in research. His expertise in this field has been accepted by the civil, criminal and family courts. He has been accepted as an expert on sleep disturbance related to wind turbine noise by the Ontario High Court and Environmental Review Tribunal and at planning inquiries in the UK, Canada and Ireland. He has given evidence on wind turbine noise and its effects to the Irish Parliament and Australian Senate. He chaired the Advisory panel of the SOMNIA study and sat on the Advisory panel for the Medicated Sleep and Wakefulness study, both major projects investigating sleep quality in the elderly, and sat on Advisory panels for several companies with interests in sleep medicine.

He was an Associate Member of the General Medical Council, chairing Investigation Committee hearings, until 2014. In 2010, he was invited to join the Board of the Society for Wind Vigilance.

He lives in Ashby Magna, Leicestershire, UK which is within 1km of the Low Spinney Wind Farm.



Bibliography

Ambrose SE, et al. 2012. Wind turbine acoustic investigation: Infrasound and low frequency noise – a case study. Bull Sci Tech Soc. 32:128

Chapman S, et al. 2013. The pattern of complaints about Australian wind farms does not match the establishment and distribution of turbines: Support for the psychogenic, 'communicated disease' hypothesis. PLoS One;8:e76584.

Colby et al. 2009. Wind Turbine Sound and Health Effects; An Expert Panel Review. American and Canadian Wind Energy Associations.

Cooper S. 2014. The results of an acoustic testing program: Cape Bridgewater Wind Farm. The Acoustic Group. Downloaded from: http://www.pacifichydro.com.au/files/2015/01/Cape-Bridgewater-Acoustic-Report.pdf

Crichton F et al. (2013). Can expectations produce symptoms from infrasound associated with wind turbines? Health Psychology, Advance online publication. doi:10.1037/a0031760

Hanning C. and Evans A. 2012. Wind turbine noise. *BMJ.* 344:e1527

Hansen K. et al. 2014 Noise monitoring in the vicinity of the Waterloo Wind Farm. Downloaded from: http://waubrafoundation.org.au/wp-content/uploads/2014/08/Hansen-Zajamsek-Hansen-Noise-Monitoring-at-Waterloo1.pdf

Hartman R. 2013. The adverse health impacts of industrial wind turbines: A scientific response to "It's all in your head". Evidence to the Charleston, Rhode Island Zoning board. Downloaded from: http://waubrafoundation.org.au /resources/hartmanr-scientific-response-its-all-your-head-nocebo/

Health Canada. 2014. Wind Turbine Noise and Health Study: Summary of Results. Downloaded from: http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php

Kelley ND, et al. 1985. Acoustic noise associated with the MOD-1 wind turbine: its source, impact and control. Solar Energy Research Institute Report. SERI/TR-635-1166. Downloaded from: http://waubrafoundation.org.au/wp-content/uploads/2013/07/Acoustic-Noise-Associated-with-the-MOD-1-Wind-Turbine.pdf

Kelley ND. 1987. A proposed metric for assessing the potential of community annoyance from wind turbine low-frequency noise emissions. Solar Energy Research Institute Report. SERI/T9-217-3261. Downloaded from: http://waubrafoundation.org.au/wp-content/uploads/2013/07/Kelley-1987-Wind-Farm-Low-Frequency-Noise-Problem-Identified.pdf

Kreibel D. 2007. The reactionary principle: inaction for public health. Occup Environ Med. 64:573

Krogh C and McMurtry R. 2014. Health Canada and Wind Turbines: too little too late. CMAJ Blogs. Downloaded from: http://cmajblogs.com/health-canada-and-wind-turbines-too-little-too-late/#_edn29

Laurie S. 2013. A critical analysis of the "complaints" data from the Chapman et al. "nocebo" research. Downloaded from: http://waubrafoundation.org.au/wp-content/uploads/2013/11/Critical-analysis-of-Chapman-complaints-data-from-Nocebo-research-paper.pdf

Magari S et al. 2014. Evaluation of community response to wind turbine-related noise in Western New York State. Noise & Health. 16-17:228-239.

Martuzzi. M. 2007. The precautionary principle: in action for public health. Occup Environ Med 64:569

McBride D et al. 2014 Investigating the impacts of wind turbine noise on quality of life in the Australian context: A case study approach. Presented to inter.noise 2014, Melbourne, Australia.

McMurtry R. 2013. Commentary on Chapman "nocebo" paper. Downloaded from: http://waubrafoundation.org.au/resources/dr-robert-mcmurtry-commentary-chapman-nocebo-paper/

Michaels D, 2005. Doubt is their product, industry groups are fighting government regulation by fomenting scientific uncertainty. Sci Am. 29:96

Morris M. 2012. Waterloo Wind Farm Survey. Downloaded from: http://www.wind-watch.org/news/wp-content/uploads/2012/07/Waterloo-Wind-Farm-Survey-April-2012-Select-Committee.pdf

Mortimer D. 2012. Statement to the Victorian Civil and Administrative Appeals Tribunal. No 2910 of 2012. Downloaded from: http://waubrafoundation.org.au/wp-content/uploads/2013/06/Statement-of-David-Mortimer-VCAT-11-1-13-.pdf

Mroczek B, Kurpas D, Karakiewicz B. Influence of distances between places of residence and wind farms on the quality of life in nearby areas. Ann Agric Environ Med. 2012; 19(4): 692-696.

Mroczek B. 2013. Personal Communication 2nd February 2013.

Nissenbaum M, Aramini J, Hanning C. 2012. Effects of Industrial Wind Turbine Noise on Sleep and Health. Noise and Health. 14;237-43.

Paller C. et al. 2013. Wind Turbine Noise, Sleep Quality, and Symptoms of Inner Ear Problems. Poster presented at Symposia of the Ontario Research Chairs in Public Health

Paller C. 2014. Exploring the Association between Proximity to Industrial Wind Turbines and Self-Reported Health Outcomes in Ontario, Canada [Master of Science in Health

Studies and Gerontology].University of Waterloo, Canada Downloaded from: uwspace.uwaterloo.ca/handle/10012/8268.

Pierpont N. 2009. Wind Turbine Syndrome: A Report on a Natural Experiment. K Selected Publications. Santa Fe, New Mexico.

Punch J. 2013. Review of Crichton et al (Can expectations produce symptoms from infrasound associated with wind turbines?). Downloaded from: http://waubrafoundation.org.au/resources/review-crichton-et-al-can-expectations-produce-symptoms-from-infrasound/

Roffensperger C and Tickner J. eds. 1999. Protecting public health and the environment: implementing the precautionary principle. Washington, DC: Island Press.

Rubin G J, Burns M, Wessely S. 2014. Possible psychological mechanisms for "wind turbine syndrome". On the windmills of your mind. Noise Health;16:116-22

Schomer P and Hessler G. 2015a. Review of the Cape Bridgewater acoustic testing program and where it is leading. Downloaded from: http://docs.wind-watch.org/cooper-review.pdf

Schomer P and Hessler G. 2015b. Further comments on the Cape Bridgewater Wind Farm study – Muddying the waters. Downloaded from: http://docs.wind-watch.org/cooper-review-2.pdf

Schneider P. 2012. Cullerin Range Wind Farm Survey. Downloaded from: http://docs.wind-watch.org/Cullerin-Range-Wind-Farm-Survey-August-2012.pdf

Schneider P. 2013. Cullerin Range Wind Farm Survey – Follow-up survey. July-August 2013. Downloaded from: http://waubrafoundation.org.au/wp-content/uploads/2013/09/CULLERIN-RANGE-WIND-FARM-SURVEY-Follow-up-July-August-2013.pdf

Stigwood M et al. 2013. Audible amplitude modulation - results of field measurements and investigations compared to psychoacoustical assessment and theoretical research. 5th International Conference on Wind Turbine Noise Denver 28-30 August 2013

Swinbanks M. 2013. Review of Crichton et al (Can expectations produce symptoms from infrasound associated with wind turbines?). Downloaded from: http://waubrafoundation.org.au/wp-content/uploads/2013/03/Swinbanks-critique-Petrie-et-al.pdf

Thorne R. 2012. Submission to the Senate Environment and Communications Legislation Committee. Downloaded from: http://www.aph.gov.au/Parliamentary_Business/Committees/SenateCommittees?url=ec_ctte/renewable_energy_2012/submissions.htm

van den Berg F et al. 2014, The relation between scores on noise annoyance and noise disturbed sleep in a public health survey. Int J Environ Res and Pub Health. 11:2314

Straboy Wind Farm Oral Hearing

PL.05B. 240166

PROOF OF EVIDENCE

OF

Dr Christopher Hanning
BSc, MB, BS, MRCS, LRCP, FRCA, MD

On behalf of the

GLENTIES WIND INFORMATION GROUP

October 2012

Contents

Summary

Section 1 sets out my expertise in sleep medicine and physiology, my brief from Glenties Wind Information Group, the scope of the report and source material.

Section 2 reviews the basic physiology of sleep. Noise can disturb sleep by causing awakenings, which are remembered and arousals, which are not recalled but are more likely. Both disrupt sleep making it unrefreshing. Research on the effects of wind turbine noise has concentrated on remembered awakenings and has thus underestimated the effects.

Inadequate or poor quality sleep has many health consequences apart from daytime sleepiness and fatigue. These include obesity, poor memory, increased risk of diabetes, heart disease and high blood pressure. Vulnerable groups such as children and the elderly may be at greater risk.

Section 3 reviews research on wind turbine noise, sleep disturbance and health to support the assertion that the proposed Straboy turbines are too close to human habitation for the health and well being of the occupants.

Two recent studies from New Zealand and the USA are reviewed in detail.

It is concluded that there is compelling evidence that wind turbine noise can and does disturb sleep and impair the health of those living too close and that current guidance is inadequate protection.

Section 4 examines the risk to sleep and health of the residents living in proximity to the proposed Straboy turbines. It is concluded that, even using the developer's predictions of night time noise, a high proportion of the occupants of the approximately 50 properties within 1.5km of the turbines will suffer unacceptable levels of sleep disturbance and potential risk to their health.

Section 5 Examines the Eire (NG3) and UK guidance (ETSU-R-97) and argues that they are technically inadequate and do not protect the public.

Section 6 presents the conclusions of the report that the appeal should be granted on grounds of risk to health and sleep disturbance.

Section 7 lists the documents cited in support of this paper.

1. Introduction

1.1 The author

1.1.1. My name is Dr Christopher Hanning, Honorary Consultant in Sleep Disorders Medicine to the University Hospitals of Leicester NHS Trust, based at Leicester General Hospital, having retired in September 2007 as Consultant in Sleep Disorders Medicine. In 1969, I obtained a First class Honours BSc in Physiology and, in 1972, qualified in medicine, MB, BS, MRCS, LRCP from St Bartholomew's Hospital Medical School. After initial training in anaesthesia, I became a Fellow of the Royal College of Anaesthetists by examination in 1976 and was awarded a doctorate from the University of Leicester in 1996. I was appointed Senior Lecturer in Anaesthesia and Honorary Consultant Anaesthetist to Leicester General Hospital in 1981. In 1996, I was appointed Consultant Anaesthetist with a special interest in Sleep Medicine to Leicester General Hospital and Honorary Senior Lecturer to the University of Leicester.

1.1.2. My interest in sleep and its disorders began over 30 years ago and has grown ever since. I founded and ran the Leicester Sleep Disorders Service, one of the longest standing and largest services in the country, until retirement. The University Hospitals of Leicester NHS Trust named the Sleep Laboratory after me as a mark of its esteem. I was a founder member and President of the British Sleep Society and its honorary secretary for four years and have written and lectured extensively on sleep and its disorders and continue to be involved in research. My expertise in this field has been accepted by the civil, criminal and family courts. I have been accepted as an expert on sleep disturbance related to wind turbine noise by the Ontario High Court and Environmental Review Tribunals. I chaired the Advisory panel of the SOMNIA study and sit on the Advisory panel for the Medicated Sleep and Wakefulness study, both major projects investigating sleep quality in the elderly, and sit on Advisory panels for several companies with interests in sleep medicine. I am an Associate Member of the General

Medical Council, chairing Investigation Committee hearings. In 2010, I was invited to join the Board of the Society for Wind Vigilance.

