The Secretary,
An Coimisiun Pleanala,
64 Marlborough Street,
Dublin 1,
D01 V902.
10/06/2026.

Miltown Malbay Windfarm Opposition Group,
C/O Laura MacMahon,
Ballinoe,
Miltown Malbay,
Co Clare,
V95E3Y9.

AN COIMISIÚN PLEANÁLA
LDG- 068545-26
ACP-
23 JUN 2026
Fee: € 50 Type: Chq
Time: 9:15 By: Reg post

An Coimisiun Pleanala case reference number: PAX03.324270.

Dear Secretary,

We the members of the Miltown Malbay Wind Farm Opposition Group wish to lodge an objection to the proposed SID application ref: PAX03.324270 by Slieveacurry Ltd on the following grounds;

As members of the receiving community to be impacted by this development we hope our views will be taken into consideration when coming to a decision on this application. This proposal forms part of an ongoing concentration and proliferation of wind energy development across the Slieveacurry, Slievenalicka, Illaunbaun, Tooreen, Lackamore and adjoining west clare uplands. The area has already been the subject of multiple planning refusals by Clare County Council and An Coimisiun Pleanala, including ACP Case Ref 312728, where serious concerns were identified regarding:

·unacceptable visual impact,
·skyline intrusion,
·cumulative landscape impact,
peatland disturbance,
hydrological risk,
biodiversity impacts,
and impacts on protected species and European sites.

The current proposal has failed to adequately overcome these previously identified concerns.

This development must not be assessed in isolation. It must be assessed cumulatively alongside:
the previously refused Slieveacurry proposal,
the refused Illaunbaun wind farm proposal,
the slievenalicka proposal,
existing operational turbines,
and all associated substations, access roads, grid connections and related infrastructure across the same upland landscape.

We have serious concerns that the cumulative environmental effects of these connected wind energy projects are being fragmented across separate planning applications rather than assessed comprehensively as a single cumulative wind energy cluster. Under the EIA Directive 2011/92/EU (as amended), projects cannot be artificially segmented or "project split" in a manner which understates their true cumulative environmental effects. There is obvious non compliance with the Environmental Impact Assessment Directive taking into account all the proposed wind energy developments in a small area.

Accordingly, we ask the planning authority to examine:

-O'Grianna & Ors v An Bord Pleanala(2014) and (2017)

-Fitzpatrick v An Bord Pleanala(2019)

-PL93.244006.

Given the overlap in;

-town lands,

-Landscape character areas,

-Ecological corridors,

-Hydrological systems,

-Visual receptors,

-And shared infrastructure,

the cumulative effects of these developments require full integrated assessment. The continued proliferation of large scale wind energy development across this sensitive upland landscape would result in the excessive industrialisation of rural west Clare and would materially damage the visual character and amenity of the area. The previous refusals already identified the landscape as visually sensitive and unsuitable for turbine development of this scale.

-Potential Cumulative Impacts of proposed development particularly during the operating phase. With great respect to the various professionals and the predictive methodologies employed to guage potential impacts, this community would like to point out that such analysis is unnecessary in our case. We live in the actuality of what exists as opposed to relying on any of your predictions. We know the impacts because we have lived with them for seven years. To our daily and nightly cost, we know noise predictions and analyses were flawed in the Slieve Callan wind farm EIAR. Why should we expect these noise predictions for Slieveacurry to be any different? We cannot but see and hear these turbines several times daily as we go about our lives. We know the negative impacts on residential amenities, we experience sleep deprivation on a regular basis, no community fund is going to offset living under such conditions!

The claim in the EIAR that "the proposed development will not introduce a new or unfamiliar feature to the landscape, as wind turbines are already a strong characteristic of the area" is deeply insulting to this community! The existing turbines were imposed on us, this claim of the developer encapsulates the attitude of the developer to this community! It is reprehensible to suggest that the existing wind farm that has caused so much hardship and strife could somehow be a mitigating factor in helping impose further hardship on the same community. Are we really expected to believe that we will hardly notice 175 m turbines on elevated ground at less than 700m from our homes? The EIAR is a developer sponsored document prepared with the sole purpose of facilitating the approval of planning permission so we can hardly be surprised that its contents are tailored accordingly.

-Too close to our homes, the nearest turbine to some homes will be 600 metres, this is too close! The WHO recommends a distance of 1km. The proposed turbines are too large and too close to existing residential dwellings, turbines of this size should not be anywhere near residential settings. It should be noted that the turbines are to be located on elevated ground which hugely increases their relative heights as compared to dwellings and will lead to a dominance of the surrounding landscape. They will be too visually overbearing on family homes with a severe proliferation of them in a small area as we are already near the Slieve Callan wind farm. This will lead to the degradation of the rural living environment and the residential desirability and value of homes within the surrounding communities. We also fear depopulation in the area as people will move away from these turbines, this will have a knock on effect on schools/businesses etc. Also our children will be denied planning permission for homes on family land as they will be too close to a wind farm. Miltown Malbay is slowly being surrounded by these developments if they are granted planning permission which contradicts the County Development plan 2023-29. It states that it is a town "well positioned" in terms of tourism and is a designated Architectural Conservation Area. Furthermore if the proposed development goes ahead, we are highly aware of the fact that the wind developer owns the whole area so they can add more turbines as they deem fit!

- Noise and shadow flicker, we are already affected by the Slieve Callan turbines so are in dread from the disturbance these proposed turbines that are essentially an extension of Slieve Callan will cause. Many of the local residents have health issues which we are sure this development will only exacerbate! It will put populations with sensory impairment and medical impairements at risk! Our autistic community, those with tumours, underlying neurological conditions can all be affected by sensory processing dysfunction which will only be enhanced by these intrusions. Miltown Malbay has embraced the autistic community by erecting communication boards, sensory gardens and seating around the area to enhance their daily routines, this proposed development will only disrupt all that hard work and affect everyone's health and wellbeing.

On the subject of noise effects;

Professional Noise Assessments

A) Noise levels at V95PNX2 Sept/Oct 2025. H134 in EIAR

B) Peer Review of Noise Assessments/Predictions for Slieveacurry Wind Farm

Many members of our group Miltown Malbay Windfarm Opposition Group are residents who have been negatively impacted by noise and shadow flicker from the Sl Callan wind farm turbines. The residents are fatigued from complaining to various bodies like Clare County Council and the EPA. The situation has reached breaking point for many of these residents. The revelation that a local woman regularly slept in her sitting room rather than her turbine noise filled bedroom prompted our community that we finally needed to tackle this issue head on. A consensus was reached whereby we decided to hire an external professional noise consultant to measure the turbine noise so that some clarity could finally be brought to the existing situation. Local residents have been privately measuring sound levels over the course of a number of years. Another tipping point was reached when ABP did not cite the loss of residential amenity among the refusal reasons for the Slieveacurry application(ABP-312728-22) in May 2024. When it became apparent that the developers were planning to reapply for planning permission, our Group decided we needed to act.

In the interests of objectivity and impartiality, we decided to commission an expert who did not reside in Ireland. The expert we commissioned is Australian based. He is

W Les Huson Bsc (Hons) Msc Cphys MInstP MIoA MAAS
who is an eminent, experienced and highly qualified and respected engineer and acoustician.

In the EIAR, the developer consultants repeatedly claim that turbine noise can be controlled by software etc. Worryingly for residents, the inherent assumption in this claim is that the noise will probably be way above permitted levels, but with software intervention the sound can be brought back down to levels that comply with planning limits. Our community, particularly those living with the constant noise from Sl Callan turbines are in no mood to entrust their future residential amenity and ability to sleep properly, to questionable software and operators located remotely. This is a totally understandable stance in view of their historic and ongoing experiences with noise from Sl Callan wind farm.
Dwelling on the claim that the turbine noise can be controlled, our community are most worried about what is likely to happen should planning or enforcement authorities deem that turbine noise needs to be measured again. Asking the wind farm consultants to measure it is meaningless seeing as they openly profess to being able to control it. Noise levels will be adjusted to acceptable levels o as to comply with planning permission limits. Should the wind farm operators or their local contacts be aware that any type of measurement, independent or otherwise, is being undertaken, hen we likely arrive at the same predetermined outcome.
n contrast, when this independent measurement and assessment was carried out in the Autumn of 2025, it was a truly random and objective assessment. We could have experienced totally calm weather whereby the turbines did not even rotate. We, or the expert, had no control over the weather or the turbines. It was undertaken quietly with average weather conditions and turbines operating in he absence of operator knowledge that the sound levels were being recorded.

The Huson report for V95PNX2 (attached) indicates very clearly what is ongoing in the vicinity of Sl Callan wind farm. It objectively confirms what local residents have suspected for years ie the Sl Callan wind farm is operating at levels that are way above those permitted by their planning permission. Effectively we contend on the basis of this report that the Sl Callan wind farm is currently operating as an unauthorised development. We are currently assessing the next move in this process.
Our community have very grave concerns about the methodologies employed in the predictions of noise levels for the proposed Slieveacurry wind farm. We feel that the locations and noise monitor positions were anything but objective. We feel that the factoring out of the Sl Callan turbines was disingenuous. As lay people, we just cannot understand how noise levels approaching 70dBs (Huson report for V95PNX2) can be ignored in the Slieveacurry assessments. We truly worry that if a property already is exposed to these levels of turbine noise, what will adding another wind farm ust 1Km away do other than make the situation even worse, particularly as the Slieveacurry turbines are bigger and more powerful. This is why we felt that we also need to have a peer review of these Slieveacurry noise predictions. This peer review has also been carried out by Mr Les Huson and is also attached(Peer Review).
The Sl Callan and the Slieveacurry wind farms will be a little over just 1Km apart. Slieveacurry and the proposed Illaunbaun and Slievenalicka wind farms will be equally close. It could be argued that they will effectively constitute one large wind farm with two small communities enclosed in a double sandwich. If the Sl Callan wind farm on its own is emitting sounds of over 70 dbs, what is adding 3 more wind farms going to do? In this context we ask the planning authorities to closely examine what the cumulative impact of all of these wind farms will be in terms of noise, shadow flicker, visual impact, habitat destruction and the general residential amenities for all the residents concerned.

-Biodiversity/wildlife in the area. This is a beautiful place full of wildlife including hen harrier(protected under Annex I of the Birds Directive 2009/147/EC), Golden Plover, Curlew, pine marten, bats, red squirrel, Marsh Fritillary butterfly(protected under Annex II of the Habitats Directive 92/43/EEC) etc, there are numerous water courses that we are in no doubt will be ruined by this development contrary to what the developer may have in their EIAR. In our view the risk of pollution will be extremely high! Just down the road in Clooneyogan there is a new initiative " Kestrel Conservation in Action", the Kestrel is designated as a red listed species so surely this should be a huge concern as they are at risk of extinction. We are being encouraged daily to support biodiversity which this development will clearly not do. A lot of the land on which the development is proposed is also peat which has led to slippage etc in the past. We do not want another disaster like Meenbog in Donegal to occur. Given the scale and concentration of wind energy development now proposed within the same upland landscape and adjoining town lands there is significant uncertainty regarding cumulative ornithological impacts, habitat fragmentation, peat stability, hydrological impacts and downstream impacts on European sites. The proposed development would materially conflict with the landscape protection, biodiversity protection and residential amenity objectives of the Clare County Development Plan.

-Wifi and tv reception, wifi is poor anyway in this rural area and since the covid pandemic a lot of people in the area work from home so these turbines will severely disrupt that! There are masts in the area supplying Miltown Malbay, Moy and Lahinch. Slieve Callan residents can attest to this fact. It should be noted that disruption is so severe in Slieve Callan there is a constant stream of tv/wifi repairmen at dwellings in that area.

-The Updated National Wind Energy Guidelines are still not in place, no development should be even considered until they are! Clare county Councillors passed a motion calling for a moratorium on all wind farm developments in June 2025 supporting this so subsequently this development should be turned down on that basis as the councillors are meant to reflect the opinions of the public that elected them.

We feel wind turbines need to be going offshore and not disrupting small local communities and leaving people existing, because you certainly could not call it living, in areas overshadowed by turbines, Clare has enough of these on land, it is rapidly becoming known as the wind farm county and not the Banner county!

We trust you will take all these points into consideration when reaching a decision and respectfully request that An Coimisiun Pleanala refuse permission for this development. Attached are signatures and names of our group members and our online petition of over 700 names

Yours Sincerely,

Miltown Malbay Wind Farm Opposition Group.

L. MacMahon.

Laura MacMahon on behalf of the group

LIST OF OVER 350 OFF OUR GROUP
NAMES AND SIGNATURES.

MILTOWN MALBAY WIND FARM OPPOSITION GROUP

Marie Naughton.
Keith NAUGHTON.
Maureen Gleeson
Matt GLEESON
Alanna Gleeson
James Gleeson
Kayleigh Naughton.
Gerry Clancy
Caroline Clancy
Matt MacMahon
L. MacMahon.
P. MacMahon
Brid Egan
S. Flynn.
B. Flynn.
P. McDermott
O. Cotter.
M. Brew.
D. Culligan.
[illegible]
Frances MacMahon.
Dearbhail MacMahon.
Martha Clancy
Geraldine Clancy

Jean Flynn
John Flynn
Kay Flynn.
Mary O'Malley
Sean O'Malley.
Cuimin O'Malley
Fiona McMahon
Dermot O'Malley
Rebecca Foley.
Mary Coffey
Anthony O'Loughlin
Mary O'Keefe.
Seán Lynch
Angie Clancy
Andy Clancy
Marie Clancy.
Mary McMahon

MILTOWN MALBAY WIND FARM

OPPOSITION GROUP

Francis O'Loughlin
Michael Conway
Nicola Ridge
Marjorie Ahern
Patricia Flanagan
PJ Conway
Noreen Skerritt
Martin Skerritt
Trevor Skerritt
Maureen McMahon
John McMahon
Sean McMahon
Aisling McMahon
[illegible] McMahon
Nathan Ruttledge
Margaret McMahon
D. Clancy
B. Costello.
[illegible]
Tricia Cahill
[illegible] Gee
Peter Gee
Jack O'Brien

Christy Boddy
Marie Boddy.
Anne Burke
Joe Burke.
Michael Murray
Geraldine O'Looney
Brid Murray
Pat Murray
Cormac Murray
Caoimhe Harvey
Meadh Murray.
Karl Geiss -
Helen Geiss.
Amanda O'Callaghan
B. O'Callaghan.
Colin Twomey.
Pat Twomey.
Christina Twomey.
Noel Hayes
Caroline Hayes
Barry O'Connor
Fergus O'Connor.
Joseph O'Rourke.
Niall Shaughnessy.
Pete McNamara.

MILTOWN MALBAY WIND FARM

OPPOSITION GROUP

Peter Laban
Sanne Laban - Gielesen
Gus Laban.
Brian McDowell
Jerry McDowell
JJ Malone
Ann Malone
Martin Malone
Catherine Malone
Niamh Malone
Katie Malone
Martin O'Brien
Bridget O'Brien
Kieran O'Brien
Shane O'Brien
Declan O'Brien
Michael Malone.
Mary Malone
Pauline Malone.
Aisling O'Brien
Joanne Malone.
Brendan O'Brien
Dara O'Brien
Terence O'Brien.
Noreen O'Brien.
Nora O'Brien.
Susan Crawford.
Eoghan McCarthy
Deirdre McCarthy
Donal Óg McCarthy
Caroline McCarthy
Brid McCarthy
Donal SNR McCarthy

BAY McDOWELL
CLOVER McDOWELL
FLYNN McDOWELL
Martin Lally
CHRIS CROWE
MARTINA CROWE.
CIARA CROWE
SHANE CROWE
KAYLEIGH O'CONNOR
BARRY O'CONNOR
BRIAN LONGE
MICHAEL CROWE
MARGARET CROWE
DAMIEN CROWE
JASON CROWE
KAREN CROWE
GERRY CROWE
SHANNON CROWE
KATRINA CROWE
THOMAS CROWE
MARY CROWE
FIONA KEATING.
MATTHEW KEATING.
STEPHEN DOWNES.
Mary Murphy
Brid Murphy
Denis Murphy.

MILTOWN MALBAY WIND FARM

OPPOSITION GROUP

Noreen Murray
Marie Killeen
Robert Killeen
Colm McDonagh
Bernie McDonagh
Michael McDonagh
Mary McDonagh
Brian Walsh
Kevin Healy.
Patrick Lenihan
Dymphna Lenihan
Jennifer Lenihan
Christopher Lenihan
Anthony Lenihan
Isabelle Brennan
Jacques Brennan
Carmel O'Shanahan.
Cathlyn Cawley.
Michael Crowe
Margaret Crowe.
Damien Crowe
Jason Crowe
Eoin Cleary
Colette Cleary.
Patricia Flannery
Luke Flannery
Charles Lynch
Maureen Lynch
Conor McKenna.
Susan Bradley.
P. Cleary
Maureen Houston

John Houston
Dave Houston
Sofie Houston
Martin McMahon
Anne McMahon
Peter Griffin
Pat Curtin
Caroline Curtin
Lorraine Curtin
Jim Blake
Dan Blake
Dani Blake
Mary Blake
Mike Blake
Jim Jr Blake
Agnieszka Deal
Krzysztof Deal.
Declan Carey
Lorraine Carey
Frank Buckley
Theresa Buckley
Tracey Buckley
Robert Kissmann
Jola Kissmann
Julie Kissmann
Zuzanna Kissmann.

MILTOWN MALBAY WIND FARM

OPPOSITION GROUP

Stephanie Hennessy
Peadar Hennessy
Frances Hennessy
Patricia Hennessy
Michael Rogers
Teresa Rogers
James Rogers
Niall Rogers
Maeve Rogers
Patrick Rogers.
Donal King
Claire King.
Gerry Ambrose.
Anne Ambrose
Betty McMahon.
Brid Foley.
Jeffrey Foley.
Jim Galvin
Teresa Galvin
Brigid Maher
Claire Corbett.
S. Bradley.
Brid O'Meara.
John O Meara
John Curtin
Clare Curtin
Diane Mitchell
Millie Mitchell
Nicole Mitchell
Mary Curtin
Sheila Curtin

John John Curtin
Eileen Curtin.
Patrick Burke
Gosia Kaminiecka
Sarah Wade
Declan Wade
Denise Deane.
Mona O'Brien
John Murphy
Dolores Murphy.
Barry O'Connor
Danny McAlinden
Evelyn McAlinden
Rory Mulcallen
Ita Mulcallen
Maria O'Looney
Mark Keller
Anthony Kitson
Josephine Kitson
Caroline White
Anne White
Teresa Considine
Michael Carey.
Jutta Brasil
Máirín Gallagher
Thomas Gallagher
Bridget Gallagher
Ciaran Gallagher
Debbie Murray
Saoirse Burke
Hannah Murray

MILTOWN MALBAY WIND FARM

OPPOSITION GROUP

Claran Skerritt
Fergal Skerritt
Trevor Skerritt
Cathy Healey.
Martin Flynn
Maureen Flynn
Raymond Flynn
John Jordan
Michelle Flynn
John Cleary
Bernie Cleary
Peter Cleary
Sarah Cleary
Antoinette Cleary
Colm Cleary.
Geraldine Lafferty
Sinead Lafferty
Roisin Lafferty
Padraig Lafferty
Stephen Coddy
Karen Checkoway
Carlos Reyes
Colm MacDonagh
Bernie MacDonagh
Josephine Finn
Anthony Carew
Eabha Carew
[illegible] Killoran
Kinga Kretowicz
Lynsey Graham
Thomas O'Halloran
Anne O'Halloran.
Martin Tolty

Marion Kenneally
Gerard Kenneally
Brendan Hayes
Eileen Keane
Tony Hayes.
Christina Hayes
Aoife Hayes.
Deirdre Hayes.
Joan Hayes.
John Fennane
Mary Fennane
Michael Hayes
Patsy Hayes
Eoin Hayes
Marie Hayes.
Chris Hayes.
Cathal MacMahon
Lisa Cantrill.
Sean Hennessy.
Ann Hennessy
Emma Hennessy.
Eoin Hennessy.
Theresa Ryan
Michael Ryan
Tomas Devitt.
Margaret Devitt
Evan Devitt
Cormac Devitt
Caoimhe Devitt
Ailbhe Devitt.

MILTOWN MALBAY WIND FARM

OPPOSITION GROUP

Katie Ryan.
Seamus Ryan.
Maire Devine
Tony Devine
Lucia Devine.
Michael Shannon.
Liam Conway
Sean Crawford.
Linda Clancy.
Ger Murphy.
Jane Murphy.
Eileen Frawley.
Edel Frawley.
Andy Clarke.
Teresa Clarke.
Moya Clarke.
Kevin McNamara.
Padraig Frawley.
[illegible] [illegible]
FRANK HEALY
ANNE HEALY
JACK HEALY
Ava McWilliams
Lisa Killian
Luke Hanbury
Kateanne Birmingham
June Burke.
Matilda Burke.
D. Buckley.

CHANGE.ORG PETITION
730 + NAMES.