1.1.3. I live in Ashby Magna, Leicestershire which is within 1km of the Low Spinney Wind Farm.

1.2. Brief from Glenties Wind Information Group

1.2.1. My brief from Glenties Wind Information Group (GWIG) was to review the potential consequences of wind turbine noise and, in particular, its effect on sleep and health and to make recommendations with regard to the proposed setback distances.

1.3. Scope of report.

1.3.1. This report centres on the effects of industrial wind turbine noise on sleep and consequent effects on health as this is the particular area of expertise of the author.

1.4. Source material

1.4.1. A full list of the publications cited and other source material is given in Section 7 and are cited in the text. Where several articles come to the same conclusion, only the most recent may be cited, in the interests of brevity. As far as possible, articles published in peer reviewed journals are cited. However, it is inevitable that some of the material is available only on the internet reflecting the paucity of government sponsored research, particularly in the UK and Eire. Sections of the Environmental Statement relating to noise (Section 5.3 principally) were studied as were the EPA Guidance note on wind turbine noise dated June 2011.

2. Background

2.1. Introduction

2.1.1. There can be no reasonable doubt that industrial wind turbines whether singly or in groups ("wind farms") generate sufficient noise to disturb the sleep and impair the health of those living nearby and this is now widely accepted. A recently published peer reviewed editorial in the British Medical Journal (Hanning 2012) states: "*A large body of evidence now exists to suggest that wind turbines disturb sleep and impair health at distances and external noise levels that are permitted in most jurisdictions, including the United Kingdom.*" "*When seeking to generate renewable energy through wind, governments must ensure that the public will not suffer harm from additional ambient noise*". An Ontario Environmental Review Tribunal heard evidence from over 20 expert witnesses (including the author) in 2011 and concluded "*... the debate should not be simplified to one about whether wind turbines can cause harm to humans. The evidence presented to the Tribunal demonstrates that they can, if facilities are placed too close to residents. The debate has now evolved to one of degree.*" *(Case Nos. 10-121 and 10-122. p 207).* In reviewing potential health impacts of sustainable energy sources, three leading members of the National Institute of Environmental Health Sciences, part of the US National Institutes of Health, state: "*Wind energy will undoubtedly create noise, which increases stress, which in turn increases the risk of cardiovascular disease and cancer.*" (Gohlke et al. 2008). Section 5.1.1 of the draft New Zealand standard on wind farm noise, 2009, states: "*Limits for wind farm noise are required to provide protection against sleep disturbance and maintain reasonable residential amenity.*" EPA guidance is based on the UK guidance, ETSU-R-97, which is predicated in part on earlier WHO guidelines and was intended to avoid sleep disturbance. As will be demonstrated, the EPA and ETSU-R-97 night time limits are set too high to prevent sleep disturbance. Reports from many different locations and different countries have a common set of symptoms and have been documented by Frey and Hadden (2012). New cases are documented regularly on the Internet. The symptoms include

sleep disturbance, fatigue, headaches, dizziness, nausea, changes in mood and inability to concentrate and have been named "wind turbine syndrome" by Dr Nina Pierpont (2009). The experiences of the Davis (2008) family from Lincolnshire whose homes were around 900m from wind turbines make salutary reading. The noise, sleep disturbance and ill health eventually drove them from their homes. The Davises subsequently took the developers and land owners to the High Court. An out of court settlement was reached before judgement had been made. Similar stories have been reported from around the world, usually in anecdotal form but in considerable numbers.

2.1.2. Phillips, an epidemiologist, has reviewed all of the anecdotal cases and case series and, in a peer reviewed journal, contends that the quantity, consistency and ubiquity of the complaints is *prima facie* epidemiological evidence of a causal link between wind turbine noise, sleep disruption and ill health (Phillips 2011).

2.1.3 The World Health Organisation Environmental Burden of Disease – European countries project (WHO EBoDE) (WHO, 2011) selected nine environmental stressors for study, including noise (S6). *"The health effects of environmental noise were selected to cover psychosocial (sleep disturbance), cardiovascular effects (elevated blood pressure, Ischaemic Heart Disease including myocardial infarction) and learning performance."* These choices emphasise the importance that WHO place upon the effects of environmental noise on sleep disturbance.

2.2. Sleep, sleep physiology and the effects of noise

2.2.1. Sleep is a universal phenomenon. Every living organism contains, within its DNA, genes for a body clock which regulates an activity-inactivity cycle. In mammals, including humans, this is expressed as one or more sleep periods per 24 hours. Sleep was previously thought to be a period of withdrawal from the world designed to allow the body to recuperate and repair itself. However, modern research has shown that sleep is primarily by

the brain and for the brain. The major purpose of sleep seems to be the proper laying down and storage of memories, hence the need for adequate sleep in children to facilitate learning and the poor memory and cognitive function in adults with impaired sleep from whatever cause.

2.2.2. Inadequate sleep has been associated not just with fatigue, sleepiness and cognitive impairment but also with an increased risk of obesity, impaired glucose tolerance (risk of diabetes), high blood pressure, heart disease, cancer, depression and impaired immunity as shown by susceptibility to the common cold virus. Sleepy people have an increased risk of road traffic accidents. Sleepiness, as a symptom, has as much impact on health as epilepsy and arthritis. It is not insignificant.

2.2.3 Humans have two types of sleep, slow wave (SWS) and rapid eye movement (REM). SWS is the deep sleep which occurs early in the night while REM or dreaming sleep occurs mostly in the second half of the night. Sleep is arranged in a succession of cycles, each lasting about 90 minutes. We commonly wake between cycles, particularly between the second and third, third and fourth and fourth and fifth cycles. Awakenings are not remembered if they are less than 30 seconds in duration. As we age, awakenings become more likely and longer so we start to remember them.

Even while deeply asleep, the brain is processing sounds and deciding whether they merit awakening either because the sound has meaning or constitutes a threat. For example, at the same noise level, awakening is more likely when one's name is called rather than a non-specific noise. Similarly, a mother will wake when her baby cries but not for a passing car.

2.2.4. Noise interferes with sleep in several ways. Firstly, it may be sufficiently audible and annoying to prevent the onset of sleep or the return to sleep following an awakening. It is clear also that some types of noise are more annoying than others. Constant noise is less annoying than irregular noise which varies in frequency and loudness, for example, snoring, particularly if accompanied by the snorts of sleep apnoea (breath holding). The swishing

or thumping impulsive noise associated with wind turbines seems to be particularly annoying as the frequency and loudness varies with changes in wind speed and local atmospheric conditions and the character of the noise may be perceived as threatening. While there is no doubt of the occurrence of these noises and their audibility over long distances, up to 3-4km in some reports, the actual cause has not yet been fully elucidated (Bowdler 2008). Despite recommendations by the UK Government's own Noise Working Group, government sponsored research in this area has been stopped. Stigwood (2008), an independent noise consultant, has demonstrated that this noise pattern is common with large turbines.

2.2.5. Secondly, noise experienced during sleep may arouse or awaken the sleeper. A sufficiently loud or prolonged noise will result in full awakening which may be long enough to recall. Short awakenings are not recalled as, during the transition from sleep to wakefulness, one of the last functions to recover is memory (strictly, the transfer of information from short term to long term memory). The reverse is true for the transition from wakefulness to sleep. Thus only awakenings of longer than 20-30 seconds are subsequently recalled. Research that relies on recalled awakenings alone will therefore underestimate the effect.

2.2.6. Noise insufficient to cause awakening may cause an arousal. An arousal is brief, often only a few seconds long, with the sleeper moving from a deep level of sleep to a lighter level and back to a deeper level. Because full wakefulness is not reached, the sleeper has no memory of the event but the sleep has been disrupted just as effectively as if wakefulness had occurred. It is possible for several hundred arousals to occur each night without the sufferer being able to recall any of them. The sleep, because it is broken, is unrefreshing resulting in sleepiness, fatigue, headaches and poor memory and concentration (Martin 1997), many of the symptoms of "wind turbine syndrome". Arousals are associated not just with an increase in brain activity but also with physiological changes, an increase in heart rate and blood pressure, which are thought to be responsible for the increase in cardiovascular risk. A clear relationship between high blood pressure and

aircraft noise exposure has been shown by the HYENA consortium (Jarup 2008) and between traffic noise and high blood pressure for adults (Barregard 2009) and, worryingly, for preschool children (Belojevic 2008). The MESA study has suggested a link between exposure to traffic and alterations in heart function (Van Hee 2009) and Selander and colleagues (2009) have suggested a link with myocardial infarction (heart attack) but neither could separate noise effects from pollution. Arousals occur naturally during sleep and increase with age (Boselli 1998), as do awakenings which may make the elderly more vulnerable to wind turbine noise. Arousals may be caused by sound events as low as 32 dB(A) and awakenings with events of 42dB(A) (Muzet and Miedema 2005). Arousals in SWS may trigger a parasomnia (sleep walking, night terrors etc.). Pierpont (2009) notes that parasomnias developed in some of the children exposed to turbine noise in her study group.

2.2.7. Arousals are caused by aircraft, railway and traffic noise. In one study of aircraft noise, arousals were four times more likely to result than awakenings and resulted in daytime sleepiness (Basner 2011). Freight trains are more likely to cause arousals than passenger trains, presumably because they are slower, generating more low frequency noise and taking longer to pass (Saremi 2008). The noise of wind turbines has been likened to a "passing train that never passes" which may explain why wind turbine noise is prone to cause sleep disruption. A recent study of over 18000 subjects has shown a link between exposure to traffic noise and "the risk of getting up tired and not rested in the morning (de Kluizenaar, 2009). This study, together with that of Basner (2011) confirms that excessive noise disturbs sleep sufficiently to impair its restorative properties and adds credence to the anecdotal reports of those living near wind turbines.

2.2.8. Noise character is an important factor in determining whether an arousal occurs. Solet and colleagues (Solet et al. 2010) in a study of the effects of noise on hospital inpatients determined the likelihood of an arousal at different sound levels for a range of sounds from telephone, intravenous fluid pump alarm, conversation, door closing, a jet aircraft passing and a

helicopter landing (Figure 1, see end of text). Those sounds with an impulsive quality (telephone and alarm) were much more likely to cause an arousal than steadier noises such as conversation. The noise least likely to cause an arousal was the jet aircraft. Note too that for the most arousing noises, at 40dBLA$_{eq10sec}$, 80-90% of the stimuli caused an arousal. It is evident that arousals will still occur at noise levels well below 35dBA.

2.2.9. Studies of different alarm signals have shown that arousals and awakenings occur at lower sound levels with low frequency sounds than those of higher frequency (Bruck 2009). Repeated short beeps of 400-520Hz were most intrusive, leading to arousal and awakening. Wind turbine noise often has a considerable low frequency component and has an impulsive nature which may, in part, explain its adverse effect on sleep. A recent laboratory study of the effects of air, road and rail traffic noise on sleep showed that the differences were explained by sound pressure level rise time, faster rises being more likely to arouse (Basner 2011). A characteristic of wind turbine noise is the rapid rise time which may explain, in part its propensity to disturb sleep.

2.2.10. It is often claimed that continual exposure to a noise results in habituation, i.e. one gets used to the noise. There is no research to confirm this assertion. A recent small study (Pirrera et al. 2009) looking at the effects of traffic noise on sleep efficiency suggests that habituation does not occur. Griefahn and colleagues (2008) have found that the increases in heart rate with traffic noise induced arousals show no habituation.

2.2.11. Sleep disturbance and impairment of the ability to return to sleep is not trivial as almost all of us can testify. The elderly may be more vulnerable, not just because they have more spontaneous awakenings than the young but because their high frequency hearing loss may remove some of the masking of the lower frequency noise characteristic of wind turbines. In the short term, the resulting deprivation of sleep results in daytime fatigue and sleepiness, poor concentration and memory function. Accident risks increase. In the longer term, sleep deprivation is linked to depression,

weight gain, diabetes, high blood pressure and heart disease. There is a very large body of literature but please see the 2009 WHO/EU Night Noise Guidelines for Europe (WHO, 2009) for a fuller consideration.

2.2.12. Sleep spindles are short bursts of high frequency oscillation seen in the brain's electrical activity (electroencephalogram, EEG) during SWS and are a marker of sleep stability. Recent research has shown that subjects with a higher spindle rate are less likely to show an arousal in response to a transient noise than a subject with a lesser rate and are less likely to report that noise disturbs their sleep (Dang-Vu et al., 2010). The spindle rate decreases with age, explaining the vulnerability of the elderly to noise induced sleep disruption. Insomniacs, when asleep, do not have necessarily have reduced spindle counts, thus suggesting that sensitivity to noise while asleep is not purely psychological but has a physical basis thus confirming the finding that noise sensitivity is, to a large degree, inherited.

A plot of sound level against the probability of stable sleep is presented (Figure 2 see end of text). This is effectively an inverted dose-response curve of log sound pressure against the likelihood of an arousal. The study only examined noise stimuli of 40-70dB(A). However, it is reasonable to extrapolate backwards to lower noise levels. For subjects with a low spindle rate, even at a stimulus level of 35dB(A) there would be an approximate 50% probability of an arousal and a 30% probability at 35dB(A). The subjects were 26.3 (± 7.5) years of age. Older subjects would be expected to have even fewer spindles and to be even more sensitive to noise. This study confirms the findings of Solet that sleep disturbance can occur at sound levels below 35dBA.

2.3. Psychological factors and noise sensitivity

2.3.1. There is considerable interaction between the psychological response to noise and sleep disturbance, each worsening the other. It is well recognised that psychological factors and personality traits influence the response to

noise. Approximately 15% of the population are noise sensitive and have both a lowered annoyance level and an enhanced cortisol response, a physiological marker of stress. Noise sensitivity is considered to be a stable, partly heritable, personality trait; the noise sensitive being at one end of a continuum with the noise tolerant at the other. It is often implied that those who are highly annoyed by noise, including wind turbine noise, are motivated simply by a dislike of the noise source or are psychologically disturbed in some way. This is simply not the case, the response of the noise sensitive being as normal a reaction as that of the noise tolerant.

2.3.2. The noise sensitive are more likely to have stress related disorders, anxiety, headaches and poor sleep than the average. They are more likely to be found in the countryside where noise disturbance is less. Pedersen (2004) reported that 50% of her rural subjects were rather or very noise sensitive. Noise sensitivity is more likely in those with brain injury, psychological disorders such as dyslexia and Autistic Spectrum Disorder and increased community noise may exacerbate depression in susceptible individuals.

Flindell and Stallen (1999) listed factors influencing the degree of annoyance to noise:

- Perceived predictability of the noise level changing
- Perceived control, either by the individual or others
- Trust and recognition of those managing the noise source
- Voice, the extent to which concerns are listened to
- General attitudes, fear of crashes and awareness of benefits
- Personal benefits, how one benefits from the noise source
- Compensation, how one is compensated due to noise exposure
- Sensitivity to noise
- Home ownership, concern about plummeting house values
- Accessibility to information relating to the noise source

to which may be added:

- Perceived value of the noise source

- Expectation of peace and quiet
- Visual impact

Disempowerment and loss of control is a common theme from reports of those subjected to excessive wind turbine noise. The impulsive character of the noise is perceived as threatening and it can not be escaped being audible within the home, the usual source of refuge and quiet to permit restoration (Pedersen 2008), a considerable loss of amenity. The end result is fear and anger at loss of control over the living environment with increased stress responses including increased difficulty in initiating and maintaining sleep. The increased wakefulness at night and the lower quality sleep increase the impact of nocturnal turbine noise on sleep, increasing the daytime fatigue and stress and so on in a reinforcing cycle.

2.3.3. The psychological response to noise and noise sensitivity is a complex area and an excellent review is given by Shepherd, a psychoacoustician (Shepherd 2010).

2.4. Masking of turbine noise

2.4.1. One of principles of NG3 and ETSU-R-97 methodology is that background noise masks turbine noise. This is not the case as has been shown by a number of studies.

2.4.2. Nelson (2007), in a small laboratory based study examined the ability of background noise to mask turbine noise. When background noise and turbine noise where adjusted to the same loudness, the residual perceived loudness of the turbine noise was approximately half of its unmasked value (1.8sone). Even when the background noise was increased from 41 to 49dB(A) the turbine noise was not fully masked. Hayes, of the Hayes McKenzie Partnership (Hayes 2007) has interpreted this by stating in evidence that: *"one would expect the wind turbine (warranted to be free of tonal noise) to be audible even if the turbine noise was 10 - 15 dB below the*

background noise level". It can be inferred that if tonal noise is present, the turbine noise will be audible at a greater level below background noise.

2.4.3. Bolin (2009) has reported an experimental study of the masking of wind turbine noise by vegetation noise (e.g. leaves rustling). Subjects were exposed to vegetation noise in a laboratory and turbine noise introduced at varying sound pressures and vice versa and a threshold for detection determined. The results were compared with the Moore and Glasberg methods for calculating masking. The results suggest that: *"....existing models of partial masking overestimate the ability to conceal wind turbine noise in ambient sounds."* In other words, wind turbine noise is not masked as well as current models predict and is thus more intrusive. This is in accord with the work of Nelson, van den Berg, Miedema and Pedersen (2010) who show that traffic noise does not mask wind turbine noise as well as predicted.

2.4.4. It is quite clear that Hayes' evidence that turbine noise is audible 10-15dB below background is entirely correct. This basic premise of NG3 and ETSU-R-97 is thus false.

2.4.5. Sound with the impulsive characteristics of wind turbine noise is chosen for alarm systems because of its audibility below background noise as well as well as its ability to arouse a sleeper. These characteristics of wind turbine noise are probably the reason why it is more annoying than other noise sources such as road traffic and why it appears to cause more sleep disturbance.

3. Wind turbine noise, sleep and health

3.1. Introduction

3.1.1. The evidence above demonstrates that it is entirely plausible that wind turbine noise has the potential to cause arousals, sleep fragmentation and sleep deprivation. As noted above, the draft New Zealand standard on wind

farm noise acknowledges that sleep disturbance is the major adverse consequence of wind turbine noise for humans.

3.1.2 Unfortunately **all** government and industry sponsored research in this area has used **reported awakenings** from sleep as an index of the effects of turbine noise and tend to dismiss the subjective symptoms. Because most of the sleep disturbance is not recalled, this approach seriously **underestimates** the effects of wind turbine noise on sleep.

3.1.3. In my expert opinion, the weight of evidence is that industrial wind turbines of the size proposed for Straboy pose an unacceptable risk to the sleep quality and health of receptors who live within 1.5km. The approximately 120 receptors within 1.5km of the Straboy windfarm would be at an unacceptable risk to their sleep quality and health and the appeal should be granted.

3.1.4. I base my opinion on the following groups of evidence:

1. Epidemiological studies and anecdotal reports of harm following exposure to wind turbine noise.
2. Opinions from other experts as to appropriate setback distances.
3. Studies of health related effects such as annoyance. Some of these studies have commented on the effects of sleep but have not used appropriate outcome measures.
4. Studies of health effects and sleep disturbance.

3.2. Epidemiological and anecdotal studies.

3.2.1. There are a large number of anecdotal reports and surveys. In the interests of brevity, they will not be detailed here but are described in an online review (Hanning 2010). One survey is particularly worthy of mention, WindVoice (Krogh 2011), as the results have been published in a peer-reviewed journal. WindVoice is a self-reporting survey of communities affected by wind turbine noise. As of July 2010, 144 responses had been received of which 118 reported one or more health effects. 84 (58%)

reported sleep disturbance and 85 (59%). There were no age differences between those that reported sleep disturbance (51.5 yr (19-79)) and those that did not (52.2 yr (26-86)). All bar five of those reporting sleep disturbance live within 1500m of the turbines adding further support to a minimum setback of at least that distance.

3.2.2. The anecdotal reports are commonly dismissed in industry sponsored reviews (for example, Colby et al. 2009) as not acceptable evidence. Phillips, an epidemiologist, in a peer reviewed article (Phillips 2011) has examined these claims, reviewed the evidence and concluded:

"There is overwhelming evidence that wind turbines cause serious health problems in nearby residents, usually stress-disorder type diseases, at a nontrivial rate. The bulk of the evidence takes the form of thousands of adverse event reports. There is also a small amount of systematically-gathered data. The adverse event reports provide compelling evidence of the seriousness of the problems and of causation in this case because of their volume, the ease of observing exposure and outcome incidence, and case-crossover data. Proponents of turbines have sought to deny these problems by making a collection of contradictory claims including that the evidence does not "count", the outcomes are not "real" diseases, the outcomes are the victims' own fault, and that acoustical models cannot explain why there are health problems so the problems must not exist. These claims appeared to have swayed many non-expert observers, though they are easily debunked."

3.2.3. The weight of epidemiological evidence is that wind turbine noise adversely effects health at distances of at least 1.5km.

3.3. Expert opinion

3.3.1. The opinions on setback distances for 19 groups of scientists, legislators and acousticians are shown in Table II (Hanning 2010). The mean (range)

setback distance recommended is 2.08km (1-3.2). Other recommendations are given in the text.

3.3.2. Thorne, an Australian acoustician who has investigated wind turbine and their health effects concludes: *"A sound level of LAeq 32 dB outside a residence and above an individual's threshold of hearing inside the home are identified as markers for serious adverse health effects affecting susceptible individuals."* (Thorne 2011).

3.3.3. The weight of expert opinion is that wind turbine noise adversely effects health at distances of at least 1.5km.

3.4. Studies of health related effects.

3.4.1. Phipps and others (2007) surveyed 1100 New Zealand households sited up to 3.5 km from a wind farm, 604 responded. 75% of all respondents reported being able to hear the noise. Two separate developments have placed over 100 turbines with capacities from 600kW to 1.65MW in a hilly to mountainous area. It has been suggested that mountainous areas may allow low frequency noise to travel further which may explain the long distance over which the turbines were heard. This suggestion tends to be confirmed by a recent study which is detailed below for convenience.

Phipps (2007a) has reported a further analysis of this data. All subjects lived more than 2km from the turbines, 85% living within 3.5km. 13% of 284 respondents heard the turbines at night either frequently or most of the time. 42 households reported occasional sleep disturbance from turbine noise and 26 were disturbed either frequently or most of the time. Phipps concludes that the New Zealand Standard for Wind Turbine Noise should be modified so that "the sound level from the wind farm should not exceed, at any residential site, and at any of the nominated wind speeds, the background sound level (L_{95}) by more than 5 dBA, or a level of 30 dBA L_{95}, whichever is less."

3.4.2. Van den Berg (2004) found that residents up to 1900 m from a wind farm expressed annoyance with the noise, a finding replicated in his more recent study reported below. Dr Amanda Harry (2007), a UK GP, conducted surveys of a number of residents living near several different turbine sites and reported a similar constellation of symptoms from all sites. A study of 42 respondents showed that 81% felt their health had been affected, in 76% it was sufficiently severe to consult a doctor and 73% felt their life quality had been adversely impacted. This study is open to criticism for its design which invited symptom reporting and was not controlled. While the proportion of those affected may be questioned it nevertheless indicates strongly that some subjects are severely affected by wind turbine noise at distances thought by governments and the industry to be safe.

3.4.3. Project WINDFARMperception. van den Berg and colleagues (2008) from the University of Groningen in the Netherlands have published a major questionnaire study of residents living within 2.5km of wind turbines, Project WINDFARMperception. A random selection of 1948 residents were sent a similar questionnaire to that used by Pedersen in her studies in Sweden (2003, 2004, 2007 and 2008), questions on health, based on the validated General Heath Questionnaire (GHQ), were added. 725 (37%) replied which is good for a survey of this type but, nevertheless, may be a weakness. Non-respondents were asked to complete a shortened questionnaire. Their responses did not differ from full respondents suggesting the latter are representative of the population as a whole.

Questions on wind turbine noise were interspersed with questions on other environmental factors to avoid bias. The sound level at the residents' dwellings was calculated, knowing the turbine type and distance, according to the international ISO standard for sound propagation, the almost identical Dutch legal model and a simple (non spectral) calculation model. The indicative sound level used was the sound level when the wind turbines operate at 8 m/s in daytime -that is: at high, but not maximum power. Ground absorption was set to 1.0, a 100% sound absorbing surface. Typical values are around 0.5 and thus the sound levels may have been under-

estimated. Noise exposure ranged between 24 and 54dB LAeq. It is worth noting that the wind industry was approached for assistance in the research but refused. Complaints such as annoyance, waking from sleep, difficulty in returning to sleep and other health complaints were related to the calculated noise levels.