Name	City	State	Postal Code	Country	Signed On
Laura Macr	clare			Ireland	########
Sylvia Molc	Shannon		0	Ireland	########
bridget sikl	cree			Ireland	########
Caroline M	Belgooly		P17	Ireland	########
Zoe Earley	Miltown Malbay		xxx	Ireland	########
Siobhan M	Miltown Malbay			Ireland	########
bernie trav	Ennis			Ireland	########
Cynthia Co:	Cooraclare Co. Clare		72051	Ireland	########
Marion O N	Miltown Malbay		V95	Ireland	########
Sarah McIn	Clohanmore Cree			Ireland	########
Lisa Carkill	Ennis			Ireland	########
Aisling McMahon				Ireland	########
Geraldine N	Dublin		D02	Ireland	########
Anne Marie	Dublin		D02	Ireland	########
Thomas Fla	Portlaoise		R32	Ireland	########
colette O'N	Tullamore			Ireland	########
Tara Rynne	Dublin		D02	Ireland	########
Fiona Egan	Ennistymon			Ireland	########
Keith Sextc	Dublin		D02	Ireland	########
Brian McDc	Lahinch			Ireland	########
Kathy Lord:	Ennis		V15	Ireland	########
Ben O Dwy	Waterford		X91	Ireland	########
Claire Elder	Ennistymon		V95	Ireland	########
johnny st jc	Lisdoonvarna		V95	Ireland	########
Dan Jamies	Lahinch		V95	Ireland	########
Teresa Carl	Lahinch		V95	Ireland	########
Fergal Mac	Dublin		D02	Ireland	########
Mary O'Malley				Ireland	########
Linda Hehi	Ennis		V15	Ireland	########
Brian O'Hal	Kells		A82	Ireland	########
John f Heac	Laois		R14	Ireland	########
Martina Gc	Castletroy			Ireland	########
Breda Carri	Dublin		D02	Ireland	########
Elizabeth C	Midleton		P25	Ireland	########
Jenny McD	County Clare		--	Ireland	########
Catherine (	Cork		default	Ireland	########
Elizabeth C	Miltown Malbay		GU18	Ireland	########
Emma O'Br	Co. Clare		0	Ireland	########
Georgina Lewis				United King	########
Michael Gr	Fitzroy		3065	Australia	########
Meabh Hea	Enfield		A83	Ireland	########
Cathy Keen	Miltown Malbay		V95	Ireland	########
Geraldine (	Dublin		D02	Ireland	########
Dolores Hu	Kinnegad			Ireland	########
Annette Va	Lahinch		V95	Ireland	########
oonagh od	Lahinch			Ireland	########
John Dunca	Dublin		D02	Ireland	########
Julianne Va	Wareham		BH20	United King	########
D F	Scotland		Fk8	United King	########

Brendan M	Dublin		D02	Ireland	########
gabi wooff			23300	France	########
Joanne Hes	Lahinch			Ireland	########
Kathleen C	Dublin		D02	Ireland	########
Colette Mu	Dublin			Ireland	########
annelies le	Havant	England	PO9 2 SN	United King	########
Paul Morris	Weymouth		Dt3	United King	########
Bernadine	Weymouth		DT3	United King	########
Kathleen C	Coore		20008	Ireland	########
Déagláin M	Cork			Ireland	########
Teresa Dur	Dublin		D02	Ireland	########
Heloiza Ne	Dublin			Ireland	########
Alain Halimi				Ireland	########
June Harhe	Ponta Delgada		9500-459	Portugal	########
Nicola Barr	Galway			Ireland	########
Eunice Dov	Tralee		V92	Ireland	########
Milos Potu	Brandys nad Labem		25001	Czechia	########
Emma Jane	Lahinch		V95	Ireland	########
Shona Blak	Co.clare			Ireland	########
Lorraine M	Ballinagh			Ireland	########
bernadette	clare			Ireland	########
Alan Frost	Morpeth	England	NE61 3SW	United King	########
Grainne He	Ennis			Ireland	########
Deborah Gallery				Ireland	########
Des Moloh	An Muileann Gcearr		N91	Ireland	########
Maeve Mci	Clare			Ireland	########
John harhe	Dublin		D02	Ireland	########
Katrina Rol	St saviour			Jersey	########
Mary kenn	lahinch			Ireland	########
James Buck	Cork			Ireland	########
Aenya Glee	Dublin		D02	Ireland	########
Melissa Ga	Dublin		D02	Ireland	########
Deirdre Lar	Co. CLare			Ireland	########
Maureen C	Lahinch		V95	Ireland	########
Martha O E	Dublin		D02	Ireland	########
Andrii Kryzl	Sligo			Ireland	########
Gleice Sant	Dublin			Ireland	########
Jolanta Kisi	Kilrush		V15	Ireland	########
Theresa O'I	Lahinch			Ireland	########
Brian Sexto	Galway		H91	Ireland	########
Thomas Wl	Bournemoι	England	Bh5 1he	United King	########
Ann Curtin	Ennistymon		V95	Ireland	########
Colette Crc	Co Clare			Ireland	########
Marie Shar	Dublin		D02	Ireland	########
Maureen G	Luimneach		V94	Ireland	########
Attracta Da	Ir			Ireland	########
Bríd Egan	Tralee		V92	Ireland	########
Matt Glees	Luimneach		V94	Ireland	########
Bob Lewis	Chichester		PO19	United King	########
Saoirse L'estrange				Ireland	########

Lia Cahill	Dublin			Ireland	########
Geraldine F	Dublin		D02	Ireland	########
Noelle Glee	Jessheim			Norway	########
Josephine I	Dublin		D02	Ireland	########
Eoghan Mc	Dublin			Ireland	########
Patrick Ma	Dublin			Ireland	########
Marian Mu	Prenton		CH43	Ireland	########
Janet Stadi	Chichester		PO19	United King	########
Udodirim L	Dublin		D02	Ireland	########
Kevin Fergu	Edenderry		R45	Ireland	########
Mary Nuge	Ennis		V15	Ireland	########
Carmel Wa	ennis		clare	Ireland	########
Joan Wood	Yonkers	New York	10710	United Stat	########
Mary Shan	Miltown Malbay		V95	Ireland	########
Niamh Vau	Tallaght			Ireland	########
Jason Clanc	Liscannor		V95	Ireland	########
Elaine Haye	Kill			Ireland	########
Ann St John	Dublin		D02	Ireland	########
Lisa Cusher	Ennistymon		V95	Ireland	########
Patrice Mu	Miltown Malbay		V95	Ireland	########
Marion Ker	Dublin		D02	Ireland	########
Emily Feen	Kildare		R51	Ireland	########
Tamara Agi	Dublin			Ireland	########
Theresa Fa	Tralee		V92	Ireland	########
Clare Darcy	Miltown malbay			Ireland	########
Syed Mazh	Galway			Ireland	########
Michael Wi	Dublin			Ireland	########
Maria Craw	Dublin			Ireland	########
Anne Burns	Ennis			Ireland	########
Jacintha Ry	Thurles		E41	Ireland	########
Triona Mcnamara				Ireland	########
Tony Egan	Tralee		V92	Ireland	########
Gwenn Frir	Doolin			Ireland	########
Nicole Byrr	Dublin		D02	Ireland	########
Caroline Ol	Ennis			Ireland	########
MARTIN Sk	Tralee		V92	Ireland	########
Andreas Stranig			33649	Germany	########
Deirdre Co	Miltown Malbay		V95	Ireland	########
Fergal Sker	Naas		0	Ireland	########
Christy Boc	Tralee		V92	Ireland	########
Trevor Ske	Co Clare			Ireland	########
Aaron Skerritt				Ireland	########
martina ske	Miltown Malbay		V95	Ireland	########
Sinead RYN	Miltown Malbay			Ireland	########
Gus Laban	Miltown Malbay			Ireland	########
Niamh ORe	Kells			Ireland	########
Frances Ma	Dublin		D02	Ireland	########
Geraldine (	limerick			Ireland	########
Derrick Gle	Roscrea		E53	Ireland	########
Chantel Cla	Could clare			Ireland	########

Geoff Wooff		23300	France	########
David Mulli	Dublin		Ireland	########
Grace McD	Ballina		Ireland	########
Sean Collin	Dublin	D02	Ireland	########
Jane Gucki	Dublin		Ireland	########
Alan Coyne	Lahinch		Ireland	########
Maggie O l	Dublin	D02	Ireland	########
Deirdre Kill	Dublin	D02	Ireland	########
Michael Ke	Dublin		Ireland	########
Anne Nest	Ennistymon		Ireland	########
Francis Mc	Coventry	CV32BX	United King	########
Ronan Tier	Luimneach	V94	Ireland	########
Sarah Clair	Dublin	D02	Ireland	########
Carol Glees	Dublin	D02	Ireland	########
Niamh Mu	Cork		Ireland	########
Brid O'Mea	Charleville	P56	Ireland	########
Tony Benn	Miltown Malbay	V95	Ireland	########
Aine Mulre	Mullingar	N91	Ireland	########
Tim Casey	Dublin	D02	Ireland	########
Finola Pow	Waterford		Ireland	########
Peter McK	Belfast	BT71LF	United King	########
Rachael Ca	Perth	6001	Australia	########
Derek Leor	Ratoath	A84	Ireland	########
SUSANA PA	Dublin		Ireland	########
Caroline Si	Dublin	D02	Ireland	########
John Skerri	Miltown Malbay	V95	Ireland	########
Fiona Whel	Miltown Malbay		Ireland	########
Ciarán OM	Dublin	D02	Ireland	########
Rose McM	Kildare	R51	Ireland	########
Brian Dillor	Kilrush	V15	Ireland	########
Phil Martin	Dublin		Ireland	########
Edel Kenny	Dublin	D02	Ireland	########
Patrick Laff	Galway	H91	Ireland	########
Mary O Ro	Listowel	V31	Ireland	########
Maria O'Co	Dublin	D02	Ireland	########
Michael Br	Dublin		Ireland	########
Rita Egan	Ennis	V15	Ireland	########
Brid Murra	Lahinch	V95	Ireland	########
Geraldine (	Miltown Malbay	V95	Ireland	########
Lara Bottazzi			Ireland	########
Stephanie	Dublin		Ireland	########
Kaka Moo	wexford		Ireland	########
John O' Me	Dublin	D02	Ireland	########
Maria Bod	Tralee	V92	Ireland	########
Ellen O'Lou	Luimneach	V94	Ireland	########
Rebecca Ke	Ennis	V15	Ireland	########
Peter Conr	Miltown Malbay		Ireland	########
Sinead Mo	Ennis		Ireland	########
Anne Mari	Cavan	H12	Ireland	########
david kenn	Dublin		Ireland	########

Aleena Vils	Dublin	D02	Ireland	########
ravel iggy	Galway	H91	Ireland	########
Dupe Afola	Dublin		Ireland	########
Robert Gra	Carlow Town	Ireland	Ireland	########
David Ring	Dublin		Ireland	########
Maura Curl	Dublin	D02	Ireland	########
Peter Ridge	Pearl River New York	10965	United Stat	########
Hannah Mu	Dublin	D02	Ireland	########
Caitlín Ní C	Dublin		Ireland	########
Esther oroi	Perl		Germany	########
Serafina Rc	Shannon	V14	Ireland	########
Peter McN	Dublin	D02	Ireland	########
Mary Murr	Miltown Malbay		Ireland	########
Louis Ryan	Dublin		Ireland	########
liam o boyl	Luimneach	V94	Ireland	########
Noreen Mu	Naas	W91	Ireland	########
Veronica H	dublin	d14	Ireland	########
Norma Gle	Tipperary		Ireland	########
Helen Rynr	Kilkee	V15	Ireland	########
Noel Curtir	Tralee	V92	Ireland	########
Justin Sken	Dublin		Ireland	########
tahmineh a	Dublin	15	Ireland	########
Sheila Hass	Ennis	V15	Ireland	########
Dympna O	Dublin	D02	Ireland	########
Swapna Shijuvarghese			Ireland	########
Edwina Mu	Dublin		Ireland	########
Padraig Laf	Dublin	D02	Ireland	########
Jonathan H	Dublin	D02	Ireland	########
adrienne h	Clare	95492	Ireland	########
Bernadette	Ennistymon	V95	Ireland	########
Brian Finn	Galway	H91	Ireland	########
Ita Kavanag	Dublin	D02	Ireland	########
Maureen G	Dublin	D02	Ireland	########
Patrick Larl	Dublin		Ireland	########
Brian OCall	Kilfinane	V35	Ireland	########
Maeve Mcl	Dublin	D02	Ireland	########
Teresa Bre	Dublin	D02	Ireland	########
Trisha Breen			Ireland	########
Claire Moll	Ennis	V15	Ireland	########
Patricia Fit	Dublin		Ireland	########
Mick O'Rou	Ennis		Ireland	########
Patricia Do	Dublin	D02	Ireland	########
Josephine I	Galway	H91	Ireland	########
Aoife Forde	Galway	H91	Ireland	########
Luighseach Long			Ireland	########
Sinead Curl	Co.Clare		Ireland	########
Úna Long	Donegal		Ireland	########
Alan Forde	Dublin	D02	Ireland	########
Emer Kierc	Galway	H91	Ireland	########
Colin Henn	Ennis		Ireland	########

Denis Murp	Dublin		D02	Ireland	########
Anne Flynn	Waterford			Ireland	########
Diane O Co	Lahinch			Ireland	########
Shane Curt	Mullingar		N91	Ireland	########
Lahinch wc	Miltown Malbay		V95	Ireland	########
Brendan Va	Clonmel		E91	Ireland	########
Roisin Byrn	Dunlavin			Ireland	########
Sinead O'R	limerick			Ireland	########
Marie Naughton				Ireland	########
Grahame N	Dublin		D02	Ireland	########
Michael Co	Nanuet	New York	10954	United Stat	########
Brid Higgins				Ireland	########
jean ocallag	miltown malbay		eire	Ireland	########
Linda ocalla	Limerick			Ireland	########
Declan Mo	Nyc	New York	10470	United Stat	########
Annika Leh	Mullingar		N91	Ireland	########
Martha Cla	Miltown Malbay			Ireland	########
Jean Flynn	clare			Ireland	########
George Nei	Luimneach			Ireland	########
Roisin McAleer				Ireland	########
Ciara Graham				Ireland	########
fycsene shi	London	England	TW9 4JH	United King	########
Paul Burch	Omagh		BT79	United King	########
Patricia Sha	Donegal		d6	Ireland	########
Pat Morriss	Dublin		D02	Ireland	########
John McNa	Grantham		NG318DF	United King	########
Mary anne	Dublin			Ireland	########
Agnes Doo	Banagher			Ireland	########
Angela Clancy				Ireland	########
Kieran O Co	Dublin		D02	Ireland	########
John Hanra	Ballyshannon			Ireland	########
Ciara McIn	Limerick			Ireland	########
Ari Solo				Ireland	########
Paula Raffe	Belfast		BT8	United King	########
Caitriona O	Dublin		D02	Ireland	########
Robert Rair	Dublin		D02	Ireland	########
Niamh Smith				Ireland	########
Deirdre Co	Dublin		D02	Ireland	########
Caitlín Ní Chaoindealbháin				Ireland	########
Caragh O' Toole				Ireland	########
Ashy Ryan	Dun Laoire			Ireland	########
Kerry O'Lou	Lahinch		V95	Ireland	########
Elaine Ni Sh	Dublin		D02	Ireland	########
Emma Care	Portarlington			Ireland	########
MAGGIE HI	co clare			Ireland	########
Roisin Mur	Wicklow			Ireland	########
Laura Doyle	Clonlara			Ireland	########
Lill Fanny S	Oslo			Norway	########
Dag Hagen	Oslo		192	Norway	########
Sarah Sinna	Dublin			Ireland	########

Helge Lore	Oslo		1	Norway	########
Kate o'brie	Dublin			Ireland	########
Elisabeth M	Sandefjord	Finnmark	3236	Norway	########
Lily Mahon	Shannon			Ireland	########
Geir Wilhel	Oslo			Norway	########
Ró Talb	Navan			Ireland	########
Daina Narkeviciute				Ireland	########
Harrieth St	Oslo	Hordaland	464	Norway	########
Meaghan G	Newbridge			Ireland	########
Mary O Ha	Galway city			Ireland	########
Inga Blix	L?ten			Norway	########
Jim Coakle	Lightwater		GU18 5XP	United King	########
Siri Lill Tho	Tofte		3482	Norway	########
Bernice En	Dublin			Ireland	########
Isobel Mur	Dublin			Ireland	########
Anne marie	Waterford			Ireland	########
Nancy Cree	Quilty Co Clare			Ireland	########
Anne Molo	Dublin		D02	Ireland	########
helena pike	London		N12 0BP	United King	########
Evelyn Mar	Ireland			Ireland	########
Christophe	Luimneach		V94	Ireland	########
Sanne Giel	Lahinch		V95	Ireland	########
Nigel de Ha	Ballineen		P47	Ireland	########
Doutsen Rc	Miltown Malbay		65	Ireland	########
Jacqui Hers	Ennistymon			Ireland	########
John O Sull	Athlone		N37	Ireland	########
Jutta Brassi	Miltown Malbay			Ireland	########
Maria mur	Dublin		D02	Ireland	########
Molly Harri	Harrisburg	Pennsylvania		United Stat	########
Siobhan Lu	Tralee		V92	Ireland	########
Honora Me	Miltown Malbay		V95	Ireland	########
Susan Pow	Dublin		D02	Ireland	########
Jennifer O'I	Kilkee			Ireland	########
Ursula McN	Dublin		D02	Ireland	########
Mary FitzPa	Dublin			Ireland	########
Kieran O'Re	Dublin		D02	Ireland	########
Jeeya Sand	Chigwell		IG76JU	United King	########
Miss claudi	Plymouth		Pl15bp	United King	########
Lorraine Qu	Carbury, Kildare.			Ireland	########
Nakila Bles	Lancaster	Missouri	63548	United Stat	########
Eamonn Ha	Dublin			Ireland	########
Conor McK	Dublin		D02	Ireland	########
Conall O Fr	Dublin			Ireland	########
Joe McMah	Dublin		D02	Ireland	########
Breda Kear	Miltown Malbay		V95	Ireland	########
Judy Burke	Tralee		V92	Ireland	########
Maggie ma	Ashbourne		A84	Ireland	########
Aimee TSO	Dublin		D02	Ireland	########
Paul K	Galway		H91	Ireland	########
dean burke	Hollywood			Ireland	########

John O'Dris	Dublin		D02	Ireland	########
Eamonn M	Killarney		P12	Ireland	########
Carmel Har	Maynooth		W23	Ireland	########
Mary Edwa	Dublin		D02	Ireland	########
Suzanne Br	Helensburgh		G84 9BJ	United King	########
Tobi daram	Navan			Ireland	########
Temitope (	Dublin		D02	Ireland	########
Elaine Sext	Ennistymon		V95	Ireland	########
Michael M	Dublin		D02	Ireland	########
Siobhán M	Ennistymon		V95	Ireland	########
Adrian O'n	Blackrock		A94	Ireland	########
Paddy Laff	Miltown Malbay		95492	Ireland	########
patricia ros	San Francis	California	94121	United Stat	########
Padraig Sa	Rohnert Pa	California	94928	United Stat	########
Modinat Sulaiman				Ireland	########
Patrick Kell	Cork		T23	Ireland	########
Gerardine I	Alamo	California	94507	United Stat	########
Carlos Rey	Portland	Oregon	97215	United Stat	########
Paraic Mur	Ennistymon		V95	Ireland	########
Mícheál Mi	7321 Barbi	California	994928	United Stat	########
Niamh Dal	Co,clare		Nil.	Ireland	########
Tony O lou	Luimneach		V94	Ireland	########
Yvonne Ro	Luimneach		V94	Ireland	########
Gerry Egan	Luimneach			Ireland	########
Barry Conw	Portlaoise		R32	Ireland	########
Aaron Hoe	Carbury			Ireland	########
Paul Dunne	Edenderry		R45	Ireland	########
David Clan	Lahinch		V95	Ireland	########
Michael Cr	Dublin		D02	Ireland	########
Angela Mo	Tullamore			Ireland	########
Séamus By	Miltown Malbay		V95	Ireland	########
Gerry Cons	Kilshanny			Ireland	########
michael ba	Kells		A82	Ireland	########
Lyra Parry				Ireland	########
Ger Clancy	Galway		H91	Ireland	########
francisco c	Dublin			Ireland	########
Michelle R	Dublin			Ireland	########
seanie con	Dublin		D02	Ireland	########
Eoin Molor	Dublin		D02	Ireland	########
Donal Paul	Dublin		D02	Ireland	########
Michael Ta	Dublin		D02	Ireland	########
Melissa Cu	Ennis Co. Clare			Ireland	########
Sean Hehir				Ireland	########
Val English	Dublin		D02	Ireland	########
Joan and V	Dublin			Ireland	########
Edel Smith	Dublin			Ireland	########
Maria Clela	Ennis		V15	Ireland	########
Sharon Ebt	Ennis		V15	Ireland	########
Mary O'Lea	Thurles		E41	Ireland	########
Zoe O'Don	Dublin			Ireland	########