Relevant conclusions include. *"Sound was the most annoying aspect of wind turbines"* and was more of an annoyance at night. Interrupted sleep and difficulty in returning to sleep increased with calculated noise level as did annoyance, both indoors and outdoors. Even at the lowest noise levels, 20% of respondents reported disturbed sleep at least one night per month. At a calculated noise level of 30-35dB LAeq, 10% were rather or very annoyed at wind turbine sound, 20% at 35-40dB LAeq and 25% at 40-43dB LAeq, equivalent to 38-41dB LA_{90}, less than the permitted minimum ETSU-R-97 night time level.

Project WINDFARMperception further found that *"Three out of four participants declare that swishing or lashing is a correct description of the sound from wind turbines. Perhaps the character of the sound is the cause of the relatively high degree of annoyance. Another possible cause is that the sound of modern wind turbines on average does not decrease at night, but rather becomes louder, whereas most other sources are less noisy at night. At the highest sound levels in this study (45 decibel or higher) there is also a higher prevalence of sleep disturbance."* The lack of a control group prevents this group from making firmer conclusions about turbine noise and sleep disturbance but it is clear that as EPA guidance permits an exterior night time noise level of 45dB, relying on its calculations will guarantee disturbed sleep for many of those living nearby.

van den Berg concluded also that, contrary to industry belief, road noise does not adequately mask turbine noise and reduce annoyance and disturbance. In addition, the authors compared their results with studies by Miedema on the annoyance from road, rail and air related noise. Wind turbine noise was several times more annoying than the other noise sources

for equivalent noise levels (**Fig 3**). Similar data is given by Pedersen (2004) (**Fig 4**) – **see end of text**.

With regard to health it was concluded that: *"There is no indication that the sound from wind turbines had an effect on respondents' health, except for the interruption of sleep. At high levels of wind turbine sound (more than 45 dB(A)) interruption of sleep was more likely than at low levels. Higher levels of background sound from road traffic also increased the odds for interrupted sleep. Annoyance from wind turbine sound was related to difficulties with falling asleep and to higher stress scores. From this study it cannot be concluded whether these health effects are caused by annoyance or vice versa or whether both are related to another factor."* The conclusions regarding general health are not justified from the data for the reasons given below and must be disregarded.

Project WINDFARMperception is currently the largest study in this field but the study is not without considerable flaws. The study may be criticised for using calculated noise levels and for not having a control group (residents not living near turbines). While several of the contributors have expertise in the investigation of health matters, none has specific expertise in the physiology and pathophysiology of sleep. The purpose of the study, as its title suggested, was the public perception of wind turbines and their noise. Health questions were added but were of a very general nature. The small number of respondents suggests that any conclusions as to the apparent lack of an effect on health must be regarded as tentative.

The analysis of reported sleep interruption and wind turbine sound levels is flawed by the use of subjects exposed to calculated external turbine sound levels of <30dB(A) (p53) as the "controls". It has been noted by several studies that calculated turbine noise is often less than measured noise and that levels as low as 30dB(A) can cause annoyance (Pedersen 2007). Examination of the odds ratio for different calculated sound levels (van den Berg Table 7.42) shows that it increases progressively with increasing sound levels starting at 30-35dB(A) and becomes statistically significant for

levels >45dB(A). If, as is not impossible, the "control" group had its sleep disturbed by wind turbine noise then the actual effect would be underestimated.

The major objection to the conclusions on health is that the study is grossly under-powered (insufficient subjects were studied for any degree of statistical confidence). Marked ill-health, "Wind turbine syndrome", to the degree reported by Pierpont (2009), does not seem to be common even amongst those exposed to high noise levels. The study tried to detect chronic disease with the GHQ, which is a fairly crude instrument. Assuming that "wind turbine syndrome" affects 1% of those exposed to calculated sound levels >45dB(A) and that 25% of the general population suffer from chronic disease (p47) then at least 30,000 subjects would need to be studied in each group (>45dB(A) v <30dB(A)) to be able to prove a difference with 95% certainty. Even if a prevalence of "wind turbine syndrome" of 5% of those exposed to >45dB(A) is assumed, then there must be at least 1250 subjects in each group. It is possible also that those with a degree of ill health are more vulnerable and more likely to develop symptoms. A general health questionnaire will not detect such people and symptom specific surveys will be required. This study therefore can not conclude that wind turbines do not cause ill health of any degree, it can not even make conclusions about severe ill health.

3.4.4. Pedersen, van den Berg and others (Pedersen 2009a&b) have further analysed the data in an attempt to model a generalised dose-response relationship for wind turbine noise. A noise metric, Lden, was calculated. Lden is based on long-term equivalent sound pressure levels adjusted for day (d), evening (e) and night). Penalties of 5 and 10dB are added for evening and night hours respectively to reflect the need for quietness at those times. dB(A) LAeq values for wind turbines may be transformed to Lden values by adding 4.7±1.5 dB (van den Berg 2008). Annoyance is used as the principal human response to wind turbine noise in this analysis. In this context, "annoyance" is more than simply irritation but is a measure of

lack of well-being in a wider sense (Pedersen 2009a) and is contrary to the WHO definition of health.

Annoyance increased with increasing sound levels, both indoors and outdoors. The proportion who were rather and very annoyed at different sound levels are shown in Table I. In summary, when outside, 18% were rather or very annoyed at sound levels of 35-40 and 40-45 dB LAeq compared to 7% at 30-35dB LAeq and 2% at <30dB LAeq. When inside, the equivalent figures were 1% at <30dB LAeq, 4% at 30-35dB LAeq, 8% at 35-40dB LAeq and 18% at 40-45dB LAeq. Those respondents who had an economic interest in the turbines had lower levels of annoyance while negative views of the visual impact of turbines increased the likelihood of annoyance.

Although the authors do not seek to recommend minimum sound levels, they do note that turbine noise was more annoying than other sources, with the possible exception of railway shunting yards and was more noticeable at night. They conclude that: *"...night time conditions should be treated as crucial in recommendations for wind turbine noise limits."* Nevertheless, it is clear from this analysis that external predicted turbine sound levels should be less than 35dB LAeq (33dB LA_{90}), considerably less than those permitted by EPA guidance, in order to reduce effects on nearby residents to acceptable levels.

3.4.5. Pedersen (2009a&b) has recently combined the datasets from three studies (Pedersen 2004 (SWE00)) and 2007 (SWE05) and van den Berg 2008 (NL07)) as they used similar questionnaires giving a total of 1764 subjects. A strong correlation was seen in all studies between calculated A weighted sound pressure levels and outdoor annoyance as noted above.

Even at sound pressures of 30-35 dB LAeq, 5-12% of subjects were very annoyed. Correlations were found also between annoyance and symptoms of stress (headache, tiredness, tension and irritability) confirming that "annoyance" is more than irritation and is a marker of impaired health. The

sleep disturbance question did not ask causation of the sleep disturbance and a background level would therefore be expected from other causes (traffic noise, weather, etc). Nevertheless, there was a clear increase in levels of sleep disturbance with A-weighted sound pressure in studies SWE00 and NL005. (Figure 5, See end of text). Pedersen states *"In the first Swedish study (SWE00) the increase of respondents that reported sleep interruption appears to be between the sound level interval 35-40 dB(A) and 40-45 dB(A). The increase came at higher sound levels in the Dutch study (NL07); between the interval 40-45 dB(A) and >45 dB(A)"*. All values are LAeq. There is no true measurement of background levels of sleep disturbance as no study had a control group, it is difficult therefore to determine at what sound pressure level turbine noise begins to have an effect. but even the conservative levels suggested above are less than those permitted by EPA guidance.

3.4.6. The weight of evidence of the health related consequences of wind turbine noise is that it adversely effects health at distances of at least 1.5km.

3.5. Sleep disturbance and health effects.

3.5.1. The Pedersen and van den Berg studies cited above, showed that a significant proportion of receptors are affected at noise levels less than those permitted by EPA guidance, even though they used an insensitive measure of sleep disturbance. The studies by Shepherd and Nissenbaum and colleagues show convincingly that wind turbine noise levels permitted under EPA guidance have a serious adverse effect on sleep.

3.5.2. Dr Daniel Shepherd, (2011) a psychoacoustician from the University of Auckland, New Zealand, has published, in a peer reviewed journal, a case-control study of the health status of residents living within 2km of the Makara windfarm. Health related quality of life (HRQoL) was measured using the WHO QOL-BREF which has four subscales, physical, including sleep, psychological, social and environmental. The questionnaire was disguised as a general health survey by adding

questions on neighbourhood problems, amenity and noise and air pollution annoyance as distractors.

34% (39) of those living within 2km of the Makara turbines responded and were compared with 158 subjects from a socio-economic matched group who lived at least 8km from a turbine. Examination of a map of the area (Shepherd 2011, page 335) shows that the residences are between 800m and 2km from the turbines, the mean being about 1.4km. While noise levels were not measured simultaneously with the study, earlier measurements showed outdoor noise levels of between 20 and 50dBA $L_{95(10min)}$ depending on meteorological conditions.

The turbine group had significantly lower (P = 0.017) mean physical HRQOL domain scores than the comparison group. This was due to a difference in perceived sleep quality between the two areas (P = 0.006) and between self-reported energy levels (P= 0.028). The turbine group had significantly lower (P = 0.018) environmental QOL scores than the comparison group. The turbine group considered their environment to be less healthy (P < 0.007) and were less satisfied with the conditions of their living space (P = 0.031). Thirdly, mean ratings for an overall quality of life item was significantly lower (P =0.019) in the turbine group.

There were no differences between groups for traffic or neighbourhood annoyance. A comparison between ratings of turbine noise was not possible, but the mean annoyance rating for turbine group individuals who specifically identified wind turbine noise as annoying (n=23) was 4.59 (SD = 0.65), indicating that the turbine noise was perceived as extremely annoying.

This carefully conducted, controlled peer-reviewed study clearly demonstrates that living within 2km of wind turbines is harmful to health. To quote the authors: *"Demonstrably, our data have also captured the effects of wind turbine noise on sleep, reinforcing pervious studies suggesting that the acoustic characteristics of turbine noise are well suited to disturb the sleep of exposed individuals."* and *"..we conclude that night-time wind turbine*

noise limits should be set conservatively to minimise harm and, on the basis of our data, suggest that setback distances need to be greater than 2km in hilly terrain."

3.5.3. Botha (2011) reports on sound monitoring carried out at the Makara wind farm. He notes that noise complaints were received immediately after the site became operational in 2009. The operators adjusted the turbines to reduce the tonal character of the noise shortly thereafter. Botha states that the sound levels recorded were within those permitted by the then current New Zealand standard. It is important to note that Shepherd's study was conducted **after** the adjustments to the turbines that were intended to eliminate noise complaints and that the sleep and health impairments occurred at levels permitted by NZ standards which are lower than those permitted by EPA guidance.

3.5.4. Nissenbaum (2010) has presented the preliminary results of a study of residents living downwind and within 300-1100m (mean 800m) of a wind farm at Mars Hill, Maine, USA. The 28 1.5MW turbines are sited on a 200m high ridge overlooking the homes. 22 of about 35 adult residents have been interviewed so far and compared with a randomly selected control group living a mean 6km away. 18/22 reported new or worsened sleep onset disturbance at least twice a week, for 9 at least 5 times per week (controls 1/28). 8/22 reported new or worsened headaches (controls 1/28) and 18/22 reported new or worsened mental health symptoms (stress 12/22, anger 18/22, anxiety 8/22, hopelessness 12/22, depression 10/22) (controls 0/28).

The 22 subjects received 15 new or increased prescriptions from their physicians in the 18 months between the start of turbine operation and the study, the majority for psychoactive medication (controls 4 prescriptions, none for psychoactive medication). 21/22 reported reduced quality of life and 20/22 considered moving away (controls 0/28 for both).

As a result of the complaints, noise monitoring during turbine operation was undertaken at the community test sites at which background noise monitoring and calculated turbine noise levels had been derived during the planning stage. The residents surveyed generally lived between the 40-45dB contours, two lived within the 45-50dB contours. Noise control regulations in Maine call for test sites to be more than 500ft from "protected properties". Six test sites are relevant to the study group and the results are given below.

Site No.	Model estimate (dB)	Range of measured sound levels (dB)
1	51	42-52
5	39	39-40
6	43	39-45
6A	42	38-44
7	40	39-44
8	47.5	41-50

It can be seen that model estimates generally underestimated the actual maximum noise levels by between 1 and 4dB. Exceedances of EPA guidance night time levels of 45dB are generally small, and only exceed by 5-7dB at the two closest sites. It is clear that the majority of residents were living at distances and sound levels that would be permitted under EPA guidance but nevertheless report high levels of sleep disturbance and health impairment.

The study may be criticised for its relatively small numbers of subjects but the presence of a control group, well matched for age and gender, adds considerable power. All differences between the groups are statistically highly significant. The turbine noise levels may be enhanced by the high concentration of turbines and the geography but the severe sleep disturbance, psychiatric symptomatology and increased medication requirement in the study group confirms the potential of wind turbine noise to adversely affect health at distances claimed to be safe.

3.5.4. A second study, published in a peer-reviewed journal (Nissenbaum et al. 2012) was conducted at two sites, Mars Hill and Vinalhaven, Maine, USA. In contrast to Mars Hill, the Vinalhaven site comprises three 2.5MW turbines on a flat tree covered island.

A questionnaire was offered to all residents meeting inclusion criteria living within 1.5 km of an IWT and to a random sample of residents meeting inclusion criteria living 3 to 7 km from an IWT between March and July of 2010. The questionnaire comprised validated instruments relating to mental and physical health (SF-36v2) (QualityMetric Inc.), sleep disturbance (Pittsburgh Sleep Quality Index (PSQI) and the Epworth Sleepiness Scale (ESS), in addition to headache functional inquiry questions and a series of attitudinal questions relating specifically to changes with exposure to IWT noise. The PSQI asks a series of questions about sleep and daytime functioning over the preceding few weeks to give an overall score of sleep quality. The ESS asks subjects to rate their likelihood, over the past few weeks, of falling asleep in eight situations on a 0-3 scale. A typical score is about 5 and scores >10 are deemed significantly sleepy.

33 and 32 adults were identified as living within 1,500 m of the nearest IWT at the Mars Hill (mean. 805 m, range 390-1,400) and Vinalhaven sites (mean 771 m range 375-1,000) respectively. 23 and 15 adults at the Mars Hill and Vinalhaven sites respectively completed questionnaires. Recruitment of control group participants continued to approximately the same number as study group participants, 25 and 16 for Mars Hill and Vinalhaven respectively.

There were no significant differences between the groups with respect to household size, age, or gender.

Table 1. Demographic data

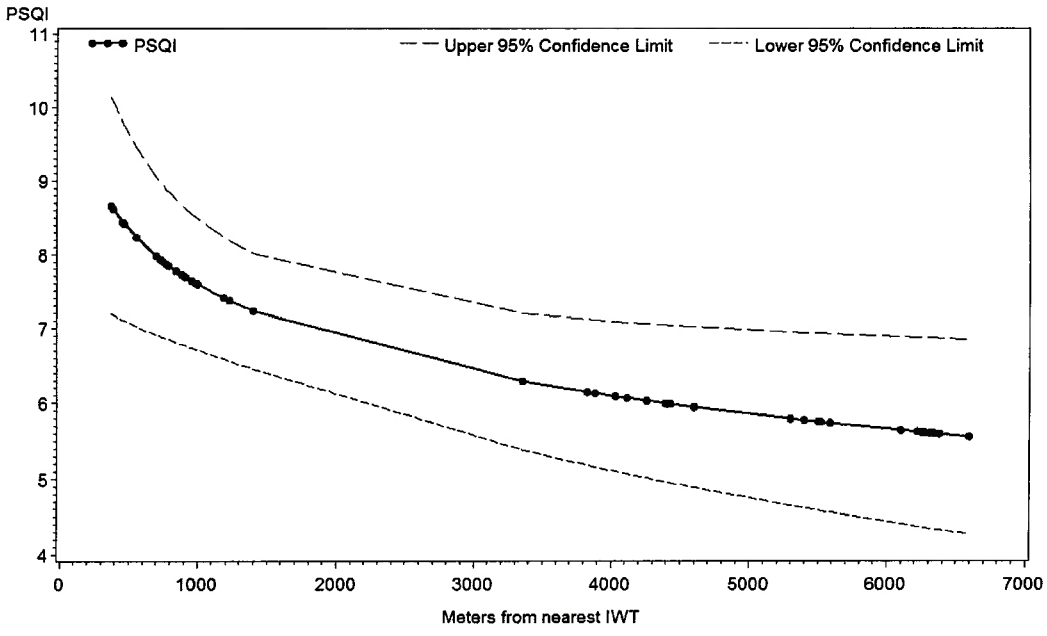
	Distance range from residence to nearest IWT (mean) in meters			
Parameter	375-750 (601)	751-1,400 (964)	3,300-5,000 (4,181)	5,300-6,600(5,800)
Sample size	18	20	14	27
Household clusters	11	12	10	23
Mean age	50	57	65	58
Male/Female	10/8	12/8	7/7	11/16

The study group had worse sleep as evidenced by significantly higher mean PSQI and ESS scores and a greater number with PSQI >5 (Table 2). More subjects in the study group had ESS scores >10 but the difference did not reach statistical significance (p=0.1313). The study group had worse mental health as evidenced by significantly higher mean mental component score of the SF36. There was no difference in the physical component scores.

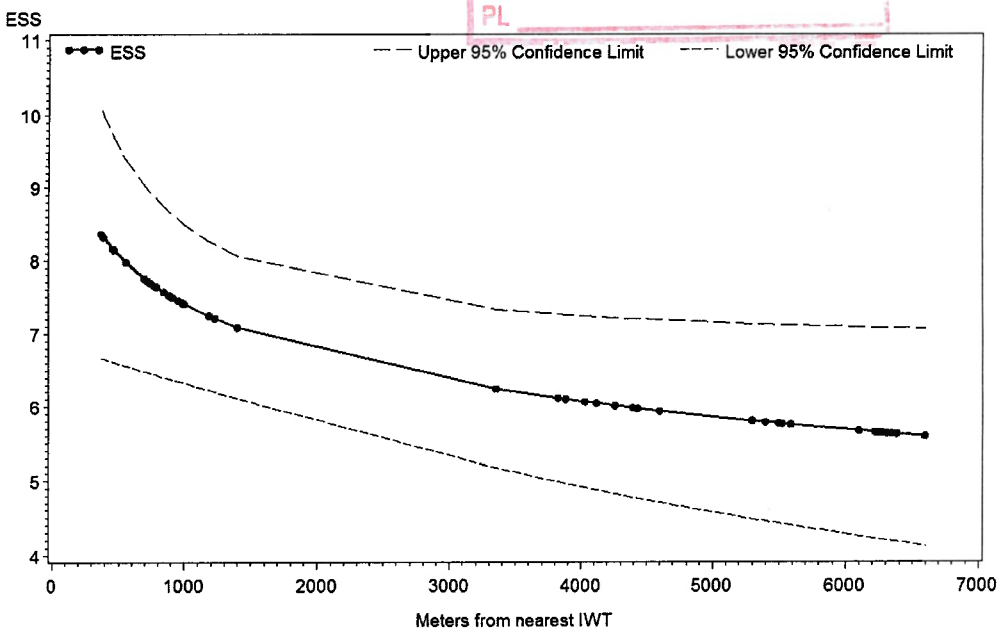
Table 2. Sleep and mental health parameters

Parameter	Distance to IWT: Range (mean) m		p
	375-1,400 (792)	3,000-6,600 (5,248)	
PSQI Mean (LSmean)	7.8 (7.6)	6.0 (5.9)	0.0461
% PSQI >5	65.8	43.9	0.0745
ESS Mean (LSmean)	7.8 (7.9)	5.7 (5.7)	0.0322
% ESS >10	23.7	9.8	0.1313
SF36 MCS Mean (LSmean)	42.0 (42.1)	52.9 (52.6)	0.0021

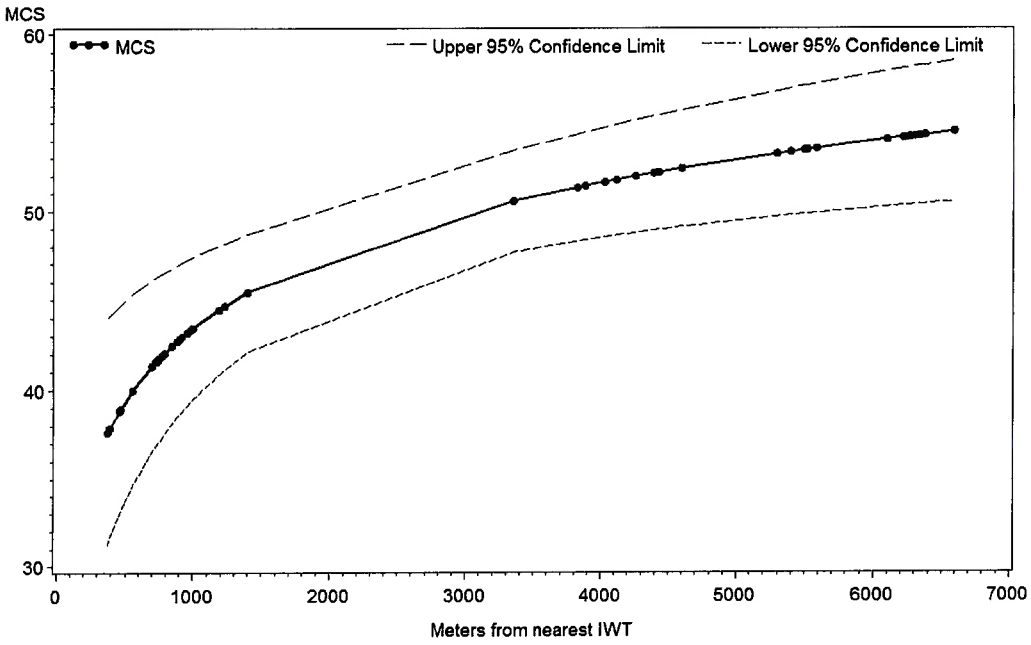
ESS, PSQI and SF36 scores were modeled against distance from the nearest IWT using the equation: Score = ln(distance) + gender + age + site [controlled for household clustering] and are shown in Graphs 1-3. In all cases, there was a clear and significant relationship with the effect diminishing with increasing distance from the IWT.



Graph 1. Modeled PSQI vs Distance. (mean, 95 % confidence limits), p-value=0.0198



Graph 2. Modeled ESS vs Distance (mean, 95 % confidence limits), p-value=0.0331



Graph 3. Modeled SF36 MCS vs Distance (mean, 95 % confidence limits), p-value=0.0014

Those living within 1.4km of IWT suffered sleep disruption which is sufficiently severe as to affect their daytime functioning and mental health. Both the ESS and PSQI are averaged measures, i.e. they ask the subject to assess their daytime sleepiness and sleep quality respectively, over a period of several weeks leading up to the present. For the ESS to increase, sleep must have been shortened or fragmented to a sufficient degree on sufficient nights for normal compensatory mechanisms to have been overcome. It must be concluded that at least some of the residents living near the Vinalhaven and Mars Hill IWT installations have suffered serious harm to their sleep and health.

Both studies have been accepted for publication in peer reviewed journals and have been presented at a major international meeting on noise and health, ICBEN 2011 (Nissenbaum 2011). Peer review by the organising committee of the meeting led to acceptance and allocation to oral presentation rather than poster presentation. In addition, the data was presented as evidence to the Kent Breeze Environmental Review Tribunal, Ontario, Canada where it was subjected to intense scrutiny by experts commissioned by the developers, Suncor, and the Ontario Ministry of the Environment. This scrutiny exceeded by a considerable margin the degree of peer-review undertaken by academic journals which rarely, if ever, examine the raw data and the calculations as occurred here. The tribunal concluded: *"This case has successfully shown that the debate should not be simplified to one about whether wind turbines can cause harm to humans. The evidence presented to the Tribunal demonstrates that they can, if facilities are placed too close to residents. The debate has now evolved to one of degree."* (p. 207).

The Tribunal was required to find that "serious" harm be caused to receptors, a requirement of Ontario law, before allowing the appeal. While it was convinced that harm occurs, it could not be persuaded that it met the definition of "serious". The windfarm commenced operations in May 2011 and the first law suit by residents has already been filed (Seglins 2011). The affected family who live 1.1km from the turbines claim *"the wind turbines*

have caused debilitating vertigo, sleep disturbance, headaches and ringing in the ears, as well as stress, depression and even suicidal thoughts."