Deirdre Cul	Kilrush		V15	Ireland	########
Cian Carew	Galway		H91	Ireland	########
Shónagh Fa	Burren			Ireland	########
Lisa Killora	Galway		H91	Ireland	########
brian kearr	Athlone		N37	Ireland	########
Kaitlyn Lyo	Gort		H91	Ireland	########
Maria Lync	Galway		H91	Ireland	########
Seamus Fin	Ballinasloe		H53	Ireland	########
Anne Slatte	Waterford		X91	Ireland	########
Cormac Finn				Ireland	########
Aoife Kelly				Ireland	########
Dolores FIN	Ballinasloe		H53	Ireland	########
Matthew S	Plymouty		Pl14qx	United King	########
Elaine Shep	London		NW10	United King	########
Eric Sheppa	Los Angele	California	90077	United Stat	########
Noreen Mc	Dublin		D02	Ireland	########
Alisha McN	Londonderry		BT48	United King	########
Tiernan Fin	Dublin		D02	Ireland	########
Hilary McA	Dublin		D02	Ireland	########
liam blake	Lahinch		V95	Ireland	########
Breda Kear	Lahinch		V95	Ireland	########
Lillian Mur	Clare			Ireland	########
Myra O Co	Miltown Malbay			Ireland	########
Patrick Hec	Naperville	Illinois	60564	United Stat	########
Neil Mac gi	Sixmilebridge			Ireland	########
Marie Burk	Ennis			Ireland	########
Loretta Hanrahan				Ireland	########
Mary Cosgı	Ennis			Ireland	########
Alison Brov	Doolin			Ireland	########
O'Malley M	Miltown malbay			Ireland	########
Caroline Dc	Ennis			Ireland	########
Dariusz Ma	Dublin		D02	Ireland	########
Karen Chec	Portland	Oregon	97215	United Stat	########
Lisa Byrne	Miltown Malbay		V95	Ireland	########
Siobhan Ol	Bronx	New York	10469	United Stat	########
Meadhbh M	Clare		V95	Ireland	########
michael mı	miltown malbay			Ireland	########
Emmet Wh	Dublin			Ireland	########
Colin Kelly	Dublin		D02	Ireland	########
Conchúbha	Sráid na Cathrach			Ireland	########
Maria Dinah Clarito				Ireland	########
Carolyn Pri	Dublin			Ireland	########
Olive Cond	Carlow			Ireland	########
Colm Elder	Dublin		D02	Ireland	########
Alan Jacqu	Athlone			Ireland	########
Pat Mc Alister			BT10 0JJ	Ireland	########
Aisling Roc	Dublin			Ireland	########
Isy Crosbie				Ireland	########
tom molon	miltown malbay			Ireland	########
Carly baile	Dublin			Ireland	########

kenneth da	None			Ireland	########
Brian Coffe	Plantation	Florida	33317	United Stat	########
Lorraine Jo	Clare			Ireland	########
Maureen D	Morganton	North Caro	28655	United Stat	########
Carlos Reye	Letterkelly	East		Ireland	########
Kevin Wals	Shannon		N/a	Ireland	########
Mary Hallo	Ennis			Ireland	########
Keavey	Caroline			Ireland	########
Lorna Bow	Newport		NP19 0LR	Ireland	########
Binil jose				Ireland	########
Daisy Love	Westport			Ireland	########
Brian O'Gorman				Ireland	########
Annr Shear	Roberton	Scotland	ML12 6RS	United King	########
Kate Baker	Co Cork		n/a	Ireland	########
Patrice Mc	Limerick			Ireland	########
Brid Oleary	Clare			Ireland	########
Maggie Crc	Miltown Malbay		V95	Ireland	########
Christine O	Los Angele:	California	90044	United Stat	########
Mary O LEARY				Ireland	########
Patrick Ole	Dublin			Ireland	########
Sanne Gielesen				Ireland	########
Valerie Ma	Dublin			Ireland	########
Maureen N	Limerick			Ireland	########
Connie Freeney				Ireland	########
Susan Craw	Clare			Ireland	########
Ciara Murtagh				Ireland	########
Cathal Mac	Clare			Ireland	########
Michelle Ca	Letterkenny			Ireland	########
Bridgeen Mc	Alister			Ireland	########
Des Elmes	Newbridge			Ireland	########
Suzanne Ga	London	England	Se152bg	United King	########
Noreen Co	Ennis			Ireland	########
sandra mu	dublin15		8	Ireland	########
Carol Kane				Ireland	########
Hannah Williams				Ireland	########
Dearbhail M	Miltown Malbay			Ireland	########
Noreen Cla	limerick			Ireland	########
Ciara Worley				Ireland	########
Rebecca Cr	Midleton			Ireland	########
Tara Moloney				Ireland	########
Samantha Loughlin				Ireland	########
Brenda Do	Dublin			Ireland	########
Michelle M	ennis			Ireland	########
Sabrina Gill	Limerick			Ireland	########
Karen mad	limerick			Ireland	########
Amy Caule	Dublin		D02	Ireland	########
Sarah Kear	Galway			Ireland	########
James Fleming				Ireland	########
Saundra Hu	Ennis			Ireland	########
Matea McCormack				Ireland	########

Veronica R	clare		Ireland	########
Megan O d	co.clare	0	Ireland	########
Natalia Brzezinska			Ireland	########
Leonora Dc	Limerick		Ireland	########
Zara Fox	Dublin		Ireland	########
Joseph Hackett			Ireland	########
Patrick Mckenna			Ireland	########
Joanne Sweeney			Ireland	########
Patricia Etherson			Ireland	########
Phil Tifft			Ireland	########
Yvette Ryai	Limerick		Ireland	########
Lontio touopi Gildas gael			Ireland	########
Noelle Don	Ennis		Ireland	########
Margaret Hartin			Ireland	########
Frances M/	Dublin	D02	Ireland	########
David McS\	Kildysart, Co Clare		Ireland	########
sylvia baxter			Ireland	########
Leigh O'Connor			Ireland	########
Tadhg O C	Dublin		Ireland	########
Patxi Azkorbebeitia		48220	Ireland	########
Maria Houl	Limerick		Ireland	########
Emma Attewell			Ireland	########
Maitiu Qui	Belfast		Ireland	########
Lukas Timer			Ireland	########
Mary F	Dublin		Ireland	########
Simon Fernandes			Ireland	########
caroline bo	Letterkenny		Ireland	########
Sarah Winie Zikhali			Ireland	########
Imaculada Oliveira			Ireland	########
Aine Mulre	Westmeath		Ireland	########
Anne Ahern			Ireland	########
Siobhan O	Mullingar		Ireland	########
Maura Foye			Ireland	########
Donal O'Dr	Dublin		Ireland	########
Andy Clarken			Ireland	########
Omar Mohamud			Ireland	########
Temitope Ajiboye			Ireland	########
Samantha Langford			Ireland	########
Keith Mcde	Ashbourne		Ireland	########
Paulina Ad:	Dublin		Ireland	########
June Reync	Dublin		Ireland	########
Annette Broughall			Ireland	########
Ger Doran	Dublin	CO. DUBLII	Ireland	########
Dylan Tcha	Cork	19107	Ireland	########
Chloe R			Ireland	########
Cherise Ring			Ireland	########
John Mc Mahon			Ireland	########
Pat Curtin			Ireland	########
Hannah Fin	galway		Ireland	########
Luca Kozak			Ireland	########

Brendan O	Miltown malbay			Ireland	########
MARIE DEVINE				Ireland	########
Chris Collis				Ireland	########
Sarah McIn	Clohanmore			Ireland	########
Brian McDowell				Ireland	########
Noreen Skerritt				Ireland	########
Maria Loor	Newbridge		W12	Ireland	########
Cintia Mag	Ennis			Ireland	########
Anne Cox	Dublin			Ireland	########
Conor Mah	Carrick on shannn			Ireland	########
Amy Mulq	Kildare		R51	Ireland	########
F Walsh				Ireland	########
Catherine Murphy				Ireland	########
Lisa Cooney			2204	Ireland	########
Kirsty Carr	Ennis			Ireland	########
Brid Killeen	Clare			Ireland	########
Kieran Kille	Miltown Malbay			Ireland	########
Peter Fee	Newham	England	E13	United King	########
Sarah Cona	Donegal			Ireland	########
Cathy Henl	Ennis			Ireland	########
Linda Clanc	Caranceja		39591	Spain	########
Maureen Flynn				Ireland	########
Michelle Fl	Miltown Malbay			Ireland	########
John Jorda	Dublin		D02	Ireland	########
Brid Finuca	Clare			Ireland	########
michelle ol	co clare			Ireland	########
Catriona Ki	Clare			Ireland	########
Damien Fin	Ennis			Ireland	########
Stephen Quigley				Ireland	########
Marian Cur	Clare			Ireland	########
Tara Quigley				Ireland	########
Clair Curtin				Ireland	########
Martin O'brien				Ireland	########
Liam Frawl	Inverness		IV38TQ	Ireland	########
Raida Algotany				Ireland	########
Kieran O br	Melbourne		3199	Australia	########
E C	Galway			Ireland	########
Eilish O'Brien				New Zealar	########
John M				Ireland	########
Ann mc do	Castlebar			Ireland	########
Ann Marie Meaney				Ireland	########
Tony Killeen				Ireland	########
Kathlyn Lafferty				Ireland	########
Michelle Curtin				Ireland	########
Tim Murphy				Ireland	########
Margaret C	Lewisham	England	SE26	United King	########
VJ Cleary	London	England	SW16 3RY	United King	########
Terence Obrien				Ireland	########
Bridget O Brien				Ireland	########
Gosia Kami	Galway			Ireland	########

Philip Chambers				Ireland	########
Claire O Ne Wicklow				Ireland	########
Mare O malley				Ireland	########
Noirin Que Miltown Malbay				Ireland	########
Patricia Flanagan				Ireland	########
Aisling O Brien				Ireland	########
Chris Crow Miltown Malbay, County Clare				Ireland	########
Susan McCabe				Ireland	########
John Scullane				Ireland	########
Kayleigh Crowe				Ireland	########
Frances Hennessy				Ireland	########
Zoe Earley-Jenkerson				Ireland	########
Bridie Costelloe				Ireland	########
Leanne Kea Dublin				Ireland	########
Maria Devoy				Ireland	########
Theresa Buckley				Ireland	########
Caroline Brown				Ireland	########
Philomena McDermott				Ireland	########
Diana Bartuss				Ireland	########
James kelly				Ireland	########
Michael Burke Burke				Ireland	########
Sophie Bou Villeurbanne			69100	France	########
Helen Geiss				Ireland	########
Jacqueline Wrexham	Wales; Cyn		LL12 8DW	United King	########
John Flynn				Ireland	########
Marjorie Ahern				Ireland	########
JEAN FLYNN				Ireland	########
Davóg Rynı Lyon			69001	France	########
N M				Ireland	########
Betty McMahon				Ireland	########
Lorraine Carey				Ireland	########
Marian Feehan				Ireland	########
Turlough Rynne				Ireland	########
Ann Hennessy				Ireland	########
Teresa Cra Ardnacrusha Co Clare				Ireland	########
Michelle BARRETT				Ireland	########
John Lynch				Ireland	########
Joanne Cor Paisley	Scotland		PA1 3BS	United King	########
Dermot Benn				Ireland	########
Stephane Corbiere				Ireland	########
Agnieszka Dul				Ireland	########
Robert Kismann				Ireland	########
Aine Rynne				Ireland	########
Mark flynn Flynn				Ireland	########
Ottavia Zar Ennis				Ireland	########
Adrian Cyganek				Ireland	########
Carol Flynn				Ireland	########
ann waters				Ireland	########
Micheal murray				Ireland	########
Alan Lynch				Ireland	########

Jace Coughlan	Ireland	########
Morgan O'I Kilkenny	Ireland	########
Anna Lynn	Ireland	########
Sonja Smitl Sligo	Ireland	########
Triona Ryai Cork	Ireland	########
Cailim Rice Dundalk	Ireland	########
Emma O Brien	Ireland	########
Anastasiia Yekimova	Ireland	########
michelle sheehan	Ireland	########
Anna Ivanova	Ireland	########
Chris Gray	Ireland	########
Tosia Kazmierczak	Ireland	########
Tim Schroeder	Ireland	########
samuel behan	Ireland	########
Colin Gorm Dublin	Ireland	########
Arkadiusz S Dublin	Ireland	########
Paul Graha Cork	Ireland	########
Tracy Fox Dublin	Ireland	########
Aoife McNulty	Ireland	########
Valerie Keating	Ireland	########
Mairtin stiofan Seoighe	Ireland	########
ann ardiff Ballivor	Ireland	########
Kadija diallo	Ireland	########
Sarah Peoples	Ireland	########
Emily Kavanagh	Ireland	########
Vivienne daly	Ireland	########
Caroline Curtin	Ireland	########
Brian Finne Dublin	Ireland	########
Ash Rawal	Ireland	########
Gabriela Villa López	Ireland	########
Maureen B Bantry Cork	Ireland	########
Ai-ZZ AAI-Z Dublin	Ireland	########
Alexandru Tita	Ireland	########
Peter Long Dublin	Ireland	########
Jane mccarthy	Ireland	########
valerie gan dublin	Ireland	########
mallika gundla	Ireland	########
Mary Nally	Ireland	########
Ronan Mcl Delgany	Ireland	########
Serena Abudu	Ireland	########
Jack O'Reilly	Ireland	########
Therese Bu limerick	Ireland	########
Emma Red Lucan	Ireland	########
Diana Estrada	Ireland	########
Michelle Daniel	Ireland	########
Lee Bradley	Ireland	########
billy bob	Ireland	########
Damien Walsh	Ireland	########
ellsie lackey	Ireland	########
Sean Walsl Midleton	Ireland	########

Debbie whi	dublin		Ireland	########
Peter Bull	Dublin	D02	Ireland	########
Ellen Furlo	County Clare		Ireland	########
Gillian Foy			Ireland	########
nicholas w	galway	n/a	Ireland	########
Genevieve Coyne			Ireland	########
E C	Dublin		Ireland	########
Craig Clohessy			Ireland	########
Tony O'Connor			Ireland	########
john King			Ireland	########
Mairead O'	cork		Ireland	########
Blake Langford			Ireland	########
Dillan Mooney			Ireland	########
James Kerr			Ireland	########
ANTHONY BRENNAN			Ireland	########
Elizabeth L	Dublin		Ireland	########
Paul Clarke	Drogheda		Ireland	########
Sean Carroll			Ireland	########
Darren Weldon			Ireland	########
William Ryan			Ireland	########
Maina Avta	Dublin	D02	Ireland	########
Patrick Holgersen			Ireland	########
Angela Mc	Killarney		Ireland	########
Mark Keho	Dublin	D02	Ireland	########
Aaron Hogan			Ireland	########
Martin Bance			Ireland	########
Eithne Brunner			Ireland	########
Len O'Shea	Tullamore		Ireland	########
Lorraine Ca	Dublin	94102	Ireland	########
Chris kelly			Ireland	########
mary walsh	Cork		Ireland	########
Brian Loughlin			Ireland	########
Brenda Clarke			Ireland	########
Pamela Ro	Portlaoise	R32	Ireland	########
Fionnghuala Miller			Ireland	########
Molly Scally			Ireland	########
kelly dunph	kilkenny		Ireland	########
Abbie Mccormack			Ireland	########

HUSON & ASSOCIATES

Peer Review of Proposed Slieveacurry Wind Farm Planning Application (PAX03.324270)

W Les Huson BSc(Hons) MSc CPhys MInstP MIoA MAAS

Slieveacurry Wind Farm Review.docx
JUNE 2026

INTRODUCTION

Huson & Associates has been commissioned by the Miltown Locals Say No To Windfarm group to review an Environmental Impact Assessment Report (EIAR) prepared by MKO Planning and Environment Consultants for Slieveacurry Ltd containing Chapter 12 'Noise and Vibration' (NVA) prepared by AWN Consulting Ltd to support a Planning Application lodged with An Coimisiun Pleanála (Case Ref. PAX03.324270) on 5 May 2026 for the Slieveacurry Renewable Energy Development. The application is for a wind farm containing up to nine wind turbines.

The proposed wind farm development (see Figure 1) has been deemed suitable for assessment by An Coimisiun Pleanála (ACP). A similar application was assessed and refused by Clare County Council with a subsequent Appeal to An Bord Pleanála that was also dismissed (8 Feb 2023).

This review also considers the grounds for refusal by Clare County Council and An Bord Pleanála (ABP-312728-22) of the prior application that was refused. The prior application had wind turbines fundamentally in the same location as the current application but without turbine T9.

An application for the Illaunbaun Wind Farm lies to the north-west, currently under review by ACP, and the application documents for this wind farm have also been reviewed insofar that they relate to the Slieveacurry Wind Farm application.

This review has been prepared by W Les Huson BSc(Hons) MSc CPhys MInstP MIOA MAAS (brief CV in Appendix A). Referenced papers can be made available on request.

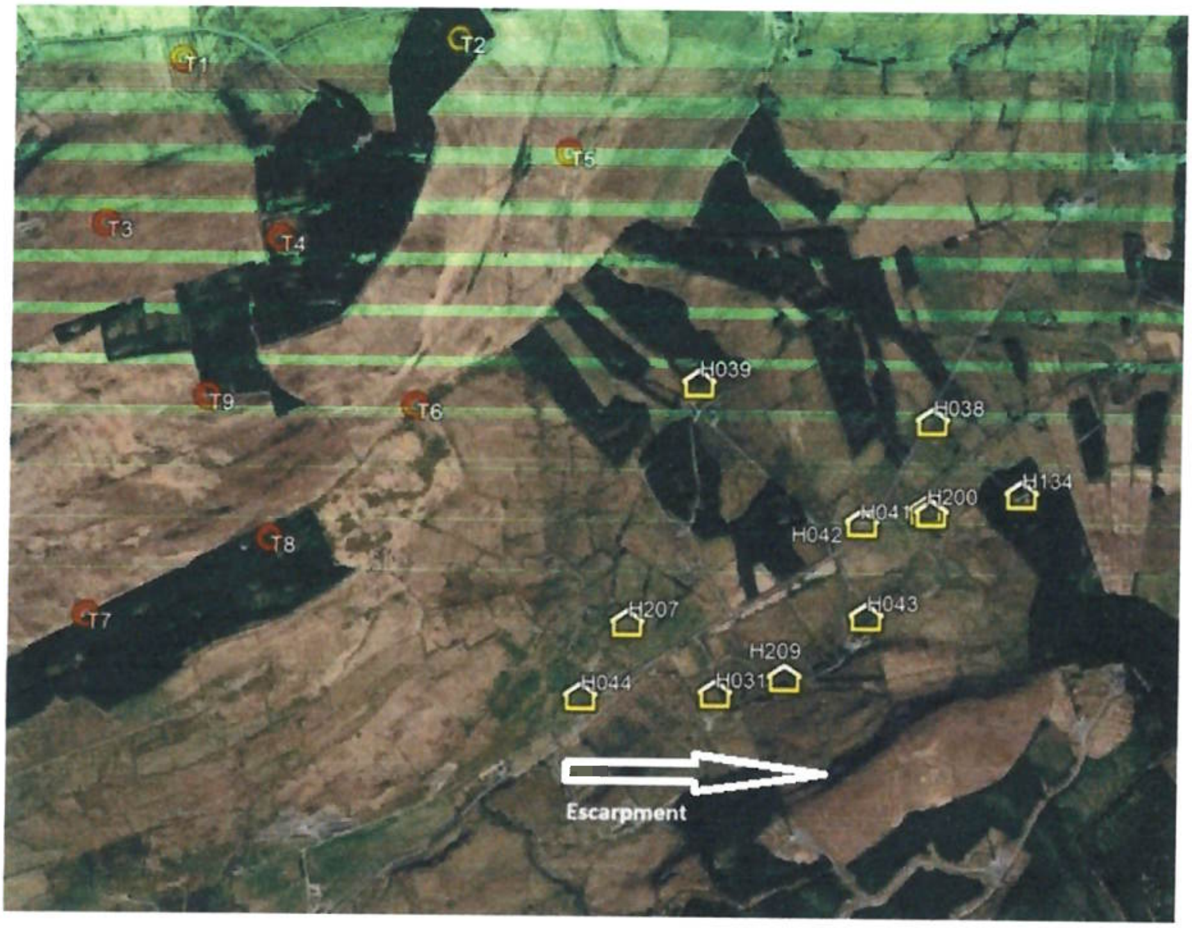

Figure 1 Location of wind turbines (T) and some NSLs

SUMMARY

An Coimisiún Pleanála would be justified in dismissing the Slieveacurry Wind Farm Application for the following reasons:

- The minimum recommended setback of 10 times the rotor diameter, a best practice setback distance of 1.5 km for the proposed wind turbine rotor diameter of 150m, has not been applied with one dwelling (H033) being only 529m from the nearest wind turbine.
- The wind turbines are located too close to each other that will result in increased wake turbulence that in turn will increase noise emission and the characteristic of amplitude modulation. The NVA has not considered these effects.
- Noise compliance with WEDG 2006 should have been completed at 10 m/s, not 8 m/s. All wind speeds in this report refer to standardised hight of 10 m above ground level.
- WEDG 2006 target noise limits have been misinterpreted in the NVA to produce higher proposed noise limits.
- WEDG 2006 requires: "Any existing turbines should not be considered as part of the prevailing background noise". Background noise measurements have all been corrupted by noise from the Slieveacallan Wind Farm and the method chosen to correct this interference is not mathematically sound and introduces increased uncertainty. A more representative and recent background survey that can be used as proxy for dwellings surrounding the Slieveacurry Wind Farm, that is less influenced by extraneous noise from the Slieveacallan Wind Farm, is that provided in the Illaunbaun Wind Farm planning application currently under review by ACP.
- Target day time noise limits should be lower at 35 dB(A) in 10 m/s wind speed.
- Predicted sound levels in the NVA are too low.
- When less optimistic noise model inputs are used the predicted noise levels shown in the NVA will be at least 2 dB higher.
- The current WEDG 2006 does not reflect best practice and is outdated, but if applied properly, shows that this proposed wind farm is non-compliant.
- The requirement from WEDG 2006 that '*that there is no significant increase in ambient noise levels at any nearby noise sensitive locations*' has not been addressed in the NVA.
- Ambient sound levels are shown at times to be below the 17 dB(A) instrument noise floor in wind speeds up to 10 m/s at H161 compared with cumulative sound levels optimistically predicted to be more than 38dB(A) at this location.