3.5.5. The weight of evidence from investigations of the effects of wind turbine noise on sleep and health is conclusive that it causes adverse effects at distances of at least 1.5km.

3.6. Conclusions

It is abundantly clear that wind turbine noise adversely effects sleep and health at setback distances and noise levels permitted by EPA guidance. There is no evidence at all that wind turbines are safe at these distances and noise levels, not a single study. In contrast there is an increasing volume of studies outlined here to the contrary.

4 Straboy and surroundings

4.1. Straboy and surroundings

4.1.1. Section 5.3.1.1. of the Environmental Statement calls this area "relatively uninhabited". There are approximately 28 dwellings within 1km of the turbines, and a further 18 within 1.5km. Assuming 2.5 occupants per household then about 70 receptors, amongst whom are likely to be some children, are at high risk of sleep disruption and consequent effects on their health and a further 45 are at moderate risk. This is not a relatively uninhabited area and the residents can not simply be dismissed. The statement at the bottom of page 111 of the ES is simply not credible.

4.1.2. No background noise measurements have been made for this site. An extraordinary omission. If this is a "relatively uninhabited" and "remote" area as is claimed then it will be expected to have very low background noise levels and, at least for daytime noise limits, will attract a lower noise limit. Table 5.3.3. of the ES quotes "typical noise levels generated from the interaction of foliage/vegetation effects at wind velocities above 8m/s." No reference is given as to the source of this data nor the conditions under which it was recorded. The values are high suggesting strongly that the main source of noise was the interaction between wind and microphone rather than vegetation. Quoted night time levels and wind speeds are greater than during the day. This ignores the effect of a stable atmosphere (wind shear) at night when wind speeds at hub level are much greater than at ground level and any masking is reduced. Using this data to justify exceedances of the already inadequate NG3 is inappropriate.

4.1.3. "WindFarm Release 4.1.2.2." was used to calculate noise emissions. ISO 9613 is used to calculate noise propagation. This standard has a ±3dB error which, conveniently, is not included in the calculations. No values are given for ground absorbancy, nor does any allowance seem to have been made for wind shear. It is therefore impossible to tell whether worst case conditions have been predicted. There has been no measurement of the

wind resource, wind direction nor the likelihood of wind shear. It is likely that the noise limits quoted will be underestimates

4.1.4. The ES cites the ACANWEA publication (Colby, 2009) to justify it's stance on health effects. The quality and authority of this review and its conclusions are open to considerable doubt (Horner, 2012). The medical members of the panel comprised a microbiologist, an otolaryngologist and an occupational health physician specialising in respiratory disease. From their biographies, none seems to have any expertise in sleep medicine or in psychology. The reference list shows that the literature review was far from complete. The panel admits that wind turbine noise causes annoyance which can lead to sleep disturbance but dismisses these findings. It is clear that they did not understand the significance of "annoyance" in a health context and neither did they comprehend the importance of sleep disturbance in causing ill-health.

The UK NHS Knowledge Service reviewed the paper (NHS 2010) and concluded: *"This research is unlikely to resolve the controversy over the potential health effects from wind turbines. This is mainly because the research on which the review was based is not sufficient to prove or disprove that there are health effects. The review itself also had some methodological shortcomings, and the reviewing group did not include an epidemiologist, usually a given for assessing potential environmental health hazards. Further research on this issue is needed."*

The Society for Wind Vigilance (Society for Wind Vigilance, 2010a&b) has reviewed the ACANWEA paper, publishing a detailed critique and concluded: *"It is apparent from this analysis that the A/CanWEA Panel Review is neither authoritative nor convincing. The work is characterized by commission of unsupportable statements and confirmation bias in the use of references. Many important references have been omitted and not considered in the discussion. Furthermore the authors have taken the position that the World Health Organization standards regarding community noise are irrelevant to their deliberation - a remarkable presumption."*

It is clear that the Colby report is not to be relied upon. It was inaccurate and incomplete when written, with the publication of the evidence cited in this report it is evident that it is no justification for the harm proposed at the Straboy site. My recent peer-reviewed editorial in the British Medical Journal (Hanning, 2012) with Professor Alun Evans, Queen's University, Belfast, gives a balanced assessment of the current evidence and is quoted more fully above.

4.1.5. The quality of the sound contour maps in the ES, as originally provided is so poor that it is impossible to make out any detail. Nevertheless, it is apparent that the turbines are sitting on ridges and hills running roughly parallel to the downwind rural road along which most of the receptors live. Many of the turbines seem to be sited close together raising concerns about wake effects and excessive amplitude modulation. Clearer copies of the maps have come to hand and show that, at a wind speed of 8m.sec^{-1} all of the properties examined will experience noise levels in excess of 35dBA using the developers own calculations and the great majority levels in excess of 40dBA. It is worth noting also that this site is not dissimilar to Mars Hill and Makara of elevated turbines above a road. There is no reason to suspect that the noise and health problems experienced at those sites will not be repeated at Straboy.

4.2. Conclusions

4.2.1. Those receptors living within 1km of the proposed turbines are at high risk of sleep disturbance and impairment to their health. Those living between 1 and 1.5km are at risk of sleep disturbance and impairment to their health even if the turbines are operating in a reduced power configuration.

5. GUIDANCE NOTES: NG3 and ETSU-R-97

5.1. NG3

5.1.1. NG3 was prepared by Ms Sinéad McAlleer, a senior scientist with Fehiley Timoney and Company, Consulting Engineers and Dr Andrew McKenzie, an acoustician with Hayes McKenzie, a UK based acoustics consultancy. A search of the relevant company websites does not suggest that either has any expertise in sleep physiology as is evident from the shortcomings. The potential conflict of interests of the two principal authors, both of whom work for companies that derive significant revenue from wind turbine developments is clear.

My comments relate to the guidance as it affects sleep and health. NG3 has been largely framed from the UK's ETSU-R-97 guidance so criticisms apply equally to both policies unless mentioned specifically.

5.1.2. Section 3.4 discusses "subjective responses to wind turbine noise" and states that the only methods by which sleep is disturbed is by preventing the onset and return to sleep. This is clearly incorrect. Studies of the effects of transport noise on sleep show that arousals are more likely than remembered arousals and there is therefore a direct effect on sleep. Shepherd (2012) notes that some of his subjects with impaired health scores did not complain of sleep disturbance. The degree of daytime sleepiness noted by Nissenbaum (2012) also makes it highly likely that there was a direct effect on sleep

5.1.3. Section 4.1 claims that turbine noise is masked by background noise. Section 2.4 of this report sets out the evidence that this statement is incorrect. The sworn evidence of Hayes (2007) should be noted particularly as he is also a partner in the Hayes McKenzie partnership.

5.1.4. Section 7.3 discusses the proposed noise limits and advocates essentially similar limits to ETSU-R-97 of 43dB L_{A90} or 5dB above background noise whichever is the greater for nighttime hours. A lower limit is set for daytime hours where background noise is less than 30dB L_{A90} but, amazingly not for nighttime

hours. Clearly, preservation of sleep for those in noise sensitive locations was not a priority.

5.1.5. A cumulative site and turbine noise limit of 45db LAeq at night time is set although it is unclear as to when that limit applies and whether developers are required to measure background levels provided they can claim that the noise levels at NSLs will be lower than this limit. The authors admit that these levels are less strict than the guidance in France, Sweden and Denmark. It should be noted that the latter has recently introduced regulations to control low frequency noise and infrasound which contradicts the claims made in Section 3.3.3 of NG3.

5.2. ETSU-R-97

5.2.1. ETSU-R-97 does not adequately protect the public from the impacts of wind turbine noise. Those framing the guidance got it wrong. The document admits that the permitted noise levels were selected so as not to unduly fetter the introduction of wind energy into electricity generation. The evidence presented above shows that they erred. Wind turbine size has increased since ETSU-R-97 was published which may be contributory.

5.2.2. A DTI report by the Hayes McKenzie Partnership (HMP) published in 2006 (DTI 2006) investigated low frequency noise at three UK wind farms (DTI 2006 CD H28). The published conclusions were that all was well with ETSU-R-97. However, draft versions of the report (DTI 2006a,b,c) came to light as a result of Freedom of Information requests. They show that HMP had recommended a reduction of the ETSU-R-97 permitted night time limits to 38dB LA90 (40dB LAeq) in the absence of AM with a further penalty of up to 5dB in the presence of modulation. These recommendations were removed from the final version of the report. No scientific explanation for their removal seems to have been offered. It was stated in the draft:

"The analysis of the external and internal noise levels indicates that it may be appropriate to re-visit the issue of the absolute night-time noise criterion specified within ETSU-R-97. To provide protection to wind farm neighbours,

it would seem appropriate to reduce the absolute noise criterion for periods when background noise levels are low. In the absence of high levels of modulation, then a level of 38 dB LA90 (40 dB LAeq) will reduce levels to an internal noise level which lies around or below 30 dB LAeq with windows open for ventilation. In the presence of high levels of aerodynamic modulation of the incident noise, then a correction for the presence of the noise should be considered."

Similarly, references to WHO guidance for the protection of sleep disturbance which supported HMP's recommendations for a reduction in ETSU-R-97 night time noise limits were removed from the drafts. It was stated:

"If one takes the guidance within the WHO for the protection against sleep disturbance of 30dB LAEq, and apply a 5 dB correction for the presence of high levels of [aerodynamic] modulation within the incident noise, then this gives rise to an internal noise criterion of 25dB LAeq. Based upon the measured building attenuation performances at Site 1 & 2, then an external level between 35 – 40dB LAEq (33-38 dB LA90) would provide sufficient protection to neighbouring occupants to minimise the risk of disturbance from the modulation of aerodynamic noise."

5.2.3. The inadequacy of ETSU-R-97 is supported by others. Many expert acousticians have severely criticised ETSU-R-97, not least Mr Dick Bowdler (Bowdler 2005), a former member of the Government's Noise Working Group considering ETSU-R-97. A number of Her Majesty's Inspectors have been equally critical, not least Mr Andrew Pykett and Ms Elizabeth Ord. The original recommendations by HMP, at least one of whose employees sat on the NWG, for a reduction in the ETSU-R-97 night time noise limits to 33-38dBA suggests very strongly that it is inappropriate to continue to rely on ETSU-R-97 as presently formulated.

5.2.4. A recent authoritative review of ETSU-R-97, *Where ETSU is silent* (Cox et al., 2012) shows how the inadequacies of ETSU, particularly in the

measurement of background noise, allowance for wind shear, calculation of turbine noise levels, allowance for tolerances in calculations and allowance for excessive amplitude modulation have conspired to permit turbines too close to residences for the well being of the residents. The authors recommend a setback of at least 2km.

5.2.5. UK Government policy is that ETSU-R-97 should be used for the assessment of the likely impact of wind turbine noise and this was restated in a 2007 policy statement. Developers will often assert that, as it is government policy, ETSU-R-97 may not be questioned. However, as Mr Justice Mitting stated in a judicial review brought by the Renewable Energy Foundation (CO/9686/2007): *"It will always be open to any objector to an application for permission to develop a site as a windfarm, to contend that the Statement is technically inadequate or erroneous."* David Forsdick, of Landmark Chambers, a leading barrister with particular expertise in planning matters, stated, at a seminar on renewable energy on the 1st October 2008 (Forsdick 2008):

"...., general policy and guidance cannot prevent consideration of:

a. the specific facts of an individual case;

b. scientific information which suggests that the general methodology may need to be adjusted on the facts of an individual case; or

c. actual experience elsewhere on the ground which shows that the government approved methodology does not always accurately predict the impacts.

Thus, whilst it is undoubtedly true that it is not for parties to an inquiry to question the merits of government policy, their evidence on the matters in the previous paragraph is plainly capable of constituting "other material considerations" which the decision maker has to take into account and, in an appropriate case, reach a conclusion on.

5.1.6. It would seem logical that the specific facts of an individual case would include the presence of particularly sensitive receptors. It is known that about 15% of the population is noise sensitive and that they are more likely to found in quiet rural areas such as Straboy. Given the population within

1.5km of the proposed turbines, it is certain that such receptors will be present.