- The soundscape in the area will change by more than 20 dB for the surrounding Community if the wind farm is approved and this is contrary to the requirement of the WEDG 2006.
- According to the Environmental Protection Agency, Ireland's 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports' (EPA, 2022), the impact of the proposed development when operational will cause a 'Very Significant' to 'Profound' effect. Accordingly, the development application presents an unacceptable impact and should be refused.
- The layout of the nine wind turbines is such that excessive amplitude modulation will arise but the NVA has not accounted for any penalty due to this or other special audible characteristics (tonality, impulsive sound).
- The sound power levels for the wind turbines of the Slieveacallan Wind Farm that were input to the cumulative noise predictions are too low by 0.5 dB that will translate to higher cumulative sound levels.
- The NVA has listed several dwellings as being derelict, yet, these properties could be occupied in the future. It is not appropriate for the NVA to set daytime and night time noise limits at 55 dBA for these properties.
- Current best practice in assessing wind farm noise should be reflective of target noise limits set in Germany and the Australian States of New South Wales and Tasmania.
- Low frequency noise impact has not been assessed, despite this being discussed in the NVA.
- With noise model inputs used in the NVA and no consideration of special audible characteristics there will be 181 noise sensitive locations (NSLs) that exceed the correct noise limit target of 35 dB(A) at 10 m/s.
- With more conservative noise model inputs (+2dB) and no special audible characteristics 207 NSLs will exceed the correct noise limit target at 10 m/s.
- If special audible characteristics were to warrant a 5 dB penalty with the correct noise model inputs, then all 208 NSLs considered in the NVA will exceed the correct noise limit target at 10 m/s.
- The NVA does not refer to any noise predictions for the substation and only refers to an unspecified detailed future design. The NVA is deficient in this regard.
- An escarpment to the south east of the proposed development has the potential to increase noise levels through reflection for dwellings between it and the proposed Slieveacurry Wind Farm that are shown in Figure 1.

The following expands upon these issues.

PLANNING GUIDANCE ON NOISE FROM WIND FARMS

The Irish Government Department of Environment Heritage and Local Government document '*Wind Energy Development Guidelines, 2006*' (WEDG 2006) detail the current guidelines to set noise limits for wind energy developments.

The NVA has adopted the principles of WEDG 2006 but has added interpretations contained in UK wind farm noise guidance using ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms' with further guidance from the Institute of Acoustics in 2013; 'A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise' (GPG) to change recommended noise limits in WEDG 2006.

It should be recognised that the scope of the GPG was not to examine noise limits described in ETSU-R-97. The GPG states that "The approval of this guide by the IoA Council should not be seen as an endorsement of the noise limits within the ETSU-R-97 document since the setting of these limits is a policy matter for Government."

Furthermore, the GPG is only applicable for those involved in the assessment and rating of wind turbine noise when applying ETSU-R-97 assessment procedures. The GPG may not be appropriate guidance if other assessment procedures are used.

WEDG 2006 requires updating and a DRAFT WEDG 2019 was prepared but not formally adopted as it remains under review.

The limits proposed in the WEDG 2006 broadly align with the UK guidance found in ETSU-R-97 that reflects but does not reference WHO guidance in 1997. However, noise limits to protect sleep were reduced by 5 dB in subsequent WHO guidance in 1999 that remain current.

WEDG 2006 does not require that ETSU-R-97 or guidance on its implementation be used to assess wind turbine noise.

WEDG 2006 states that "*Good acoustical design and carefully considered siting of turbines is essential to ensure that there is no significant increase in ambient noise levels at any nearby noise sensitive* locations." This requirement is a test that has not been addressed in the NVA.

WEDG 2006 has been drafted to balance the objectives of providing renewable power with acoustic amenity and for quiet areas states; "*in low noise environments where background noise is less than 30 dB(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 35-40 dB(A).*"

Justice Richards observed the following in a recent Supreme Court nuisance noise case (Uren v Bald Hills Wind Farm S ECI 2020 00471) 25 March 2022 in Australia:

"The *generation of renewable energy by the wind farm is a socially valuable activity, and it is in the public interest for it to continue. However, there is not a binary choice to be made between the generation of clean energy by the wind farm, and a good night's sleep for its neighbours. It should be possible to achieve both.*"

A recent court case in Ireland (Ms Justice Emily Egan) echoes this observation:

"*There is not a binary choice to be made between the generation of clean energy by the wind farm and a good night's sleep for its neighbours. It should be possible to achieve both.*"

The WEDG 2006 does not set fixed noise limits. The guideline provides advice for local authorities (Councils) to develop their own planning guidelines for noise that can differ from those suggested in WEDG 2006. In this regard, for example, the Limerick County Council has set low frequency noise guidelines that are not contained within the WEDG 2006 and they also allow a night time noise limit of 38 dB(A), L90, or Background plus 5 dB. Many other local councils have set noise criteria for wind farms that differ from those in the WEDG 2006.

BACKGROUND NOISE MEASUREMENTS

NVA, Appendix 12-5 and NVA Table 15, has chosen to set lenient target noise limits in the daytime at 45 dB(A) L90 or background plus 5 dB, whichever is the greater, where background noise levels were >30 dB(A) from five residences (A, B, C, D and E) around the proposed development, all of which were acknowledged to be affected by noise from the Slieveacallan Wind Farm.

Several proxy locations are suggested to be representative of the five background measurement locations. For example, Background measurements at location E (H006) is suggested to be representative for H002, H003, H004, H006, H008, H011, H012, H013, H014, H026, H069, H115, H116, H117, H118, H119, H140, H141, H142, H143, H144, H145, H146, H160, H161, H162, H163, H177, H178, H180, H181, H182, H183, H186, H187, H188, H189, H190, H191, H192, H198, and H213.

Conversely, if one of those proxies had background measurements unaffected by noise from the Slieveacallan Wind Farm then that could be used as a proxy to represent those listed above.

The NVA has suggested correcting their background noise measurements by removing data outside particular wind directions and to further correct the corruption from the Slieveacallan Wind Farm by 'removing' its contribution.

However, the 'removal' method of correction is to simply take LAeq predicted noise levels, corrected by 2 dB to LA90 and then to take predicted LA90 levels away from background measurement data. This correction methods is not mathematically sound and it is preferable to use background data from a representative location in the area that is unaffected by noise from other wind farms.

It would have been possible to use background noise measurements taken for the Slieveacallan Wind Farm before it was constructed but this data would be more than 16 years old.

I suggest that the background survey data (November 2023) from NML2 in the Illaunbaun Wind Farm application to ACP is the most recent and reliable background noise survey upon which to set target noise limits for all NSLs surrounding the proposed Slieveacurry Wind Farm.

It should be noted that measured background sound levels regularly fall below 20 dB(A) in wind speeds up to 8 m/s. When consideration is given to the compression of sound level measurements close to the noise floor of the sound level measurement instruments[1] the real average background sound levels at many noise measurement locations (NMLs) will be well below 30 dB(A), justifying the lower target base noise limit of 35 dB(A) from the range suggested in WEDG 2006 during the daytime.

[1] Huson, W. Les. "Constraints imposed by and limitations of IEC61672 for the measurement of wind farm sound emissions" 6th International Conference on Wind Turbine Noise, Glasgow 20-23 April 2015

This effect is also highlighted in BS 4142:2014+A1:2019, section 8.1 which notes: "*Care is necessary in circumstances where background sound levels are low to ensure that self-generated and electrical noise within the measurement system does not unduly influence reported values, which may be the case if the measured background sound levels are less than 10 dB above the noise floor of the measuring system.*"

'Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3)' has been referenced about infrasound and low frequency (12.3.5.9) but the NVA has not mentioned that it also provides compliance limits in the daytime between 35 dBA and 40 dBA for quiet daytime environments of less than 30 dBA that echoes the lower limits in WEDG 2006.

For situations where the *average corrected* background noise level is <30 dB(A) the NVA has elected to apply the least stringent noise limit of 40 dB(A) and no noise sensitive locations (NSLs) have been assigned the 35 dB(A) base noise limit.

Background sound levels that set target noise limits generally increase with wind speed and the background measurements at H162 from the Illaunbaun Wind Farm application to ACP shows this effect in the following table.

Location		**4m/s**	**5m/s**	**6m/s**	**7m/s**	**8m/s**	**9m/s**	**10m/s**	**11m/s**	**12m/s**
H162 (NML2)	**Day**	20.0	20.7	21.7	23	24.6	26.3	28.1	30.1	32.1
	Night	20.3	21.3	22.5	23.9	25.4	26.9	28.6	30.3	32.1

VIBRATION

Section 12.3.7 refers to vibration generated by the wind turbines. Whilst ground borne vibration is expected to be low there is the possibility of induced building vibration due to acoustic emissions from wind turbines. The mechanism producing this effect is described by Kelley[2].

NOISE LIMITS

The 2018 World Health Organization (WHO) Environmental Noise Guidelines for the European Region suggests a provisional outdoor target noise limit for wind farm noise of <45 L_{den}. This roughly equates to 37.3 dB, LAeq[3] and supports the lower noise level target of 35.3 dB(A), L90 (37.3 dB LAeq – 2 dB), not that proposed in the NVA.

Based on background measurements that were unaffected by noise from the Slieveacallan Wind Farm, reported in the Illaunbaun Wind Farm EIAR (NML2, November 2023) for dwelling H162 in winds less than 11 m/s, the target noise limit should be 35 dB(A) in the day time.

Again, the NVA is not applying best practice.

[2] N.D.Kelley. A Proposed Metric for Assessing the Potential of Community Annoyance from Wind Turbine Low-Frequency Noise Emissions. Windpower '87 Conference and Exposition October 5-8, 1987 San Francisco, California.
[3] Davy, J.L., Burgemeister, K., Hillman, D. *et al.* A Review of the Potential Impacts of Wind Turbine Noise in the Australian Context. *Acoust Aust* **48**, 181–197 (2020). https://doi.org/10.1007/s40857-020-00192-4

Section 12.3.5 of the NVA states: "The Guidelines (DoEHLG 2006) are based on detailed recommendations set out in ETSU-R-97. The ETSU-R-97 document has been used to supplement the guidance contained within the Guidelines (DoEHLG 2006), where appropriate and necessary."

Guidelines DoEHLG 2006 (WEDG 2006) is not based upon detailed recommendations set out in ETSU-R-97, rather, it was considered and bears similarity to parts of ETSU-R-97 such as the target night time noise limit and the use of LA90 to measure and assess wind turbine noise.

WEDG 2006 is a workable stand-alone document and the NVA should not rely on guidelines from the UK Institute of Acoustics (currently under review) that are specifically used to implement ETSU-R-97.

WEDG 2006 outlines the current assessment requirements which do not refer to or require interpretations from the UK IoA Good Practice Guide that in some cases alter WEDG 2006 recommended noise levels.

Section 12.5.2 of the NVA outlines a rationale for the choice of noise limits that are used in the NVA.

The rationale to adopt a 43 dB(A), L90 or *Background plus 5 dB, whichever is the higher* noise limit at night is a less stringent target than WEDG 2006 recommends.

The proposed night time noise limit in the NVA is too lenient by allowing night time noise limits greater than 43 dB(A), L90.

WEDG 2006 references Environmental Protection Agency (2003) Environmental Noise Survey - Guidance Document, EPA Wexford, that has been superseded by Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4).

The NVA (12.3.6.1 and 12.5.2) references NG4 for guidance on establishing if NSLs can be considered to be in 'low background noise' areas. 'Low background noise areas' are required to be assessed when applying WEDG 2006.

NG4 suggests that a daytime noise criterion of 45dB(A). Leq, applies in 'areas of low background noise'. The parameter referenced in NG4 is a rating value (LAr), based on LAeq so the LA90 target noise limit is 43 dB(A), LA90 (45dB minus 2 dB to represent LA90).

The NVA author shows in Table 12-5 that in the Evening this reduces to 40 dB(A), Leq (38 dB(A), L90) and at night the criterion reduces to 35 dB(A), Leq (33 dB(A), L90).

NG4 also has recommended criteria for Quiet Areas and properties surrounding this development comply with a designation of 'Quiet Areas' for their location. Under these circumstances the criteria changes to noise from the proposed development to be at least 10dB below the average daytime, evening and night time background noise levels measured during the long-term baseline noise survey.

NVA section 12.5.2 use NG4 as a reference document to suggest noise criteria for the proposed wind farm that are at least 10 dB higher than NG4 recommends at night for both Quiet Areas and 'areas of low background noise'.

Likewise, the proposed daytime noise limit of 40 dB(A), L90 is 7 dB higher than the evening period for 'areas of low background noise' and at least 10 dB higher than the NG4 criteria for Quiet Areas.

If WEDG 2006 is to apply to this proposed development then the lower day time noise limit of 35 dB(A), L90 should apply and, in addition, consideration must be given to any significant increase in noise levels.

The NVA suggests that: "In line with ETSU-R-97 guidance (see Section 12.3.5.1), a fixed lower threshold of 45 dB LA90 or a maximum increase of 5 dB above background noise (whichever is the higher) is proposed for NSLs identified as being involved in the project."

However, WEDG 2006 does not differentiate between NSLs involved in a wind farm project or not, it states: "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." WEDG 2006 noise limits apply to *any* occupied dwelling whether they are associated with the project or not.

The NVA has listed several dwellings as being derelict, yet, these properties could be occupied in the future. It is not appropriate for the NVA to set daytime and night time noise limits at 55 dBA for these properties. The NVA predicts noise levels above 40 dB for 'derelict' dwellings H005, H034. H035, H045, H046, H199, H206, H207 and H209.

In the NVA, section 12.5.2 it has been incorrectly interpreted that when background sound levels become greater than 30 dB(A) at higher wind speeds that the lower range of noise limits suggested in WEDG 2006 (35 to 40 dB(A), L90) do not apply and the limit suddenly reverts to 45 dB(A) L90. This is incorrect.

The test of a quiet area is made at lower wind speeds (below 5 m/s according to BS4142 and NG4 where wind-induced noise on a microphone is minimised) and once determined applies at all higher wind speeds.

Section 12.5.3 of the NVA confirms that background sound levels at low wind speed, when there is no corruption from the Slieveacallan Wind Farm, demonstrate that the NSLs can be defined as areas of low background noise.

As wind farms operate 24/7 the limiting criterion for this development should be 35 dB(A), L90 during the day time (WEDG 2006 includes 'evening' into the description of 'day time') and predicted noise levels must be compared to this limit to assess if the development is acceptable.

A 35 dB(A), L90 noise limit during the day is based upon a day time background level of 28.1 dB(A), L90 at 10 m/s measured at H162.

Thus, the lower limit should be set at 35 dB(A) in wind speeds at or below 10 m/s.

In summary, the noise criterion suggested in the NVA for the proposed development at 8 m/s is too high by 10 dB during the daytime period if the WEDG 2006 limits are to be applied correctly. Additionally, for associated landowners the proposed limit at night is 2 dB too high.

Dwellings associated with the proposed development should have the same target noise limits as other non-associated NSLs.

Under these circumstances the predicted sound levels from the NVA at many dwellings exceed the appropriate recommended noise limit and ACP will be justified in refusing the proposed development.

The predicted sound levels for this development are overly optimistic. With appropriately set noise model inputs to reflect a conservative assessment the degree of non-compliance is greater by at least another 2 dB.

The NVA (12.4.4.2) has suggested hopefully and naïvely that:

A warranty will be provided by the manufacturer of the selected turbine to ensure that the noise output, including tonality, is controlled.

NOISE PREDICTIONS

Cumulative noise contour predictions in the NVA (Appendix 12-4) are made for the 8 m/s wind speed case.

For the 9 m/s wind speed case the predictions are the same.

Appendix 12-5 lists cumulative predicted sound levels at different NSLs for integer wind speeds up to 9 m/s.

The NVA does not explain why the sound power levels for the Slieveacallan Wind Farm wind turbines have only 1.5 dB added for uncertainty rather than 2 dB that was applied for the Illaunbaun and Slieveacurry wind turbines. The additional 0.5 dB will translate to higher predicted cumulative noise levels.

The test from WEDG 2006 for a low noise environment is not separated into that during the Day or Night.

At 10 m/s the day and night background noise level is less than 30 dB(A) that justifies the area to be classified as a 'low noise environment'. The noise limit at this wind speed should be 35 dB(A), not 45 dB(A).

A lower limit from the range 35 to 40 dB(A) from WEDG 2006 is recommended as it matches recommendations in NG4 for the evening.

At 8m/s the NVA is suggesting that a higher noise limit of 45 dB(A) should apply, based on background measurements, all of which the NVA admits have been affected by noise from the Slieveacallan Wind Farm. I strongly disagree.

The NVA is suggesting a target noise limit of 40 dB(A) or 45 dB(A) during the Day, dependent on corrupted background sound levels, and 43 dB(A) at night. Again, I disagree.

The target noise limit during the day should be 35 dB(A) at 10 m/s and below, not 45 dB(A) as claimed in the NVA for all noise sensitive locations.

The NVA predicts a sound level at NSL H039 of 43.2 dB(A) at 8 m/s, when applying the optimistic noise model inputs used in the NVA. This exceeds the NVA suggested night time limit by 0.2 dB.

However, if more conservative noise model inputs are used where the receiver height is 1.5m and the ground absorption value, G, is 0 then the predicted sound level for this dwelling becomes 45.2 dB(A).

Under both noise model prediction scenarios, the predicted sound level at NSL H039 exceed the correct 35 dB(A) daytime noise limit at 10 m/s and below.

The NVA has used very optimistic noise modelling and assumed that the sound from the proposed wind farm will not be tonal, impulsive or have any significant amplitude modulation characteristics that, in my experience, often occur.

The NVA (12.5.3) does not provide any noise predictions for the substation and defers to future detailed design. It is common knowledge that substation noise has tonal characteristics and the NVA should have included noise predictions for the substation to compare against the recommended 35 dB(A), LAr noise criterion. The NVA has suggested a target level of 35 dB(A), Leq, rather than LAr

LA90 statistic or LAeq

Use of the LA90 statistic does not capture short term noise events that are often observed from wind farms. Such noise events are often referred to as 'whump' or 'thump' type sounds are thought to be caused by wind flow delamination across the rotor blades when wind conditions change.

The benefit of a condition requiring the LAeq is that such events can reflect the extent of intermittent louder sounds that the LA90 statistic cannot.

However, if an LA90 level is specified as a noise condition then an added provision to prevent impulsive noise or tonality could be applied.

Such a condition was applied for the Cloghan Wind Farm in Offaly, as follows:

Noise levels emanating from wind farm noise when measured at the nearest noise sensitive properties, i.e. dwelling houses, shall not exceed 43 dB(A) $L_{A90(10\ minutes)}$. There shall be no tonal or impulsive noise and measurements shall be made in accordance with ISO recommendations R1996-1 (Acoustics-description and measurement of environmental noise, part 1; basic qualities and procedures).

BEST PRACTICE

WEDG2006 is outdated and not currently 'best practice'.

The most recent (29 July 2025) review of best practice in setting wind farm noise limits has been completed by the EPA of Tasmania, Australia, that has revised its wind farm noise guideline limit and set 35 dB(A), Leq as the appropriate base noise limit to be met. A copy of the Policy is in Appendix D.

Current best practice in wind farm noise guidance is also provided in the Australian States of New South Wales and Queensland where night time target noise limits are set at 35 dB(A) Leq or background plus 5 dB with additional penalties for special audible characteristics such as tonality, impulsiveness, and amplitude modulation.

Germany also has for a long time had a night time noise level limit of 35 dB(A) Leq.

Wind farms have been approved under these target noise limits and a good balance has been struck to provide renewable energy and protect the nearby population.

A target noise limit of 35 dB(A), Leq approximates to 33 dB(A), L90 that lies 2 dB below the lowest recommended day-time absolute limits in WEDG 2006 for quiet areas and reflects modern expectations for the protection of a nearby community.

NOISE MODEL

The NVA has used the ISO 9613-2 noise model that includes ground absorption and used manufacturer's data from Vestas for the V150. Vestas manufacturer's data normally includes a clause for 'Limitations', as follows:

These values as stated in the present document are to be regarded as "best estimates" for the octave band performance for the turbine. The values are to be regarded as informative and cannot in any way be used as guaranteed for any projects.

Given such *limitations*, it would be expected that uncertainty values greater than 2 dB would be appropriate.

ISO 9613-2 prediction results are sensitive to the value of ground absorption/attenuation effect, G, that can range between 0 and 1. G=0 indicates no ground absorption and G=1 represents full ground absorption of sound.

A paper by Brittain and Charalampous[4] shows the inadequacy of the ground effect calculations in ISO 9613-2 for a source height of 100m, which conveniently approximates the hub height of the proposed candidate wind turbines in the NVA.

The NVA has used a value of G=0.5 in the ISO 9613-2 noise model for all the ground between the wind turbines and all noise sensitive receivers with an artificial receiver height of 4m (in practice all sound level surveys are completed at a height of between 1.2m to 1.5m).

The peculiarities of the ground effect calculation in ISO 9613-2 show that predicted sound levels for a receiver height of 4m there is a 2 dB difference in predicted sound levels depending on whether G=0 or G=0.5 is used. G=0 produces typically 2 dB higher predicted sound levels than when G=0.5 is used and 4 dB higher compared to G=1.

It is best practice to err on the side of conservatism and use G=0 when using ISO 9613-2.

This point was made by Eric Sloth, one of the authors of the JOULE[5] study in his presentation (Appendix B) where he advises that if ISO 9613-2 is to be used for wind farm noise predictions, then G=0 should be used with additional corrections to account for site effects such as inflow turbulence.

The NVA has not accounted for any site effects that can increase wind turbine sound power levels.

Furthermore, the NVA *assumes* that there will be no special audible characteristics from whatever wind turbine is chosen to be used in the wind farm. Only test results can confirm this assumption but none have been supplied in the NVA.

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[4] Brittain, F., Charalampous, P: 'Assessing Accuracy of ISO 9613-2 for Calculating Ground Effects of Stack Height and Distance Using Olive Tree Labs OTL Suite'. NOISE-CON 2016, Providence, Rhode Island, 13-15 June, 2016

[5] Bass, J.,Sloth, E., Bullmore 'Development of a Wind Farm Noise Prediction Model,' JOULE project JOR3-CT95-0051, 1998

The ISO 9613-2 noise model has a stated limitation for its calculations in conditions where the source to receiver average height does not exceed 30m and when average propagation enhancement from vector wind does not exceed 1m/s to 5m/s measured at a height above ground between 3m and 11m.

ISO 9613-2 for this wind farm application is being applied well outside of its intended use.

The NVA has not commented on the uncertainty associated with the use of ISO 9613-2. The preferred IEA method recommended in the JOULE report suggests a standard deviation uncertainty of 0.004dB/m.

For a propagation distance of 1000m this translates to +/-4 dB (+/- one standard deviation). ISO 9613-2 predictions are estimated in Table 5 of the standard to have an uncertainty of +/-3dB at 1000m if all inputs are accurate but notes that:

"The estimates of accuracy in table 5 are for downwind conditions averaged over independent situations (as specified in clause 5). They should not necessarily be expected to agree with the variation in measurements made at a given site on a given day. The latter can be expected to be considerably larger than the values in table 5."

The JOULE study also noted the following:

"As a result of the measurements just described it has been concluded that:

- Noise levels at all distances from the source do vary, even if the source of sound has a constant power level.
- The measured variation in noise levels increases with increasing distance from the source.
- Based on typical wind speed ranges of between $0ms^{-1}$ and $10ms^{-1}$ encountered during the experimental measurements, the one standard deviation spread of noise levels either side the mean level was found to increase at a rate of approximately 0.004dB(A) per meter increase in the source to receiver separation distance."

The fact that wind farm sound levels vary with increasing distance (assuming all wind turbines emit a constant sound level) suggests that the use of the L90 statistic underestimates the true impact of noise from a wind farm.

Whilst it is advantageous to use an L90 statistic to reduce extraneous noise effects on a measurement it unfortunately underestimates the true higher levels of noise caused by the wind farm.

This underestimation can be compensated for by adding the standard deviation of 0.004dB/m measured in the JOULE study, in which case the predictions in the NVA would be increased by about 3 dB for the nearest dwellings.

A more realistic estimation of the higher sound levels from a wind farm is the predicted sound level using the simple IEA model (cut down ISO 9613-2 with corrections) plus the addition of one standard deviation uncertainty.

For a dwelling 1000m away the prediction should use the IEA model output plus 4dB (0.004dB/m at 1000m).

The American National Standards Institute (ANSI) published ANSI/ACP 111-1[6] to ensure predictions of sound from wind farms are repeatable, uniform, and more easily understood by all interested parties.

ANSI/ACP 111-1 draws on existing standard methods in ISO 9613-1, ISO 9613-2, and IEC 61400-11 to establish a uniform method of predicting future project sound levels such that predevelopment sound assessment results and predictions used in research can be readily compared. The standardisation of predictions ensures a robust and repeatable process that improves regulatory confidence in the results and reduces potential confusion.

The apparent wind turbine model-specific sound power level should be determined in accordance with IEC 61400-11 for the downwind location. Using this sound power level as the basis, propagation modelling should be conducted in accordance with the ISO 9613-2 standard (Acoustics—Sound Attenuation During Propagation Outdoors Part 2: General Method of Calculation) using either of two sets of parameters, identified as Option 1 and Option 2:

Option 1

A. Ground factor of G=0.

B. Receptor height of 1.5 meters for consistency with existing standards.

C. Turbine modelled at hub height using vendor's apparent downwind sound power level specified consistent with IEC 61400-11.

D. No other model adjustments.

Option 2

A. Ground factor of G=0.5.

B. Receptor height of 4 meters.

C. Turbine modelled at hub height using vendor's apparent downwind sound power level specified consistent with IEC 61400-11.

D. A model adjustment of + 2 decibels.

Option 1 and Option 2 produce the same result only when the correction factor of +2 dB is added to predicted sound levels using Option 1.

As there is now (2022) a National Standard, rather than an outdated guideline (IoA GPG, 2013) to standardise ISO9613-2 noise model inputs I urge An Coimisiun Pleanála to only consider the recommendations of ANSI/ACP 111-1 when assessing wind farm noise predictions.

When applied to this proposed development the predicted sound levels offered are all 2 dB too low.

Another issue that can arise is the reflection from certain structures that ISO9613-2 does not consider.

A 50 m high escarpment shown in Figure 1 can enhance sound levels through reflection for the NSLs shown.

[6] American National Standards Institute (ANSI). April 2022. Standard ACP 111-1, Wind Turbine Sound Modeling.

WIND TURBINE LAYOUT

It is customary in the design of a wind farm to take account of the distances between wind turbines to minimise noise emissions and to maximise efficiency. An outline of such design considerations can be found in 'NSW Wind Energy Handbook 2002': Sustainable Energy Development Authority of NSW (SEDA).

From page 53 of the SEDA document:

"A wind-farm layout must take into account that turbines have substantial 'wakes', which interfere with each other depending on wind direction and spacing. The general rule of thumb for spacing (the '5r-8r rule') is five times rotor diameter abreast and eight times rotor diameter downwind."

Appendix B of the IEC61400-11 standard indicates that at high wind speeds, wind turbulence becomes the primary source of sound. It suggests that these effects should be minimized during testing and optionally reported.

A general outline of site layout considerations has been provided by Suzlon Energy. A summary of site effects from Suzlon is provided in Appendix C that suggests the *minimum* wind turbine separations to be 3r-5r, depending on wind direction. Fow a wind turbine layout that is exposed to wind from multiple directions the design limit is 5r.

In the current layout of the Slieveacurry Wind Farm, the distance between the nearest neighbouring wind turbine towers is typically less than 420 m.

The V150 wind turbines have a rotor diameter, 'r', of 150 m. The spacing between the turbines is 2.8 times the rotor diameter (2.8r), which is significantly less than the recommended 8r spacing to reduce wake turbulence effects from SEDA and 5r spacing suggested by Suzlon.

An increase in wake turbulence from the wind turbines will lead to higher noise emissions and lower efficiency of the wind farm.

The NVA has not considered the potential increase in sound power caused by wake effects.

AMPLITUDE MODULATION (AM)

The NVA discusses AM at length in the NVA (section 12.3.5.11) but reaches no conclusion on a penalty scheme to account for this special audible characteristic. Section 12.7.4.1.1 suggests that the UK IoA 'Preferred Method' is a reliable and robust method to assess AM. This is not true; the reference method greatly underestimates the occurrence of AM for peak to trough levels exceeding 3 dB and it fails to properly assess multiple wind turbines.

With some modifications it has been used in IEC 61400-11-2 but that is for a single wind turbine, not many turbines in a wind farm.

NG3 describes AM under the heading of 'Temporal Characteristics' and states for AM that:

"The mechanism behind this is not clearly understood. However, features which are

thought to enhance this effect are:

- *close spacing of turbines in linear rows*

- *tower height to rotor diameter ratio less than approximately 0.75*
- *stable atmospheric conditions*
- *topography leading to different wind directions being seen by the blades at different points in their rotation"*

Note that the tower height (100m) to rotor diameter (150m) ratio is 0.66. (V150)

It can safely be assumed that AM *will* be an observable effect at NSLs because the turbine spacing is too close, the tower height to rotor diameter ratio is 0.66 (less than 0.75), and stable atmospheric conditions will occur from time to time.

An Coimisiun Pleanála should consider that AM is to be expected for this wind farm configuration that would warrant an additional penalty to predicted sound levels that have not been applied in the NVA.

A recent research paper by Colas et. al.[7] published in 2025 quantifies the amount of increased AM and sound power caused by increased wake turbulence resulting from wind turbines spaced too close together.

Colas simulated wind turbines with large-eddy simulation (LES) plus an aero acoustic model and parabolic-equation sound propagation. They compare three layouts: aligned (downstream in the wake), side-by-side, and staggered with the following results for downstream in the wake:

- Wake-induced flow focusing and turbulence increase downwind sound pressure levels (SPL) by several dB relative to a single turbine.
- AM depth increases by several dB in regions where the downstream turbine's wake-modified emission dominates.
- AM is highly sensitive to the relative rotor phase; certain angular offsets maximize constructive interference in the modulated component.

While Colas et al. focus on configuration rather than explicit "rotor diameter-spacing rules," the aligned case corresponds to a downstream turbine placed within the strong part of the wake (typical farm spacings of order 4–7 rotor diameters). The fact that they see "several dB" increases in both SPL and AM depth is a direct quantification of the effect of wake-enhanced inflow non-uniformity on AM.

ETSU-R-97 incorrectly addressed amplitude modulation and made a sweeping assumption that such a characteristic was rare in modern wind farms.

This is not the case and it is now recognised that amplitude modulation is the most intrusive sound characteristic of wind turbines and that tonality and impulsiveness also occur at many wind farms.

The current UK IoA GPG refers in section 7.2 to ongoing research. Since the publication of the GPG in 2013 there has been much ongoing research and amplitude modulation is known to be a significant concern for residents near modern wind farms.

[7] Colas, J. Emmanuelli, A. Dragna, D. Stevens, R. J. A. M. "Modeling wind farm noise emission and propagation: effects of flow and layout" arXiv:2508.13128v2 [physics.flu-dyn] 19 Aug 2025

The following figures illustrate A-weighted sound levels over a 10-minute period that were recorded at a rate of ten samples per second 800 m from two MM82 2MW wind turbines outside a dwelling.

The measurement was taken when the wind turbines were operating in the early hours of the morning when there was no extraneous insect, bird or animal sound but there was sound from wind in trees and foliage. This was confirmed by listening to the audio recordings taken at the same time.

Figure 2 shows the 100ms 'short' LAeq values and a single $L_{A95,10min}$ level for the data.

LA95 was calculated for this figure because the limit for this wind farm is in terms of LA95.

However, the LA90 would only be slightly higher at approximately 38 dB(A).

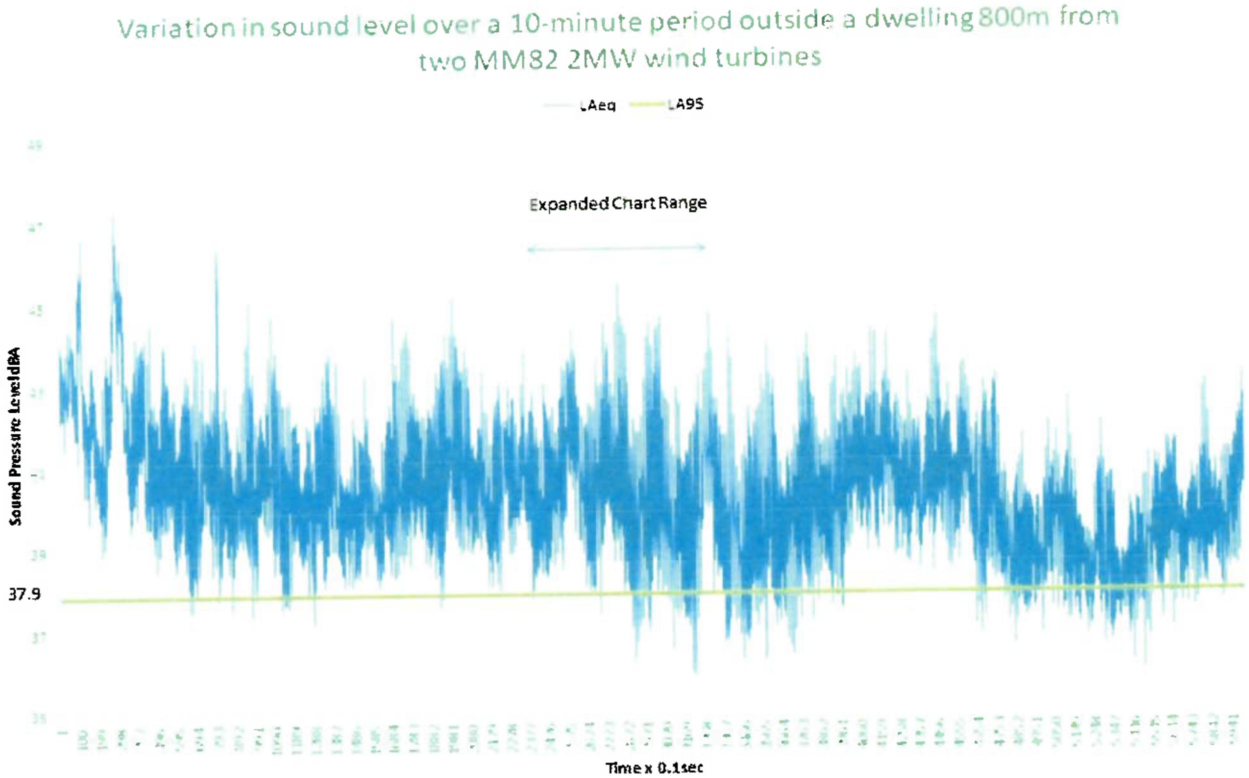


Figure 2

An expanded range from Figure 2 is shown in Figure 3 to provide more detail.

The repetitive variation in sound level is caused by sound from the two wind turbines as the blades rotate.

Sound caused by wind in trees and foliage is random, not repetitive as shown in these two charts.

Each peak and trough repetition can be linked to each time a blade passes through a part of the swept area.

As each wind turbine operates independently of others the small difference in rotation speed between these two wind turbines is causing the peak and trough repetitions to combine yielding a trace that can appear to synchronise at blade passing repetition to the time when the blades are out of synchronisation yielding an apparent doubling of the blade passing repetition.

For a wind farm containing many wind turbines the peak and trough level and repetitions vary randomly.

However, when synchronised the sound levels add together to produce an overall higher sound level compared to when the individual turbine blades lose synchronisation.

Figure 2 shows the interacting effect for two wind turbines where the first part of the 10-second chart shows the turbines to be out of synchronisation with a generally lower sound level variation peak to trough compared to later in the chart where the turbine blade rotations synchronise causing higher overall peak to trough sound level changes.

An unfortunate disadvantage in using the L90 statistic is that the character of sound level changes during any 10-minute measurement are lost and sound level variations are greatly underestimated.

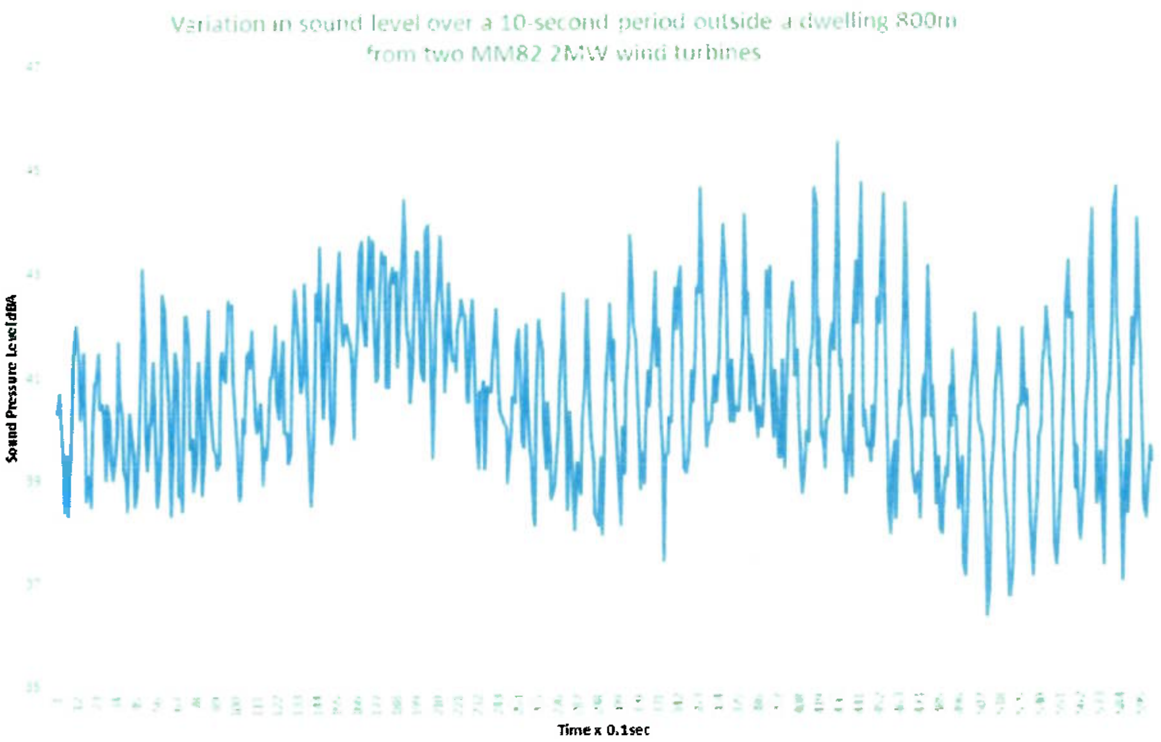


Figure 3

A common observation of unusual sound level change occurs when 'whump' or 'thump' is described by observers.

Whump and thump are thought to originate from the aerodynamic sound of wind turbine blades when they encounter wind turbulence or are incorrectly adjusted for the incoming wind that causes a blade to stall temporarily. Placing wind turbines too close to each other will increase wind turbulence and increase AM[8,9] and the instances of 'whump and thump' sounds.

The occasional whump and thump sounds are much louder than normal wind turbine sounds and the fact that they would not occur for more than 9 minutes in any 10-minute recording means that the LA90 centile would not identify such events.

[8] Sinayoko, S. 'On predicting wind turbine noise and amplitude modulation' 6th Int. conf. wind turbine noise, 2015
[9] Buck, S. et al 'Experimental validation of a wind turbine turbulent inflow noise prediction code', AIAA Journal 2016

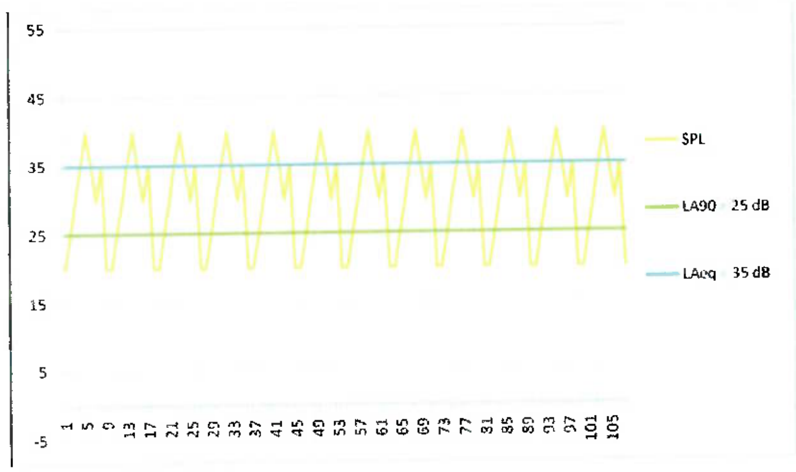
Sound levels vary throughout the measurement period in the 10-minute duration of the chart above (Figure 1) ranging from a maximum level of just over 47 dB(A) to a minimum level of about 36 dB(A). From the 6000 sound level samples the single statistical L95 parameter obtained from this chart is 37.9 dB(A), shown as a red line across the chart.

The L90 centile is only sensitive to the lowest 10 % of sound levels within any 10-minute sample. For example, in the chart above there could be sound levels that reached 100 dB(A) for up to 9 minutes that would have no bearing on the calculated L95 value of 37.9 dB(A) or L90 of 38 dB(A).

The IoA AM Preferred Method fails to correctly evaluate AM from just two wind turbines and fares even worse when more than two wind turbines combine to produce AM.

A report[10] was prepared for DEFRA that outlines a wind farm noise statutory nuisance complaint methodology. Section 5.4.5 of this report (NAN-R-277) explains the difference between a centile statistical noise metric such as an L90 and the energy averaging Leq as follows:

> "5.4.5 Noise Indices
>
> By convention wind farm noise in the UK is measured using the LA90,10-minute noise index, as it is argued that this index minimises the influence of extraneous noise. However, excepting ETSU –R-97, there are few if any standards that set noise limits using this index. Additionally, it is argued that because the LA90,10min index focuses on the quietest periods in the measurement period it is relatively insensitive to rapid fluctuations in noise level where the noise varies rapidly over a short period e.g. as with aerodynamic/amplitude modulation, and the impact of such characteristics can be underestimated using the LA90,t noise index.
>
> However, elsewhere in the world the LAeq,t index is preferred for wind turbine noise. Use of the LAeq,t or derivatives for environmental noise measurement is recommended by international standards and bodies e.g. ISO 1996 and the WHO, and British Standards such as BS 4142, BS 7445 and BS 8223. Additionally, there are a range of standards and guidance that offer guideline and recommended values of LAeq.T noise levels against which to weigh any measurement. The energy averaging nature of this index means it tends to be biased towards the highest noise levels that occur during a measurement. The figure below shows an indicative sound pressure level trace of a time varying noise signal (SPL) and the approximate LAeq,t and LA90,t values.