5.3. Conclusions

5.3.1. It is clear that both NG3 and ETSU-R-97 are *"technically inadequate and erroneous"*. Neither provides adequate protection to the sleep quality and health of receptors.

6. Conclusions

There is no published experimental evidence that wind turbines are safe with respect to sleep disturbance and health at the distances and noise levels permitted by NG3 and proposed at Straboy. Not a single paper can be offered, merely unsubstantiated assertions and assumptions. In contrast, there is good evidence, described above, that those receptors living with 1.5km of the proposed turbines are at significant risk of disturbance to their sleep and consequent effects on their health.

The evidence presented constitutes material evidence why the Appeal should be granted on the grounds of an unacceptable health risk to nearby receptors.

CD Hanning
12th October 2012

7. Bibliography

Barregard L, Bonde E and Ohrstrom E. 2009. Risk of hypertension from exposure to road traffic noise in a population based sample. *Occup. Environ. Med.* 66:410-415.

Basner M, Muller U and Elmenhorst E. (2011) Single and combined effects of air, road, and rail traffic noise on sleep and recuperation. *Sleep.* 34:11-23.

Belojevic G et al. 2008. Urban road traffic noise and blood pressure and heart rate in preschool children. *Environment International*. 34:226-231

Bolin K., 2009. Wind Turbine Noise and Natural Sounds-Masking, Propagation and Modeling. Doctoral Thesis. Royal Institute of Technology, Stockholm.

Boselli M et al. 1998. Effect of age on EEG arousals in normal sleep. *Sleep*, 21 (4): 351-357

Botha P. Wind turbine noise and health-related quality of life of nearby residents: a cross-sectional study in New Zealand. ; INCE Europe. ISBN:978-88-88942-33-9. Rome, Italy: Proceedings of the 4th International Meeting on Wind Turbine Noise; 2011. p. 1-8.

Bowdler D. 2005. ETSU-R-97: why it is wrong. New Acoustics. www.newacoustics.co.uk

Bowdler D. 2008. Amplitude Modulation of Wind Turbine Noise. A Review of the Evidence. New Acoustics. www.newacoustics.co.uk

Bruck D et al. 2009. How does the pitch and pattern of a signal affect auditory arousal? Journal of Sleep Research 18:196-203

Colby et al. 2009. Wind Turbine Sound and Health Effects; An Expert Panel Review. American and Canadian Wind Energy Associations.

Cox R, Unwin D and Sherman T. 2012. Wind turbine noise impact assessment, where ETSU is silent. http://www.wind-watch.org/documents/where-etsu-is-silent-wind-turbine-noise-impact-assessment/

Dang-Vu et al. 2010. Spontaneous brain rhythms predict sleep stability in the face of noise. Current Biology. 20:R626-7.

Davis J and Davis S. Noise pollution from wind turbines – living with amplitude modulation, low frequency emissions and sleep deprivation. Proceedings of Wind Turbine Noise 2007.

de Kluizenaar, Y et al. 2009. Long-term road traffic noise exposure is associated with an increase in morning tiredness. J Acoust Soc Am 126:626-33

DTI. 2006. The Measurement of Low Frequency Noise at Three UK Wind Farms – W/45/00656/00/00 – Hayes McKenzie Partnership. Plus draft reports 2006a, b, c.

Flindell IH, Stallen PM. 1999. Non-acoustical factors in environmental noise. Noise Health;1:11-6

Forsdick D. 2008 Noise and wind turbine proposals. Renewable Energy Seminar paper, 1st October 2008. http://www.landmarkchambers.co.uk /__data/assets/pdf_file/0004/32539/3.2_Noise__and__Wind_Turbines.pdf

Frey BJ. and Hadden PJ. 2012. Wind turbines and proximity to homes: The impact of wind turbines on health. http://www.windvigilance.com/ Frey_Hadden_WT_noise_health_01Jan2012.pdf

Gohlke JM et al. 2008. Health, economy and environment: sustainable energy choices for a nation. Environmental Health Perspectives. 116:A236-7

Griefahn B; et al. 2008. Autonomic arousals related to traffic noise during sleep. Sleep. 31:569-577.

Hanning C. 2010. Wind turbine noise, sleep and health. http://www.windvigilance.com/about-adverse-health-effects/wind-turbine-noise-sleep-and-health-by-dr-hanning

Hanning C. and Evans A. 2012. Wind turbine noise. *BMJ.* 344:e1527

Harry A. 2007. Wind turbines, noise and health. www.savewesternny.org/pdf/ wtnoise_health_2007_a_barry.pdf

Hayes M. 2007. Affidavit in reply. Makara Wind Farm. New Zealand Environmental Court. W59/2007

Horner B, Jeffery R, Krogh C. 2011. Literature Reviews on Wind Turbines and Health: Are They Enough? *Bulletin of Science, Technology & Society*. 31: 399-413,

Jarup L et al. 2008. Hypertension and Exposure to Noise Near Airports: the HYENA Study. Environmental Health Perspectives. 116:329–333

Krogh, C, et al. 2011. WindVOiCe, a Self-Reporting Survey: Adverse Health Effects, Industrial Wind Turbines, and the Need for Vigilance Monitoring. *Bull Sci Tech Soc*. ;31: 334

Martin SE. et al. 1997. The effect of nonvisible sleep fragmentation on daytime function. American Journal of Respiratory and Critical Care Medicine, 155 (5): 1596-1601

Muzet A, Miedema H. 2005. Short-term effects of transportation noise on sleep with specific attention to mechanisms and possible health impact. Draft paper presented at the Third Meeting on Night Noise Guidelines, WHO European Center for Environment and Health, Lisbon, Portugal 26-28 April 2005. Pp. 5-7 in *Report on the Third Meeting on Night Noise Guidelines*, available at: http://www.euro.who.int/Document/NOH/3rd_NNG_final_rep_rev. pdf.

Nelson D. 2007. Perceived loudness of wind turbine noise in the presence of ambient sound. Second International Meeting on Wind Turbine Noise. Lyon, France.

New Zealand Standards. 2009. Acoustics – Wind farm noise DZ6808/v2.4 Committee: 6808

National Health Service, News Service. 2010. Wind turbine sound 'needs research'. http://www.nhs.uk/news/2010/01January/Pages/Wind-turbine-sound-and-health.aspx

Nissenbaum M. 2010. Mars Hill study, preliminary results. http://www.windvigilance.com/mars_hill.aspx

Nissenbaum M, Aramini J, Hanning C. 2011. Adverse health effects of industrial wind turbines: a preliminary report. Proceedings of 10th International Congress on Noise as a Public Health Problem (ICBEN) 2011, London, UK.

Nissenbaum M, Aramini J, Hanning C. 2012. Effects of Industrial Wind Turbine Noise on Sleep and Health. *Noise and Health*. In Press.

Pedersen E and Persson Waye K. 2003. "Perception and annoyance of wind turbine noise in a flat landscape", Proceedings of Internoise 2002, Dearborn

Pedersen E and Persson Waye K. 2004. Perception and annoyance due to wind turbine noise—a dose-response relationship *J. Acoust. Soc. Am.* 116 3460–347

Pedersen E and Persson Waye K. 2007 Wind turbine noise, annoyance and self-reported health and well-being in different living environments *Occup. Environ. Med.* 64;480–6

Pedersen E. and Persson Waye K. 2008. Wind turbines – low level noise sources interfering with restoration? Environmental Research Letters. 3:015002

Pedersen E. 2009a. Effects of wind turbine noise on humans. Third International Meeting on Wind Turbine Noise, Aalborg 17-19 June 2009.

Pedersen E et al. 2009b. Response to noise from modern wind farms in The Netherlands. J Acoust. Soc. Am. 126:634-643.

Pedersen E, van den Berg F, Bakker R, Bouma J. 2010. Can road traffic mask sound from wind turbines? Response to wind turbine sound at different levels of road traffic sound. *Energy Policy* 38:2520-7

Phillips C. 2011. Properly interpreting the epidemiologic evidence about the health effects of industrial wind turbines on nearby residents. *Bull Sci Tech Soc* 31:303-8.

Phipps R et al. 2007. Visual and noise effects reported by residents living close to Manawatu wind farms: preliminary survey results. Evidence to the Joint Commissioners, 8th-26th March 2007, Palmerston North

Phipps R. 2007a. Evidence of Dr Robyn Phipps, In the Matter of Moturimu Wind Farm Application heard before the Joint Commissioners 8th – 26th March 2007 Palmerston North

Pierpont N. 2009. Wind Turbine Syndrome: A Report on a Natural Experiment. K Selected Publications. Santa Fe, New Mexico.

Pirrera S, De Valck E, Cluydts R. 2009. Nocturnal road traffic noise and sleep quality: Habituation effects assessed in a test-retest field situation. Sleep 32:A422.

Saremi M et al. 2008. Sleep related arousals caused by different types of train. Journal of Sleep Research 17:Supplement 1;P394

Seglins D and Nicol J. 2011. Ontario family sues Suncor, alleging health problems, CBC News: http://www.cbc.ca/news/health/story/2011/09/21/ seglins-windfarms.html

Selander J et al. 2009. Long term exposure to road traffic noise and myocardial infarction. Epidemiology. 20:272-279

Shepherd D. 2010. Wind turbine noise and health in the New Zealand context. In: Rapley, B. I. and Bakker, H. H. C., Sound, Noise, Flicker and the Human Perception of Wind Farm Activity. Atkinson & Rapley Consulting Ltd, Palmerston

Shepherd D, McBride D, Welch D, Dirks K, Hill E. 2011. Evaluating the impact of wind turbine noise on health related quality of life. *Noise Health* 13:333-9.

Society for Wind Vigilance 2010 a & b. An Analysis of the American/Canadian Wind Energy Association sponsored: "Wind Turbine Sound and Health Effects: An Expert Panel Review, December 2009".

Solet, J. M., et al. (2010).Evidence-based design meets evidence-based medicine: The sound sleep study. Concord, CA: The Center for Health Design

Stigwood M. 2008. Evidence to the Public Enquiry into the proposed North Dover Wind Park. PINS Ref: APP/X2220/A/08/2071880/NWF.

Thorne R. 2011. The Problems With "Noise Numbers" for Wind Farm Noise Assessment. *Bulletin of Science Technology Society*. 31:262-290

van den Berg GP. 2004. Effects of the wind profile at night on wind turbine sound. Journal of Sound and Vibration. 277:955-970

van den Berg G P., et al. 2008. WINDFARMperception. Visual and acoustic impact of wind turbine farms on residents. FP6-2005-Science-and-Society-20. Specific Support Action Project no. 044628

Van Hee VC et al. 2009. Exposure to traffic and left ventricular mass and function. The Multi-ethnic study of atherosclerosis (MESA). Am J Respir Crit Care Med. 179:827-834.

World Health Organisation. 2009. Night noise guidelines for Europe. Copenhagen.

World Health Organisation. 2011. Burden of disease from environmental noise: Quantification of healthy life years lost in Europe. WHO Regional Office for Europe, Copenhagen.

Figure 1. Arousal probability threshold curve for non-REM2 (light sleep). X axis signifies A-weighted equivalent sound level measured over 10-seconds. From Solet 2010.

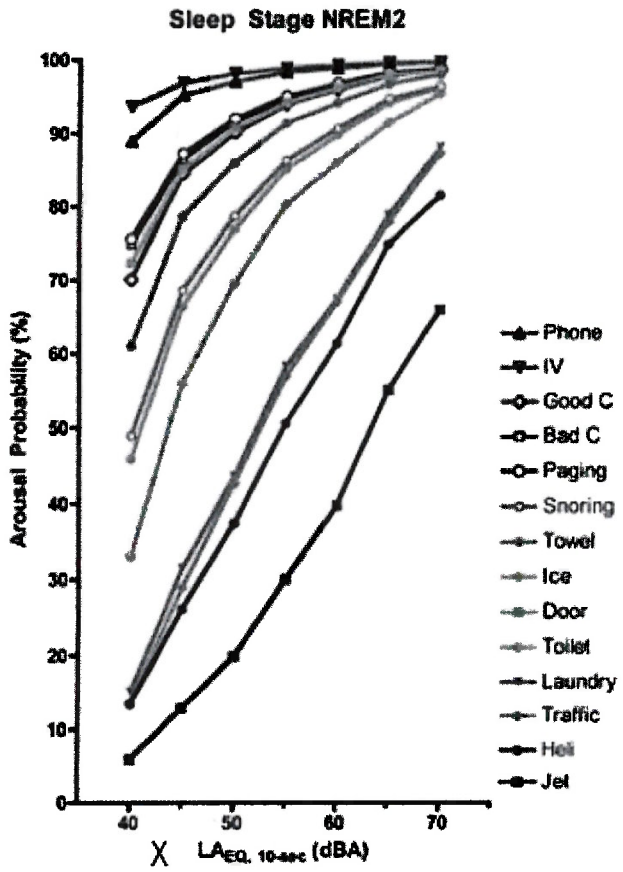


Figure 2. Spindle rate and sleep stability. Observations were pooled among subjects in the lower and upper halves of the spindle rate distribution (ranges 4.57-5.44 and 5.58-6.14 spindles/min respectively) based on EEG lead C3 during stage N2. Corresponding sleep survival curves were derived from each pool in stage N2 using the Kaplan-Meier (product-limit) method.