[10] NANR277 "Wind farm noise statutory nuisance complaint methodology DEFRA (2011)

Figure 13 $L_{Aeq,t}$ and $L_{A90,t}$ values of an indicative time varying noise signal"

The current GPG also explains in section 7.1 that the guide cannot provide a definitive set of AM conditions for a wind farm, despite suggesting some options.

There is a current noise condition in force for the Denbrook Wind Farm that addresses AM limits, which has been accepted by the High Court in the UK, as follows:

"Condition 20

At the request of the local planning authority following receipt of a complaint the wind farm operator shall, at its expense, employ a consultant approved by the local planning authority, to assess whether noise immissions at the complainant's dwelling are characterised by greater than expected amplitude modulation. Amplitude modulation is the modulation of the level of broadB(A)nd noise emitted by a turbine at blade passing frequency. These will be deemed greater than expected if the following characteristics apply:

(a) A change in the measured $L_{Aeq,\ 125\ milliseconds}$ turbine noise level of more than 3 dB (represented as a rise and fall in sound energy levels each of more than 3 dB) occurring within a 2 second period.

(b) The change identified in (a) above shall not occur less than 5 times in any one minute period providing the $L_{Aeq,\ 1\ minute}$ turbine sound energy level for that minute is not below 28 dB.

(c) The changes identified in (a) and (b) above shall not occur for fewer than 6 minutes in any hour.

Noise immissions at the complainant's dwelling shall be measured not further than 35 m from the relevant building, and not closer than within 3.5 m of any reflecting building or surface, or within 1.2 m of the ground."

An Coimisiún Pleanála may wish to consider Condition 20 of the Denbrook Wind Farm as a model AM condition for any future wind farm that they approve.

Conditions referencing the IoA AM Preferred Method should be avoided for wind farms.

INFRASOUND, LOW FREQUENCY NOISE (ILFN) AND HEALTH EFFECTS

The EIAR (Chapter 5) has referred to the Health Service Executive (HSE) Position Paper on Wind Turbines and Public Health (2017) but only insofar that published scientific evidence is inconsistent and sparse. So, some published research supports there being adverse health effects and other research does not support there being adverse health effects from wind turbines.

Chapter 5 of the EIAR lists several other references to health effects, many of which are outdated. For example, Chapter 5 section 5.5.1(3) refers to a 'A Rapid Review of the Evidence', NHMRC 2010 but neglects to note that the NHMRC subsequently awarded AU$3,300,000 to two universities to investigate the issues, recognising that there was not enough evidence to base a conclusion upon.

The NVA (12.3.5.9) has cited several references from the UK Institute of Acoustics (UK IoA) generally supporting the idea that low frequency and infrasound from modern wind farms are insignificant and that there is no need to consider these effects in any noise impact assessment.

However, it is now recognised that infrasound and low frequency sound is emitted from wind turbines and that the infrasonic pulses are unlike any other environmental sound source.

Furthermore, advice from the UK IoA to its Members has no relevance to the assessment process in Ireland. For example, the UK IoA's guidance conflicts with Limerick County Council's planning requirements for wind farms, which specifically calls for a low-frequency noise assessment.

Figure 4 shows the change in infrasound levels near to the Cape Bridgewater wind farm measured inside a nearby stone dwelling during changes in operation from stopped to 15% and 45% power generation.

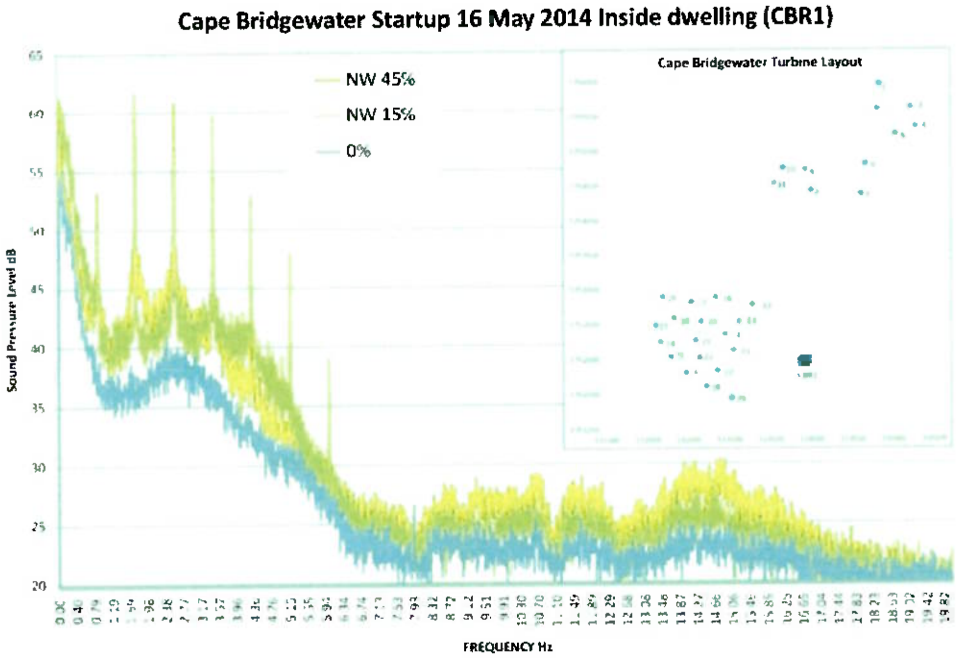


Figure 4

References that have used the dB(G) filter to assess wind farm ILFN are not credible because the G weighting filter attenuates the blade pass pulses and the harmonics associated with those pulses (<5Hz).

The WHO 2018 Environmental Noise Guidelines completed the most comprehensive peer review of studies in this area and states: "Five low-quality systematic reviews of wind turbine noise effects on mental health and well-being have been carried out (Ellenbogen et al., 2012; Kurpas et al., 2013; Merlin et al., 2013; Onakpoya et al., 2015; Schmidt & Klokker, 2014). These reviews differed in their conclusions and delivered inconsistent evidence that wind turbine noise exposure is associated with poorer quality of life, well-being and mental health."

Because there were differences of opinion from the research that was cited the WHO rated this work of low quality: "Therefore, the evidence for no substantial effect of wind turbine noise on quality of life, well-being or mental health was rated very low quality".

However, it is incorrect to suggest that there is *no* evidence that wind farm noise can cause adverse health effects. The WHO rate the research demonstrating no adverse health effects as low quality.

The meaning embedded in the WHO's phrasing is critical to how its guidance is interpreted.

The WHO refers to a lack of evidence for no adverse effect, not a lack of evidence for an adverse effect.

Research is ongoing but one of the published papers in 2019 by researchers at Flinders University (Nguyen, D. P., Hansen, K. et al. Wind farm infrasound detectability and its effects on the perception of wind farm noise amplitude modulation, Acoustics 2019) stated in its conclusions that: "Overall these preliminary results suggest that WF noise complaints could potentially be governed to some degree by the presence of infrasound" and that " We found that self-reported noise sensitive individuals can detect the presence of low-level infrasound (48 ± 2 dB(G)) above chance."

The finding that infrasound at levels of 48 +/- 2 dB(G) can be observed by individuals is in stark contrast to the generally used limit of perception of 85 dB(G).

Although the G-weighted filter significantly attenuates the blade pass and associated harmonics from a wind turbine it is worth noting that the 2006 Hayes McKenzie report show the result of an on/off test in that report, shown below (Figure 12 from reference).

An extract from this report explains that "Wind turbine noise may result in internal noise levels within a dwelling that is just above the threshold of audibility," that was assumed to be 85 dB(G).

The 2019 Flinders University research changes the threshold of audibility of wind farm noise to 48 +/- 2 dB(G) which would change the conclusion in the Hayes McKenzie DTI report; 'The measurement of low frequency noise at three UK wind farms', URN no. 06/1412 from 2006.

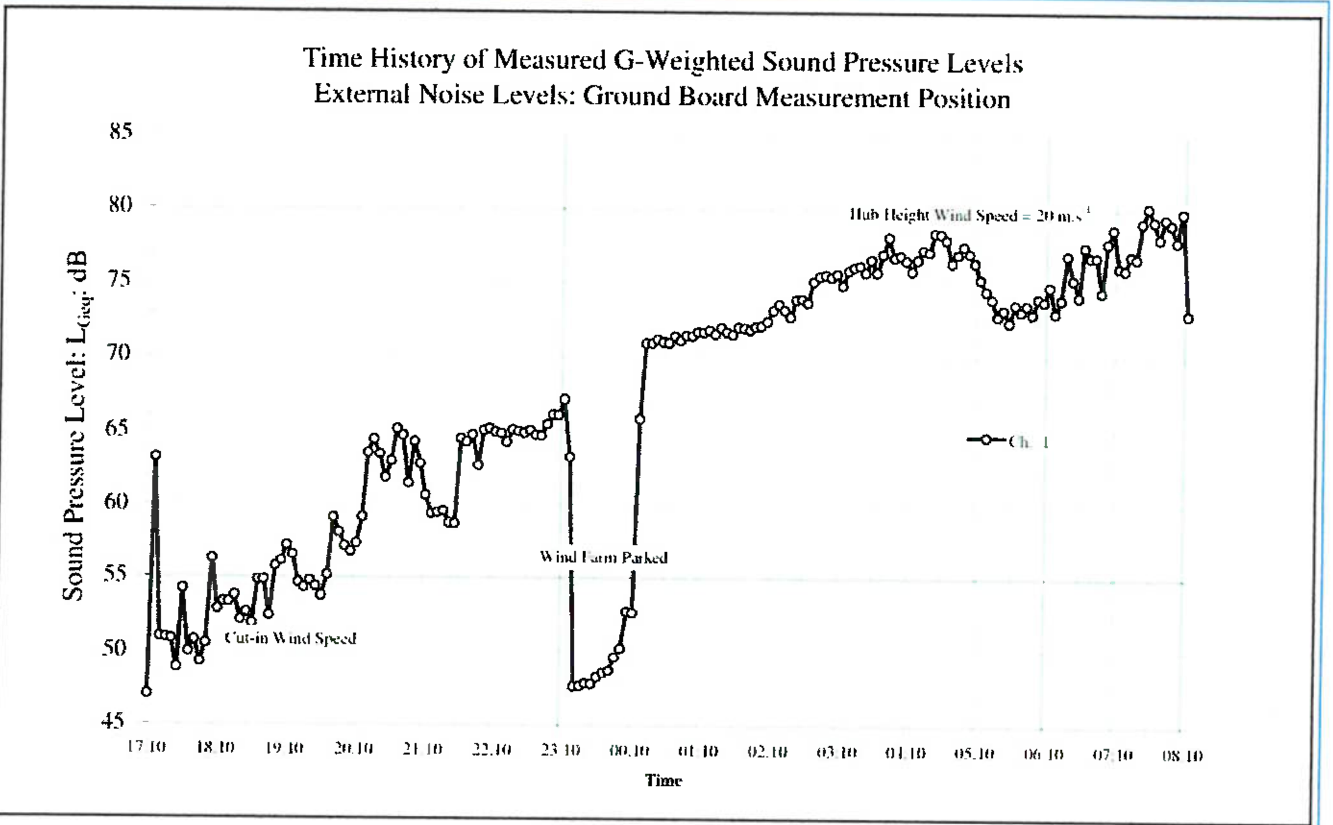


Figure 12: Time History Figure of G-Weighted Sound Pressure Levels for a Wind Farm

Much of the recent research into human response to wind farm generated infrasound has been based on *synthesised* wind farm sound played to subjects in a laboratory"

A paper by Cooper, S. ("The use of synthesised or actual wind turbine noise for subjective evaluation purposes" PROCEEDINGS of the 23rd International Congress on Acoustics 2019) is critical of the use of synthesised wind farm infrasound signals and has noted that it was the change in amplitude of the infrasound signal that was observed to be a significant factor in subject disquiet.

Unfortunately, the issue of adverse health effects from wind farm generated infrasound remains contentious and authorities may wish to consider an appropriate condition when approving future wind farm developments if ongoing Australian, or other relevant international research, finds adverse health effects from infrasound.

My own measurements at the Cape Bridgewater Wind Farm, also confirmed by S Cooper in his 2014 study[11], showed that low frequency sound from the output shaft of the gearboxes to the generators exceeded DEFRA NAN-R-45 indoor recommended guideline values at 32 Hz.

Furthermore, the 32 Hz tones were modulated in frequency and random in level.

The NVA has not considered low frequency noise impacts. The A-weighting filter significantly attenuates low frequency noise, which is why DEFRA NAN-R-45 uses unweighted one third octave sound levels in the frequency range from 10 Hz through to 200 Hz.

Low frequency sound is an important issue that should be reported in an EIAR. An example requirement has been implemented in Planning by the Limerick County Council that applies the Danish low frequency guideline limits.

I have recently measured low frequency sound outside a dwelling during on/off testing near to a newly constructed wind farm. Figure 5 shows the results of measurements at the dwelling that is approximately 2 km from the nearest 3.6 MW wind turbine.

Measurements of the 40 Hz, 50 Hz, 63 Hz and 80 Hz one third octave unweighted sound levels before, and after the shutdown period, just prior to midnight, show that the threshold values of DEFRA NAN-R-45 were exceeded. Outside measurements were corrected to indoor levels for typical building façade attenuation according to Downey and Parnell (2017).

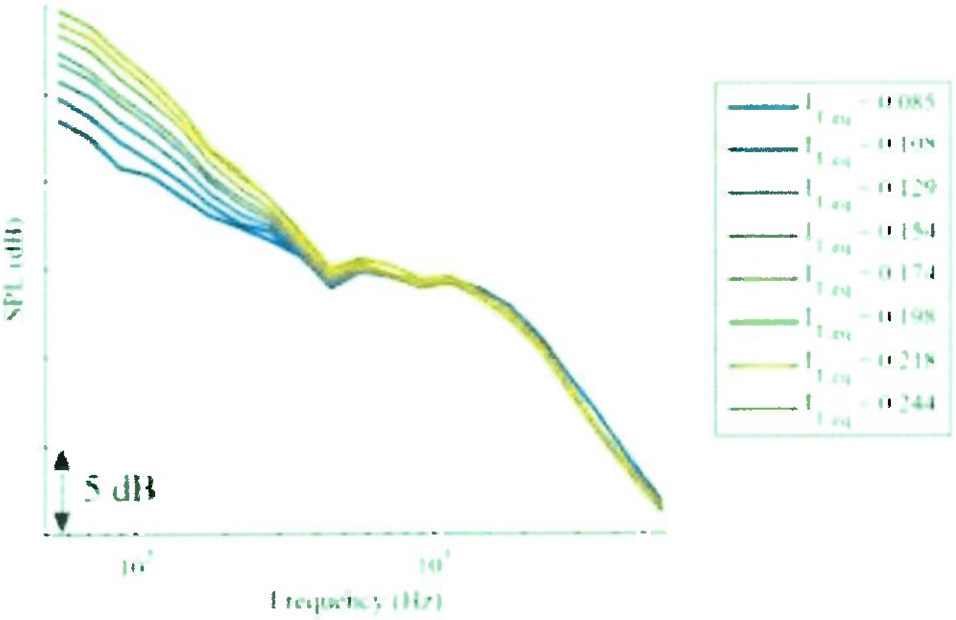
The occupants of the dwelling had complained about low frequency noise nuisance from the nearby wind farm and in this instance, the complaints were justified.

Both Colas and Buck show that wake turbulence from wind turbines spaced too close together cause increase in low frequency sound from downwind turbines.

Buck et al.[12] studied the turbulent inflow noise experimentally on a full-scale wind turbine with a 108 m diameter and 2.3 MW capacity. The purpose of the study was to assess the effect of inflow turbulence on wind turbine noise. Fifty hours of sound data were collected by 12 microphones mounted at different angles. The results showed a high correlation between turbulence intensity and noise levels. Buck shows the correlation between turbulence intensity and sound pressure level in the following chart:

[11] Cooper, S. "The results of an acoustic testing program - Cape Bridgewater Wind Farm" The Acoustic Group Report 44.5100.R7MSC, Nov 2014

[12] Buck, Steven & Oerlemans, Stefan & Palo, Scott. (2016). Experimental characterization of turbulent inflow noise on a full-scale wind turbine. Journal of Sound and Vibration. 385. 10.1016/j.jsv.2016.09.010.



The correlation between turbulence intensity and sound pressure level [Steven Buck]

The NVA has mistakenly dismissed ILFN as an issue.

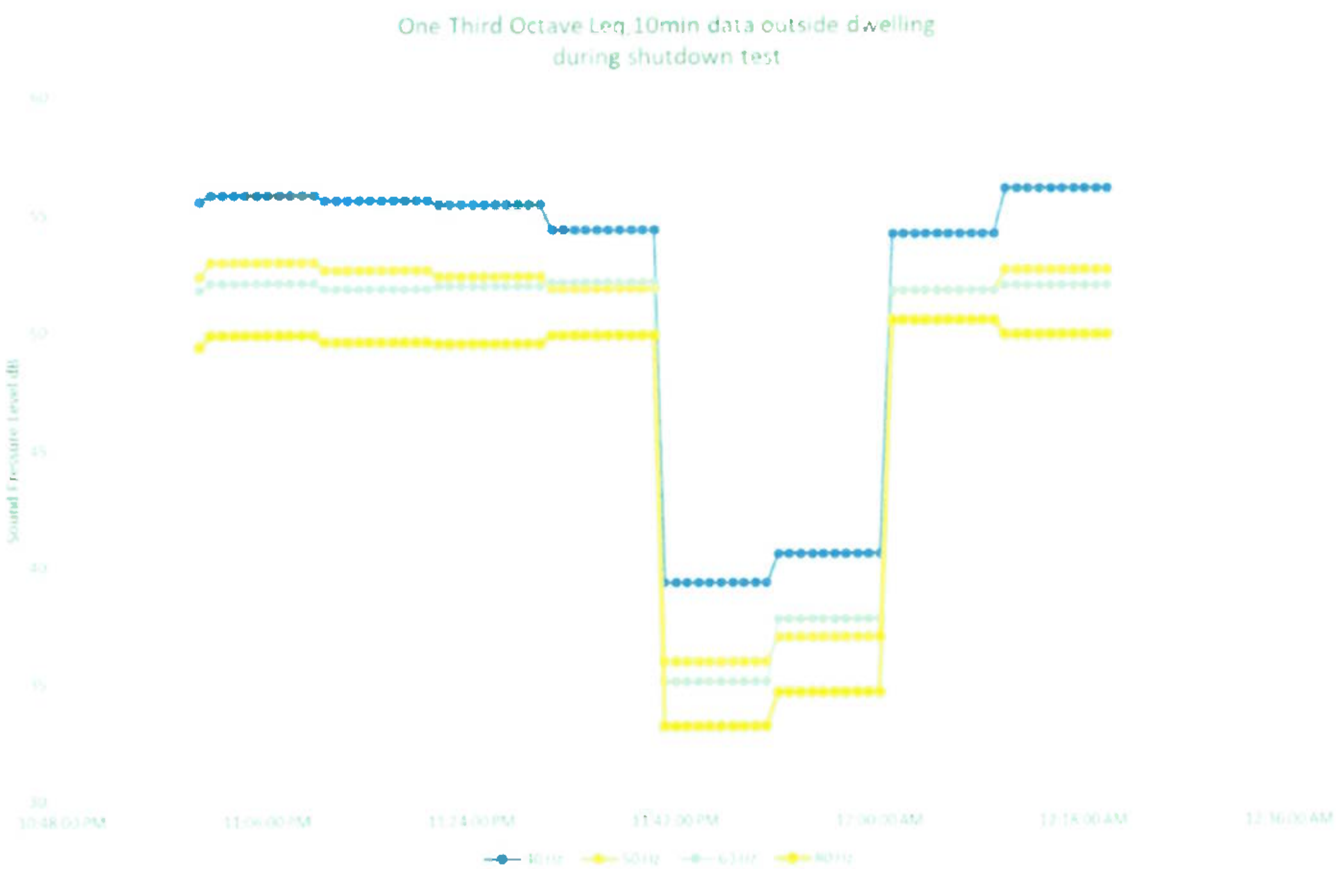


Figure 5

It would be advisable to measure current ambient ILFN at the NSLs to supplement A-weighted Background survey results.

Low frequency noise predictions should also be completed in frequencies below that which ISO9613-2 allows. ISO9613-2 is only applicable for the octave bands from 63 Hz through to 8 kHz.

The NVA is deficient in the assessment of ILFN.

SETBACKS

The NVA has mentioned in section 12.3.7 that dwelling H033 is 529m from a wind turbine.

The HSE position paper also refers to best practice for setback distance from any turbine to a dwelling of 10 times the rotor diameter. This equates to a best practice setback distance of 1.5 km for the proposed candidate wind turbine rotor diameter of 150m.

Wind turbines are proposed to be less than 530 m from the nearest dwelling so best practice according to the HSE position paper has not been applied.

Clare County Council (CCC) reasons for refusal

CCC list four reasons for refusal dated 20 January 2022, of which only Reason 2 refers to noise, as follows:

"It is an objective of the Clare County Council Development Plan, 2017-2023, as varied, as set out under Objective CDP 8.40 € to strike an appropriate balance between facilitating renewable and wind energy related development and protecting the residential amenity of neighbouring properties. Having regard to the scale and height of the turbines as proposed, the location of the site on this open landscape and the proximity to existing residential properties, it is considered that the consequential noise and disturbance generated from the proposed wind turbines in combination with existing and permitted windfarms would seriously injure the amenities of residential property in the vicinity. Furthermore it is considered that the proposed turbines would be visually overbearing on existing properties and thus depreciate the value of property in the vicinity. The proposed development would therefore be contrary to Objective CDP 8.40 of the development plan and be contrary to the proper planning and development of the area."

Most of the deficiencies highlighted in this peer review of the EIAR and NVA are reflected in the concerns of the CCC that provided its reasoning for refusal.

The Appeal to An Coimisiun Pleanála was also dismissed.

The main difference between this and the earlier application is the addition of an extra wind turbine (T9).

CONCLUSIONS

The NVA does not provide any confidence that an acceptable noise impact will result from the proposed development.

An Coimisiun Pleanála should dismiss/refuse the Slieveacurry Wind Farm application.

The NVA within the EIAR does not consider site effects or audible characteristics such as low frequency, tonality or amplitude modulation.

The assessment methodology adopted in the NVA follows guidelines that have been shown to be deficient and are currently under review.

The WEDG 2006 guidelines recommend a range of acceptable sound levels during the day but the NVA has elected to choose the highest noise limit in the range that could be applied, based upon what I consider to be an incorrect evaluation of the test for a low noise environment.

The NVA predicts optimistic sound levels that demonstrate increases in noise of more than 10 dB for the surrounding residents that conflicts with the objectives of WEDG 2006.

The impact assessment approach from IEMA for operational noise from the development has not been applied correctly.

If it was properly applied then the development would have an impact described as 'Very Substantial Effect' according to IEMA Guidelines and 'Very Significant' and 'Profound' effect according to 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports' (EPA, 2022). This is contrary to the suggestion in the NVA (12.6.3.1.1) that operational noise is 'not significant'.

Appendix A

CV of William Leslie Huson

QUALIFICATIONS

BSc (Hons) Applied Physics, UK 1975

MSc Sound and Vibration Studies, Institute of Sound and Vibration Research, Southampton, UK 1977

PROFESSIONAL AFFILIATIONS

Chartered Physicist, UK

Member of the Institute of Physics, UK

Member of the Institute of Acoustics, UK

Member of the Australian Acoustical Society

Member of the AV0001acoustics working group for Standards Australia

Australian representative for the International Institute of Noise Control Engineers (I-INCE) Technical Study Group 5 *A GLOBALAPPROACH TO NOISE CONTROL POLICY* (Now disbanded after completion of the scope of work defining this group – see http://www.i-ince.org/data/iince061.pdf)

EXPERIENCE

Since graduating I have been involved in several scientific areas of research and development. My early experience was in constructing a microwave device to measure the temperature of plasma inside a nuclear fusion experimentation device at the UKAEA, Culham Laboratory in the UK. I then worked in research and development of thermal imaging devices prior to completing a Masters in Sound and Vibration Studies. My work since then (1977) has been primarily associated with acoustics and vibration both terrestrial and underwater.

Prior to 1991 I worked as a Sound and Vibration consultant in the UK for 12 years with involvement in a wide range of industries.

For the past 35 years I have worked in Australia as a noise and vibration consultant and have operated through my own consultancy firm for the past 29 years. I am experienced in modelling acoustic propagation from a variety of sources such as railways, roads, aircraft, underwater ordnance, wind farms, pile driving, blasting and numerous types of industry.

I have also prepared the Brisbane Noise Survey in 1998 for the Brisbane City Council and was the author of the Noise Impact Assessment Planning Scheme Policy for Brisbane City Council's City 2000 Planning Scheme.

Of relevance to wind farm related assessment is the work I completed for the Toora Wind Farm in 2002 which involved detailed analysis of pre and post construction noise data using NZS6808 1998 to check compliance with license conditions. NZS6808 is based upon ETSU-R-97. My experiences in the analysis of wind farm noise data led to a paper that was presented at the joint Australia and New Zealand Acoustics conference in 2006; "Review of the Application of NZS6808 to wind farms in Australia." This paper highlighted the sources of error that were implicit and allowed in the NZS6808, 1998 standard and ETSU-R-97. The latest version of the NZS6808 standard (2010) addresses a number, but not all, of the data analysis error concerns described in my paper. ETSU-R-97 and the Institute of Acoustics Good Practice Guide to the Assessment and Rating of Wind Turbine Noise is regularly referenced when interpreting parts of NZS6808 in Australia and I am familiar with this document and the supporting Supplementary Guidance Notes (GPG).

Over the past thirteen years I have been independently gathering sound data in the audible and infrasound parts of the acoustic spectrum at numerous wind farms in Australia, the UK and Ireland. A summary of some of this research work on infrasound was presented in a peer reviewed paper: Huson, W. Les. "Stationary wind turbine infrasound emissions and propagation loss measurements." 6th International Conference on Wind Turbine Noise, Glasgow 20-23 April 2015.

I have investigated the Preferred IoA Method for the assessment of amplitude modulation (AM) in detail and applied it to several wind farm measurements taken outside dwellings near to numerous wind farms in Australia and the UK. The findings of this work are the realisation that the Preferred IoA Method is only suitable for assessing a single wind turbine, that the resulting AM values greatly underestimate short term peak to trough amplitude modulation levels observed, and that the Method is wholly unsuitable to assess AM (peak to trough amplitude modulation) from multiple wind turbines.

Detailed analysis of AM from wind farms has revealed that many AM events also exhibit impulsiveness when evaluated according to BS 4142:2014+A1:2019.

Appendix B

Presentation by E Sloth

Vestas

BONUS Energy A/S

Problems related to the use of the existing noise measurement standards when predicting noise from wind turbines and wind farms.

Erik Sloth Vestas

Niels Christian Møller Nielsen VESTAS
Ejler Kristensen BONUS Energy
Bo Søndergaard DELTA

DELTA

Overview

- Noise Measurements (IEC 61400-11:2002)
  - Short description of the measurement method
  - Use of measurement results, including influence on inaccuracy.
- Noise prediction
  - Terrain and meteorology influence on the actual emitted sound
  - Methods used in noise calculations
- Noise assessment
  - Descriptors
  - Noise limits
  - Further investigations needed

Noise Measurements (IEC 61400-11:2002)

We correct for:

Air pressure
Air temperature

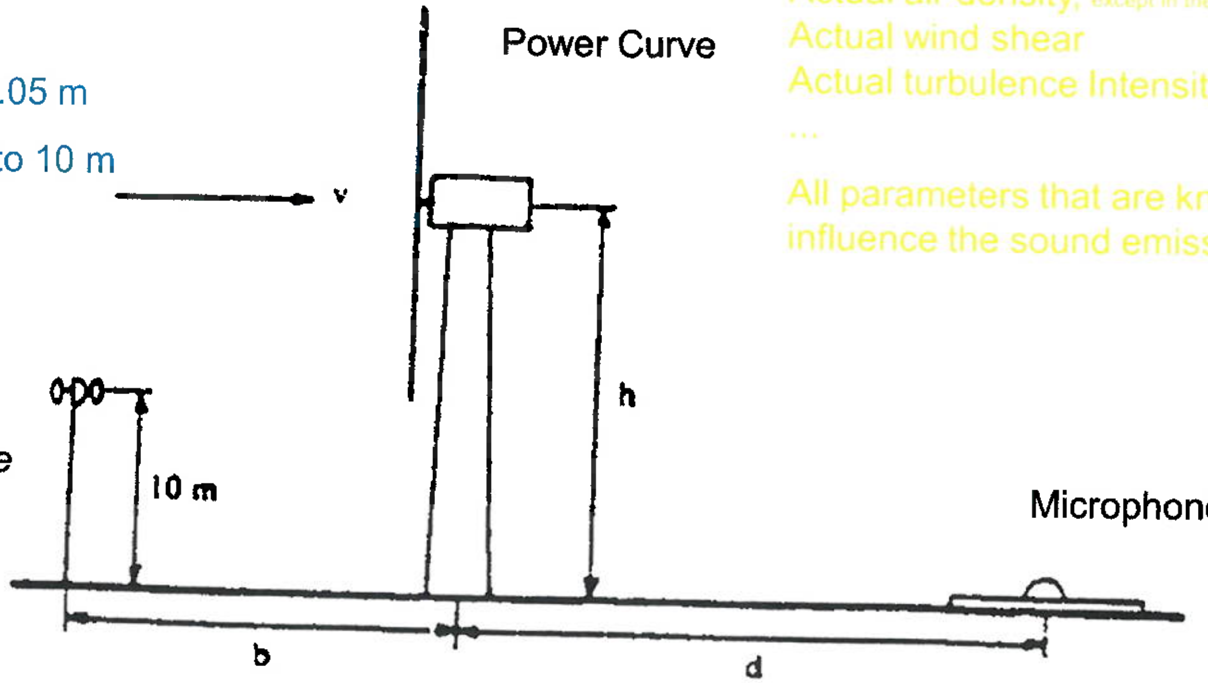
Standard terrain roughness z = 0.05 m

All recalculated to 10 m wind speed

We do not correct for

Actual inflow angels
Actual air density, except in the power curve
Actual wind shear
Actual turbulence Intensity
...

All parameters that are known to influence the sound emission



Anemometer
For background noise only

Noise Measurement

- The results are standardized noise levels, which are fairly comparable from measurement to measurement on a given turbine type.
- The wind turbine is used as a wind speed meter through a power curve measured on an ideal site (IEC 61400-12) OBS impossible if actual terrain does not fulfill conditions
- Other parameters influence the noise level: relative humidity, turbulence, inflow angle, wind shear, turbine pitching are not accounted for.

- The result is a fairly good tool for verification of warranties, but not a good tool for predicting noise at imission points where people actually can get annoyed.

- The Sound Power Level related to the produced power or at least the sound power level as a function of hub height wind speed could be a more basic relationship

Typical problems in using the measurement results

- Where do we see the major deviations from standardized conditions during actual use of measurement results

- The wind turbines are almost always raised at sites where roughness differ from the standardized completely flat measurement site.

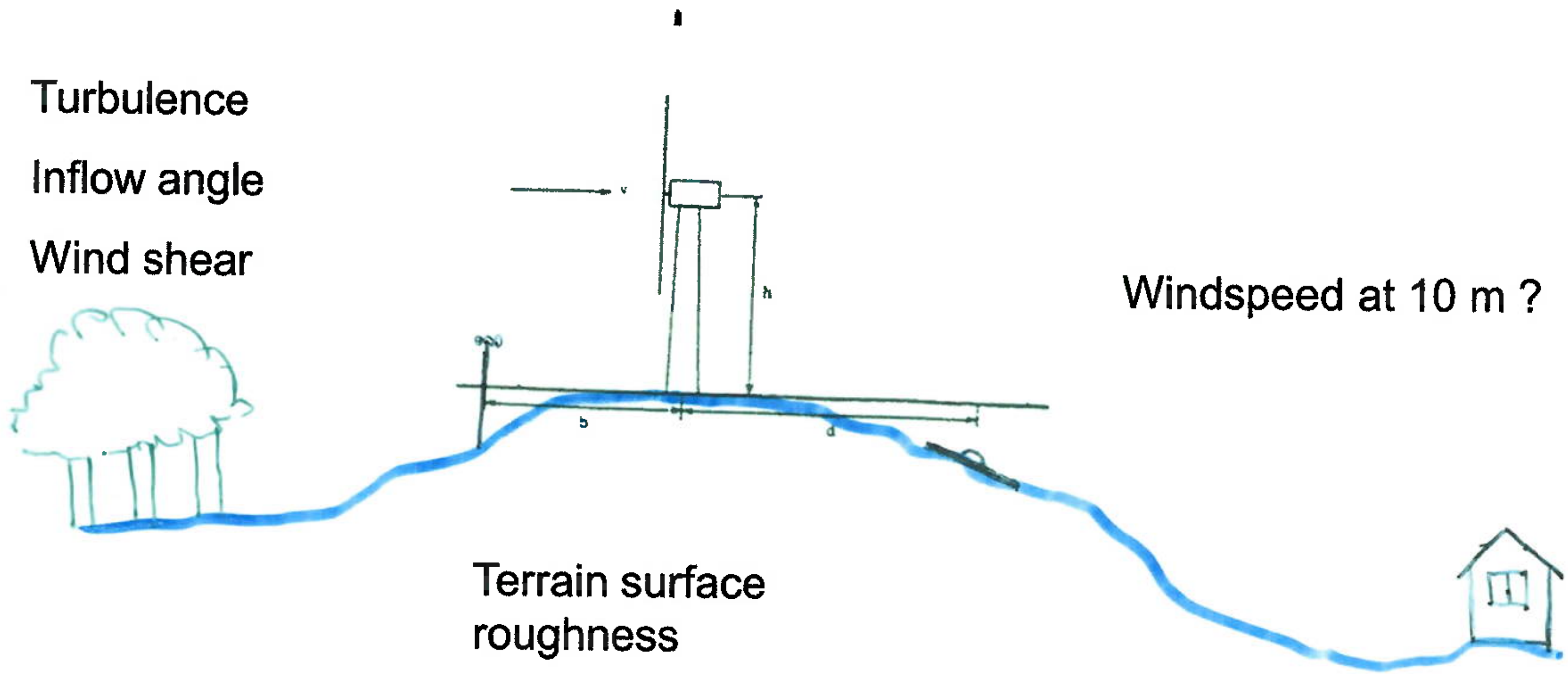
- Further we see different air density
- different wind shear
- different turbulence in inflow air
- different inflow angles

- Finally we often see other hub heights than used during documentation

Use of measurement results

For noise control measurements

For noise level calculations



Conclusion on measurement results

- The differences in site conditions creates differences in emitted sound power level.
- The differences could be both increased and decreased emitted sound power levels in real life applications
- The differences will transfer directly to the imitted sound power levels, and may thereby create increased annoyances in real life

- Therefore – site specific sound power levels should be used unless a good safety margin is present using standardized emission levels.

Uncertainty

- According to IEC 61400-11:2002 the standard deviation of a measurement results is app. 0.9 – 1.5 for an ideal site
- If the measurements are made at a site with considerable turbulence intensity or wind shear the standard deviation can be app. 2.0 dB
- The result is that when used for calculating the noise from a wind farm at an imission point, some WTG will be higher than the expected level and some will be lower.
- To correct for this, the measured inaccuracy <u>cannot</u> be placed upon the total calculated level, but must be included in the calculations.
- The result is that the higher the number of WTG's in the project is, the smaller the resulting inaccuracy.
- If the results are used for calculating the noise from a wind farm the standard deviation should be calculated as the weighted standard deviation

$$\sigma_{res} = \sigma_{method} + \sigma_{source} = \sigma_{method} + \frac{\sqrt{\sum (\sigma_i \cdot 10^{L_i/10})^2}}{\sum 10^{L_i/10}}$$

Solution to the outlined problems

- Accept that different sound power levels should be used in predictions and warranties.

- Avoid using sound power levels that include inaccuracy in predictions unless there is a good safety margin.

- The inaccuracy should be included in the calculation – the higher the number of WTG's the less the probability that all are in the high end of the uncertainty interval

- Use sound power levels that at least are corrected for: hub height, wind shear, air density, turbulence, inflow angle

- Be careful to make sure that the background noise measurements and wind conditions at the turbine positions uses the same reference position.

Noise level calculation models

- There are lots of different noise level calculation models:
  - ISO 9613-2 which is the model that we see the most
  - VDI 2714
  - Concawe
  - BS 5228
  - General Prediction Method (Danish)
  - Danish EPA Guidelines
  - Netherlands Guidelines 1999
  - Swedish method (land/sea)
  - .....

- Most of the methods are developed for noise from Industry, wind speeds below 5 m/s and standard meteorological conditions and must be suspected to give poor results at larger distances.
- ISO 9613-2 is known sometimes to overestimate the terrain effects if soft ground is used
- Manufacturers, developers, consultants and authorities have an interest in a noise level calculation model developed specifically for wind turbine noise

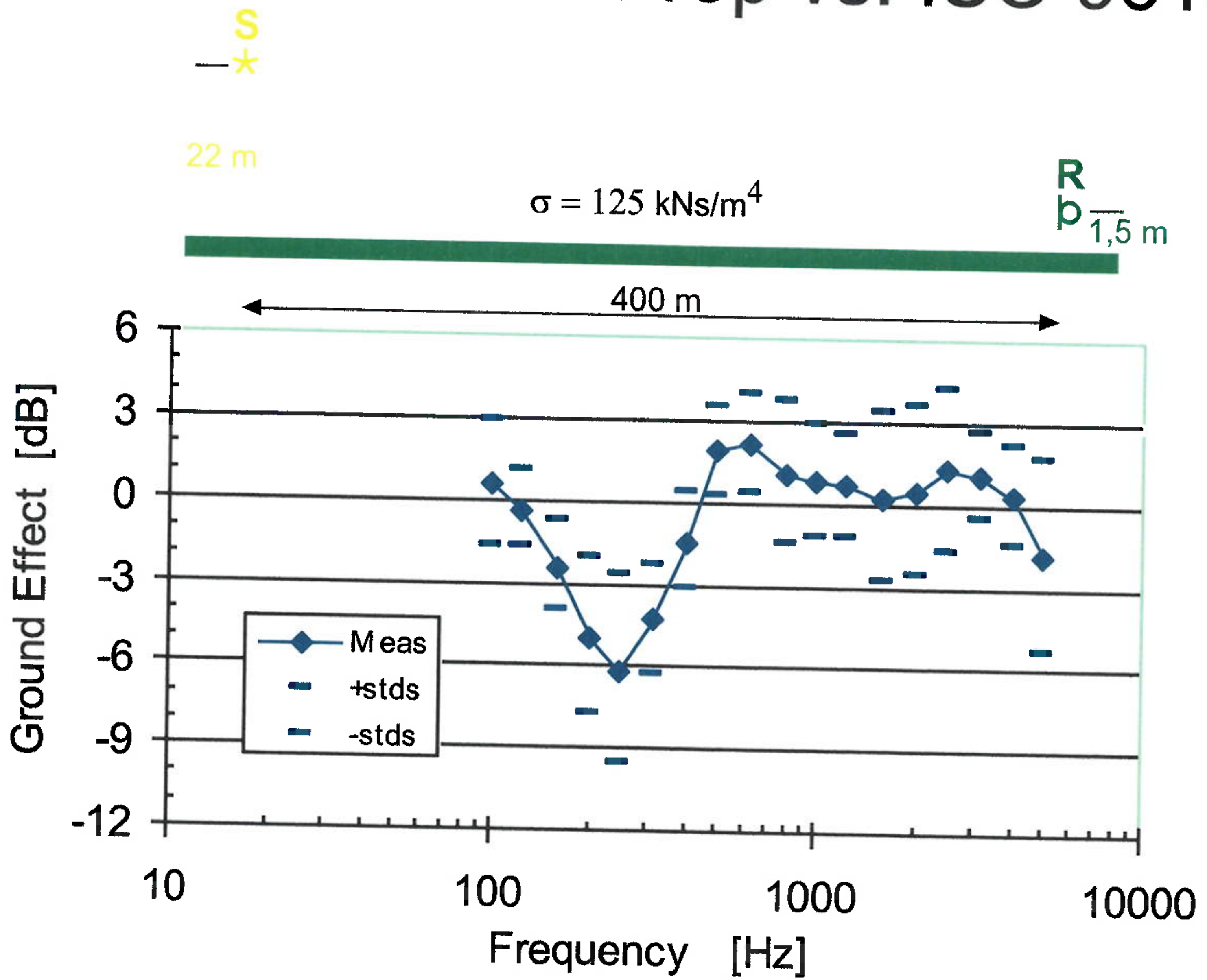
Noise calculation models

- In an EU project JOR3-CT95-0065 a model for wind turbine noise propagation (WiTuProp) was developed giving good results