Backward extrapolation of the response curve for low spindle rate subjects shows only a 50% likelihood of stable sleep at noise levels of 35 dB(A) and 75% likelihood for those with high spindle rates. From Dang-Vu et al., 2010

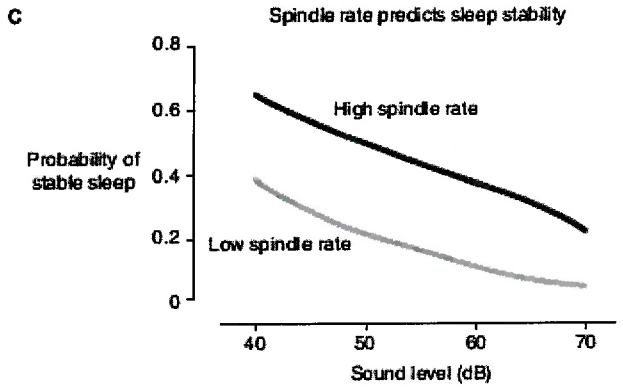


Figure 3. Sound level and annoyance for different noise sources (van den Berg 2008)

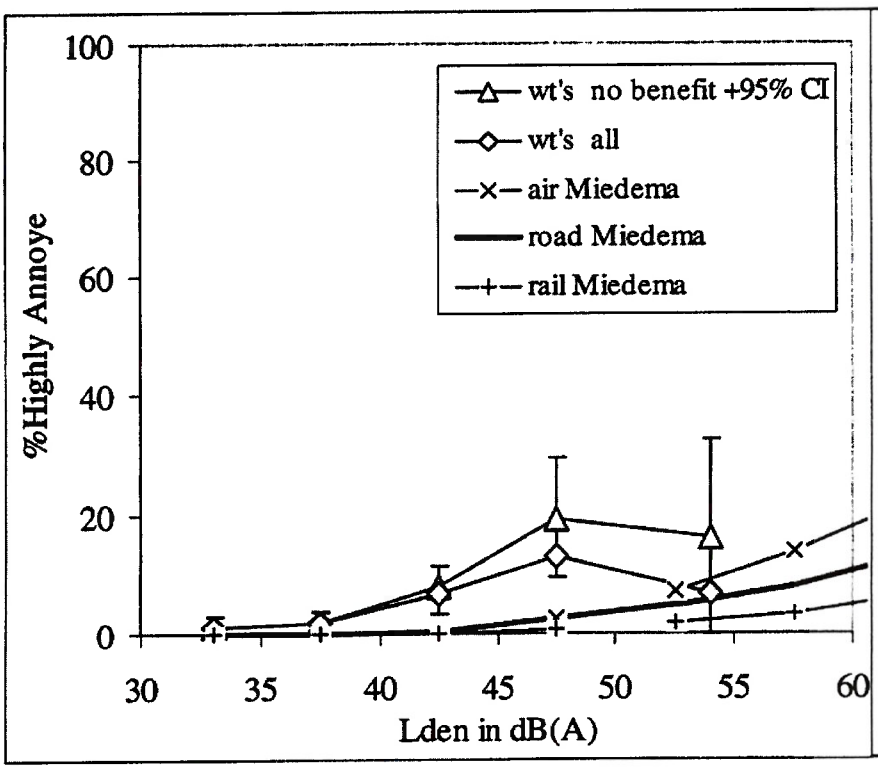
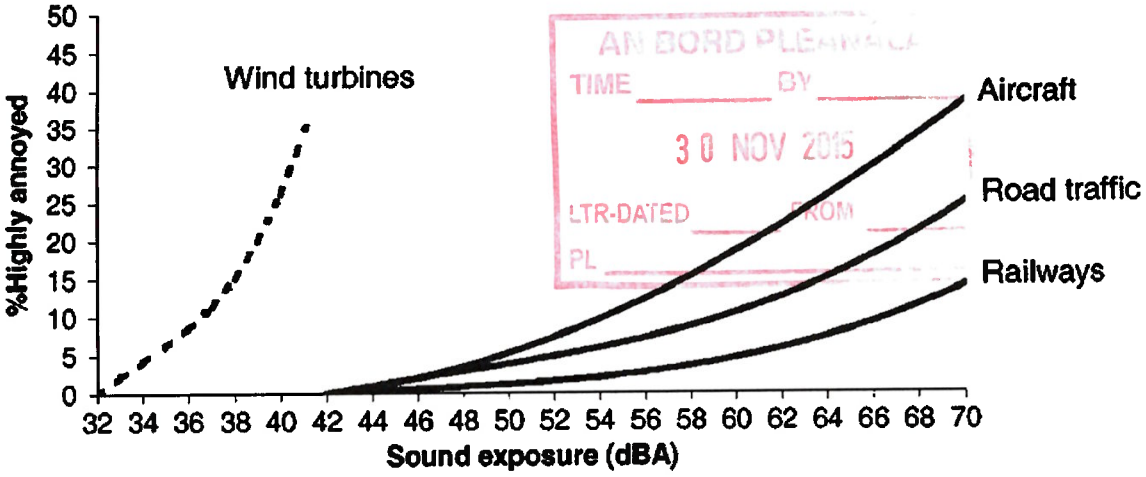


Figure 8.1: relation between sound level Lden and percentage highly annoyed residents exposed to that sound, for three transportation noise sources and for wind turbines; the relation is given for all respondents and for those that have no economical benefit from a wind turbine.

Bars denote 95% confidence interval for non-benefitters.

Figure 4. Sound level and annoyance for different noise sources (Pedersen E and Persson Waye, 2004)



Sound exposure is for wind turbines calculated A-weighted L_{eq} for a hypothetical time period and for transportation DNL.

Figure 5. Relationship between A-weighted sound pressure levels (equivalent levels at wind speed 8 m/s, 10 m over the ground) and proportion of respondents disturbed in the sleep by noise in three studies: SWE00 (*n* = 341), SWE05 (*n* = 746) and NL07 (only respondents that did not benefit economically from wind turbines; *n* = 593). (Pedersen 2009)

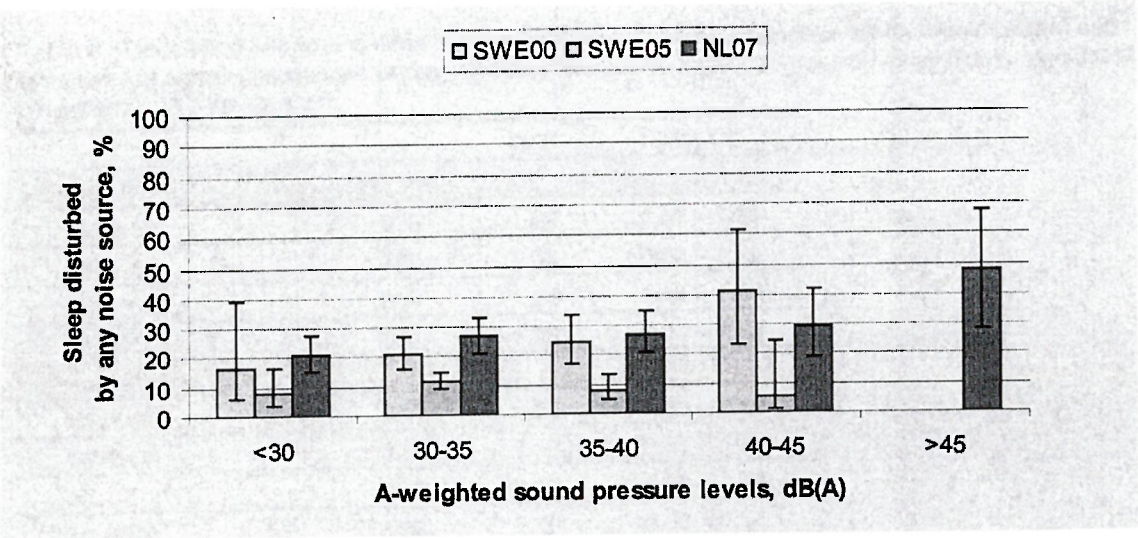


Table I. Response to wind turbine noise outdoors or indoors, proportion of respondents (*n*=708) according to 5-dB(A) sound level intervals, and 95% confidence intervals (95%CI). (From Pedersen 2009a)

	Predicted *A*-weighted sound pressure levels dB(A)				
	<30	30–35	35–40	40–45	>45
Outdoors *n*	178	213	159	93	65
Do not notice (%) (95%CI)	75 (68–81)	46(40–53)	21(16–28)	13 (8–21)	8(3–17)
Notice, but not annoyed (%) (95%CI)	20 (15–27)	36(30–43)	41(34–49)	46 (36–56)	58(46–70)
Slightly annoyed (%) (95%CI)	2 (1–6)	10(7–15)	20 (15–27)	23 (15–32)	22(13–33)
Rather annoyed (%) (95%CI)	1 (0–4)	6(4–10)	12 (8–18)	6 (3–13)	6(2–15)
Very annoyed (%) (95%CI)	1 (0–4)	1(0–4)	6 (3–10)	12 (7–20)	6(2–15)
Indoors, *n*	178	203	159	94	65
Do not notice (%) (95%CI)	87 (81–91)	73(67–79)	61(53–68)	37 (28–47)	46(35–58)
Notice, but not annoyed (%) (95%CI)	11(7–17)	15(11–20)	22 (16–29)	31(22–31)	38(28–51)
Slightly annoyed (%) (95%CI)	1 (0–4)	8(5–12)	9 (6–15)	16 (10–25)	9(4–19)
Rather annoyed (%) (95%CI)	0 (0–2)	3(1–6)	4 (2–8)	6 (3–13)	5(2–13)
Very annoyed (%) (95%CI)	1 (0–4)	1(0–4)	4 (2–8)	10 (5–17)	2(0–8)

Table II. Recommendations for setback of residential properties from industrial wind turbines

Note 1. The 2km limit from edges of towns and villages seems to have been set more for visual than noise reasons
Note 2. Dixsaut and colleagues (2009) report a review of this recommendation by AFSSET. They concluded that the 1.5km setback was "not relevant" and would compromise wind park development.

Authority	Year	Notes	Recommendation	
			Miles	Kilometres
Frey & Hadden	2007	Scientists. Turbines >2MW	>1.24	>2
Frey & Hadden	2007	Scientists. Turbines <2MW	1.24	2
Harry	2007	UK Physician	1.5	2.4
Pierpont	2008	US Physician	1.5	2.4
Welsh Affairs Select Committee	1994	Recommendation for smaller turbines	0.93	1.5
Scottish Executive	2007	See note 1.	1.24	2
Adams	2008	US Lawyer	1.55	2.5
Bowdler	2007	UK Noise engineer	1.24	2
French National Academy of Medicine	2006	French physicians See note 2	0.93	1.5
The Noise Association	2006	UK scientists	1	1.6
Kamperman & James	2008	US Noise engineers	>.62	>1

Kamperman	2008	US Noise engineer	>1.24	>2
Bennett	2008	NZ Scientist	>0.93	>1.5
Acoustic Ecology Institute	2009	US Noise engineer	0.93	1.5
NSW General Purpose Standing Committee	2009	Legislators	1.24	2
Thorne	2010	Aus/NZ acoustician	1.24	2
Horonjeff	2010	US acoustician	1.5-2	2.4-3.2
Shepherd	2011	Psychoacoustician	1.24	2
Cox et al	2012	UK engineer	1.24	2