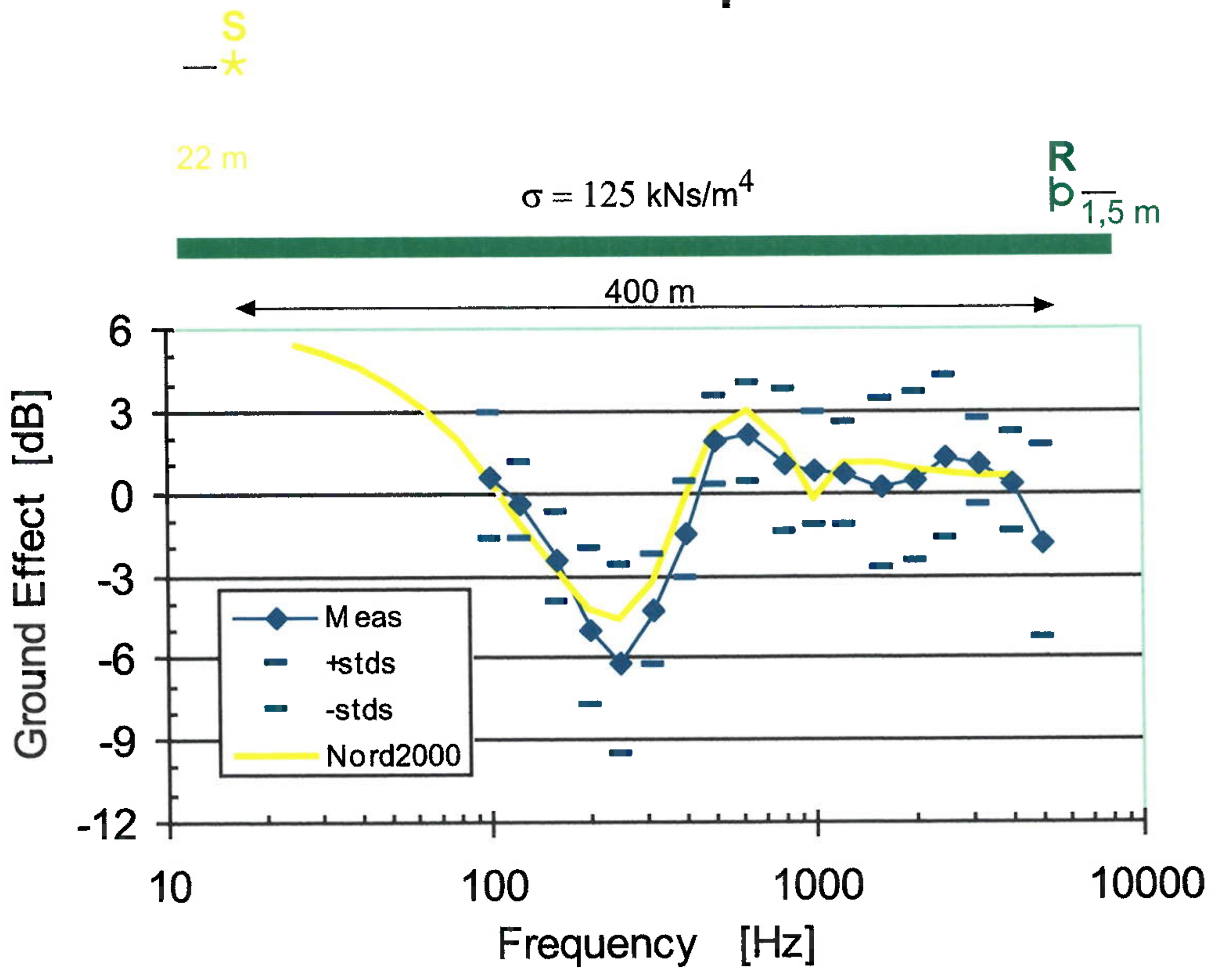
- The WiTuProp model takes into account
  - meteorological conditions:
    - Wind speed / terrrain surface roughness and direction
    - Air temperature and air temperature gradient
    - Relative air humidity
  - The ground type
    - Flow resistivity for grassland and harder surfaces
  - Screening (by terain or screens / barriers)

- WiTuProp is a special case of a more comprehensive model developed later: *NORD2000*

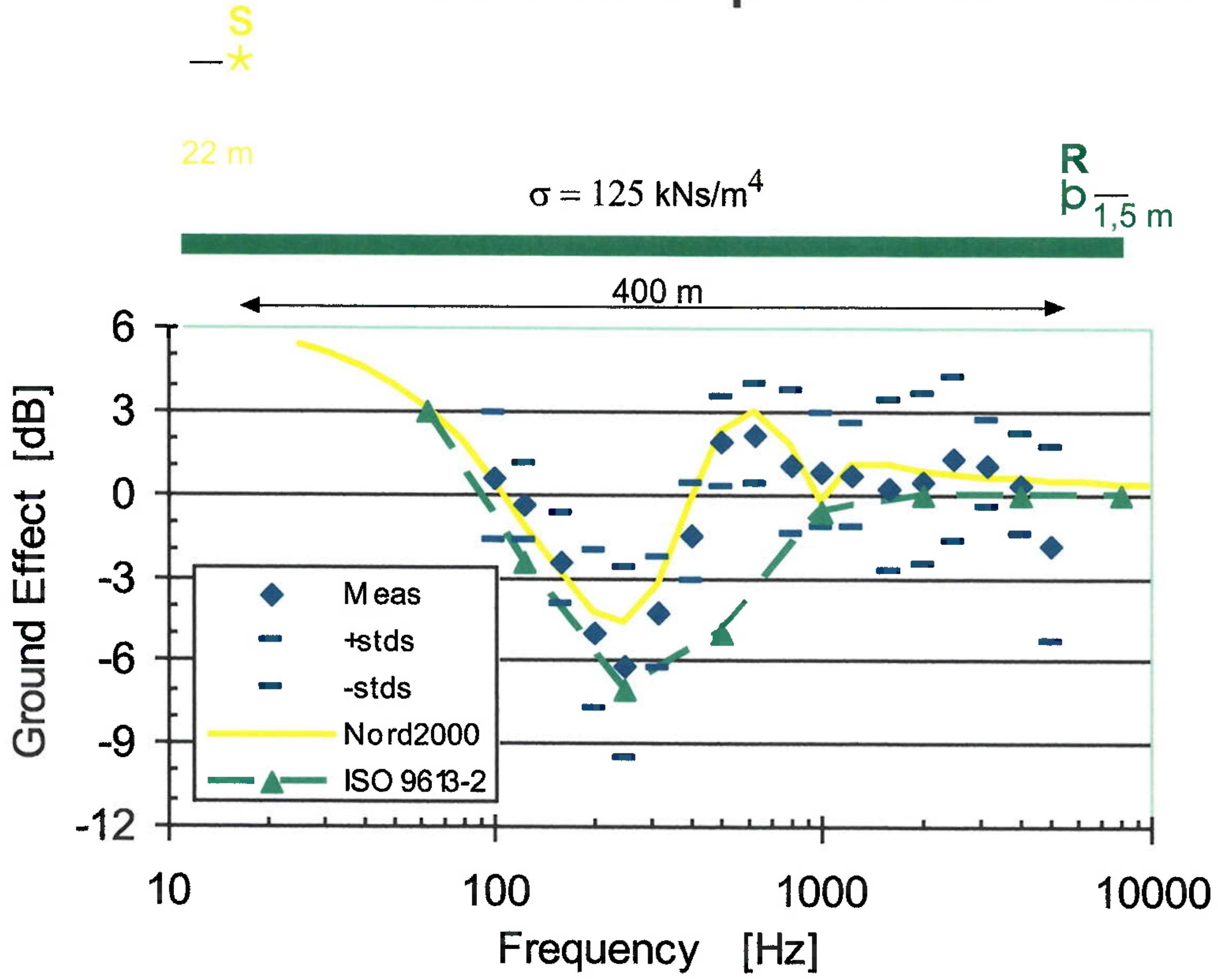
Nord2000 / WiTuProp vs. ISO 9613-2



Nord2000 / WiTuProp vs. ISO 9613-2



Nord2000 / WiTuProp vs. ISO 9613-2



Nord2000 model

- Meteorological conditions are better covered
- Complex terrain profiles (hill/valley)
- Mixed ground
- Terrain roughness
- Improved screen modelling
- 1/3 octave-band results
- Physical model – NOT empirical

Recommendation if the advanced model is not used:

- Use ISO 9613-2
- Make sure that hard terrain is used
- Be careful when defining screening effects from terrain - specially edge effects can be difficult to model

Noise Assessment

- The noise level at the imission points are normally given as an A-weighted noise level at different wind speeds.
- A tonality evaluation is normally included for the receiving points.

What do we know of the annoyance of the noise:

- We know that noise from wind turbines sometimes annoys people even if the noise is below the noise limits.
- Often people complaints on low frequency noise which many investigations often show in not present
- The noise limits are usually adapted from industrial noise limits and are based upon the principle that a given percentage of the population will feel annoyed when the limit is exactly fulfilled.
- Evaluation of tonality in the turbine noise is more based on the reproducibility of the results than on pure knowledge on what is actually annoying

Noise assessment

- Other descriptors need to be investigated to understand the annoyance caused by wind turbines
  - Low frequency noise and Infrasound – we cannot see it in our measurements
  - Modulation – may be the parameter that is heard as low frequency noise
  - Masking – which noise can mask noise from wind turbines
  - Other characteristics
  - ..
- This mean that tape recordings should me made on all sites in order to enable later analysis of up till now unrecognized parameters.
- In order to enable listener tests, artificial head investigations should be made
- We as a producer cannot cover this alone, since the local rules always need to be followed

Our recommended research program

- Artificial head measurements on real turbines of different sizes
- Background noise measurements on real sites
- Listener tests on obtained results
- These measurements are being made on a test basis during our Danish measurements

- General Research that is needed in this area includes
  - Psychoacoustic experiments
  - Listener test
  - Measurements at low frequencies
  - Analysis for other characteristics
  - ..

Questions ?

Appendix C

Suzlon Energy – Site effects

When searching the internet for the definition of the word "layout" I came across following:

Layout in word processing and desktop publishing refers to the arrangement of text and graphics. The layout of a document can determine which points are emphasised and whether the document is aesthetically pleasing. While no computer program can substitute for a professional layout artist, a powerful desktop publishing tool can make it easier to lay out professional looking documents (source: www.webopedia.com)

In principle the same is valid for wind farm planning: The term layout in wind industry is used for choosing optimal locations for wind turbines. Tools like flow models help to identify the best positions, but cannot replace the engineer making the final decision by balancing interests.

So what is that engineering experience, what factors influence the decision?

Jessica Rautenstrauch, wind energy consultant from Anemos, Germany, at work.
© Paul Langrock (www.unendlich-viel-energie.de)

Wind resource

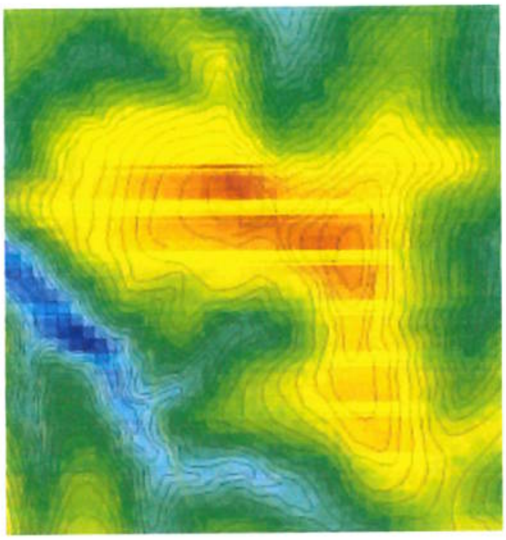
The wind resource is the most obvious factor to concentrate on when choosing a wind turbine location. We have a wide range of options to determine the wind resource of the site. The quality of the tools varies significantly and so does their price.

Common sense is a good starting point. Nature itself helps to guide us to suitable sites. Flagging of trees – permanent flagging and not the temporary bending in the wind – shows us the prevailing wind direction and is a good indicator for the strength of the wind.

However because of the uncertainty involved, using common sense as the only tool is of course insufficient. For any bankable estimate of the energy yield on-site wind speed measurements are required. The number of measurement masts required for a specific site depends next to the size of the project mainly on the complexity of the terrain. The measurement height should be minimum 2/3 of the expected future hub height. An increase in measurement height beyond this leads to a reduction of the uncertainty in the energy estimate. The measurement period must be one year or more to avoid any seasonal bias. Since the wind speed varies also inter-annually typically up to +/-12% a long-term correction is highly recommended.

The measured wind regime is extrapolated across the site to derive a resource map of the site using different flow models /4, 5/. A wind map like the one in Graph 1 can then be used to identify the windiest locations.

However additionally technical constraints should be taken into account when developing a layout /3/. A number of site specific wind load parameters can be extracted from the wind speed measurement. They are used to optimize the technical suitability of the chosen layout and the wind turbine type for the site specific wind regime.



Graph 1: Example Wind Resource Map. The colours denote the energy content of the wind, red high and blue low energy content.

Technical restrictions

Wind turbines are designed for specific conditions. During the construction and design phase assumptions are made about the wind climate that the wind turbines will be exposed to. In rough terms: For very complex sites with high wind speeds "heavy-duty" versions of wind turbines are available, which are sturdier but also more costly. Low wind speed sites in flat terrain do not put so high demands on the on the wind turbine structure, hence the construction can be more light-weight and hence cheaper. The different turbines have been classified by the IEC, class 1 being the highest wind speed class. The following table is a simplified summary of the IEC classification /1/.

IEC class	I	II	III	IV
V_{ave} (m/s) annual average wind speed at hub height	10	8.5	7.5	5
V_{ref} (m/s) 50-year maximum 10-minute wind speed	50	42.5	37.5	30

Table 1: IEC classes

But not only the wind speed but also other parameters play a role and have to be checked, when developing a layout for a specific turbine.

One of the most important parameters is the turbulence intensity. Turbulence intensity quantifies how much the wind varies typically within 10 minutes. Because the fatigue loads of a number of major components in a wind turbine are mainly caused by turbulence, the knowledge of how turbulent a site is of crucial importance.

We have to distinguish between two different sources of turbulence. Turbulence is generated by terrain features – which is referred to as ambient turbulence intensity - as well as by neighbouring wind turbines – which referred to as induced turbulence (Figure 1). Sources of ambient turbulence are for example forests, hills, cliffs or thermal effects. Thus ambient turbulence can be reduced by avoiding critical terrain features. But the wake-induced turbulence has far more impact than the ambient turbulence intensity /2/. Decreasing the spacing increases the turbulence induced by the wakes of neighbouring wind turbines meaning that there are limits to how close you can space the turbines. As a general rule the distance between wind turbines in prevailing wind direction should be a minimum of the equivalent of five rotor diameters. The spacing inside a row perpendicular to the main wind direction should be a minimum of three rotor diameters.

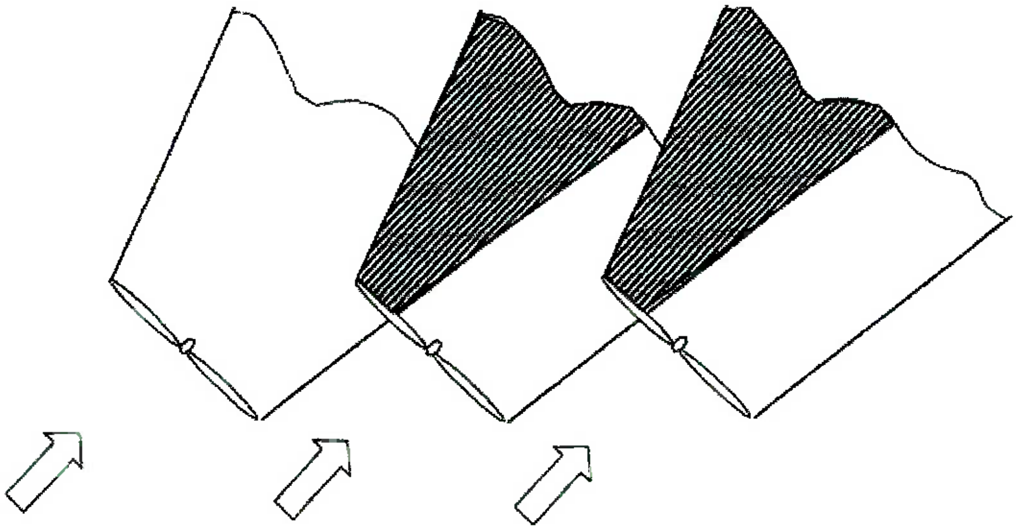


Figure 1: Shadowing in wind farm

If a layout is too close the resulting fatigue loads might be too high. In order to then ensure the lifetime of the main components wind sector management might have to be applied, meaning that some wind turbines might have to be switched off when they are operating in the wake of the neighbouring wind turbine.

Another parameter which has to be checked when developing a layout is the flow inclination, velocity tilt or in-flow angle. When wind turbines are to be placed on steep slopes or cliffs the wind might hit the rotor not perpendicular but at an angle. This angle is related to the terrain slope. With increasing height above ground level the effect of the terrain slope is normally reduced such that the terrain slope is only of indicative use to estimate the velocity tilt. A large in-flow angle will not only reduce the energy production but will also lead to an increased level of fatigue of some of the mayor components.

Figure 2: Distorted wind profile at steep slope (left) and behind a forest (right)

Furthermore a steep slope might cause a negative gradient across some parts of the rotor (Figure 2).

Normally the wind speed increases with increasing height. In flat terrain the wind speed increases logarithmically with height. In complex terrain the wind profile is not a simple increase and additionally a separation of the flow might occur, leading to heavily increased turbulence. The resulting wind speed gradients across the rotor lead to high fatigue loads particularly on the yaw system.

Obstacles like forest can have a similar effect on the wind profile and should be thus avoided.

Planning constraints

Next to the wind resource and technical considerations a good layout should also take planning constraints into account. The visual impact is course the most obvious. A layout that follows the shape of the terrain rather than straight rows of wind turbines appears to be less intrusive. Noise is another important parameter to take into account. Next to noise also the impact due to flicker at the nearest inhabited houses should be estimated. The accepted levels vary from country to country.

Electro-magnetic interference can cause problems. Hence placing wind turbines in a transmission corridor should be avoided.

Some areas on site might have to be excluded from development due to other factors related to fauna, flora and archaeology.

Jessica Rautenstrauch, wind energy consultant
from Anemos, Germany, at work.
© Paul Langrock (www.unendlich-viel-energie.de)

Summary

A large number of parameters have to be taken into account when developing a layout. Some work can be done using tools, but in the end the balance between financial, technical and planning constraints can be best done by an experiences engineer.

Literature

/1/ IEC 61400-1, Ed.2 – Wind Turbine Generator Systems – Part 1: Safety Requirements, FDIS 998

/2/ S. Frandsen, St.; L. Thøgersen, L.;: Integrated Fatigue Loading for Wind Turbines in Wind Farms by Combining Ambient Turbulence and Wakes; Wind Engineering, Vol. 23 No. 6, 1999

/3/ K. Kaiser, W. Langreder: Site Specific Wind Parameter and their Effect on Mechanical Loads, Proceedings EWEC, Copenhagen, 2001

/4/ E.rik L. Petersen, N. G. Mortensen, L. Landberg, J. Højstrup and H. Frank: (, Wind Power Meteorology Part I: Climate and Turbulence, Wind Energy, 1, 25-45 (1998), Risø-I-1206, 1997

/5/ E. L. Petersen, N. G. Mortensen, L. Landberg, J. Højstrup and H. Frank: Wind Power Meteorology Part II: Siting and Models, Wind Energy, 1, 55-72 (1998)

Wiebke Langreder
Suzlon Energy: www.suzlon.com

Appendix D

EPA Tasmania wind farm noise policy

EPA Board Policy

Noise limits for wind energy projects

EPA TASMANIA
ENVIRONMENT PROTECTION AUTHORITY

Application

This policy is adopted by the Board of the Environment Protection Authority (EPA Board) for the purpose of assessing wind energy projects and requiring conditions or restrictions in respect to wind farm noise under the *Environmental Management and Pollution Control Act 1994* (EMPCA).

This policy supersedes any previous policy of the EPA Board in respect to operational noise criteria for wind energy projects. This policy does not apply to construction noise.

This policy applies from 31 July 2025 and will apply to all wind energy projects currently under assessment. It remains in place until revoked.

Technical terms

L_{Aeq} means the A-weighted equivalent continuous sound level.

L_{A90} means the A-weighted sound level that is exceeded for 90% of the measurement period.

dB means decibel.

dB(A) means decibel when stating A-weighted sound pressure level.

Design Criteria

The predicted equivalent noise level at any noise sensitive premises should not exceed the greater of:

a) 35 dB(A) $L_{Aeq,\ 10\ min}$; or
b) Background (L_{A90}) + 5 dB(A).

This design criteria applies to all noise emissions from the activity, inclusive of wind turbines and all ancillary infrastructure. It has been set for the protection of sensitive receivers during periods of low background noise.

The background noise for day, evening and night-time must be calculated separately to determine the applicable (lowest) background level, and is not to be averaged across a 24-hour period.

For predictive purposes, a difference of ~2 dB between measured $L_{A90,\ 10\ min}$ levels and $L_{Aeq,10\ min}$ emissions from the activity must be noted. The predicted noise levels should be adjusted for special audio characteristics and/or the applicable adjustment factors must be discussed.

The EPA South Australia *Wind farms environmental noise guidelines 2021* (or the most recent revised version of that document) is to be used for assessing whether a wind farm can meet this design criteria, except where that guideline may be inconsistent with this policy.

Noise Measurements

If approved, wind energy projects will contain conditions and restrictions to enforce the design criteria. The following guidance is provided for the interpretation of EPA Board wind energy project noise requirements:

1. It is generally acceptable for wind turbine noise to be measured in L_{A90}, but note that alternative techniques may be required (including measuring in L_{Aeq}) to better detect special audible characteristics (dominant and intrusive characteristics) and noise fluctuations or intermittent noise.

2. An appropriate conversion factor must be added to the measured L_{A90} level to derive the representative L_{Aeq} noise level. To be representative of L_{Aeq}, generally applying +2 dB(A) conversion factor to the measured L_{A90} level is acceptable.

3. Where special audible characteristics (dominant and intrusive characteristics) are detected from any wind farm noise, a correction factor must be applied in accordance with the *Tasmanian Noise Measurement Procedures Manual*.

4. The EPA South Australia *Wind farms environmental noise guidelines 2021* (or the most recent revised version of that document) is to be used for all wind farm noise measurements, except where that guideline may be inconsistent with this policy.

29 July 2025

Andrew Paul
Chair
Environment Protection Authority Board

LHUSON & ASSOCIATES

REPORT

NOISE SURVEY

V95 PNX2

CLIENT: Lafferty, O'Halloran, CEPA

Job No LHA468
January 2026

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NOISE SURVEY

V95 PNX2

EXECUTIVE SUMMARY

Data from a noise survey completed between 12 September 2025 and 5 October 2025 at V95 PNX2 (dwelling) has been analysed to test compliance with permitted noise limits for the Slieve Callan Wind Farm and to assess if annoyance can be caused due to the characteristics of the sound (amplitude modulation, AM; low frequency noise, LFN; tonality and impulsiveness).

AM, tonality, low frequency noise, and impulsivity have all been observed during the survey when the wind turbines are operating, as assessed using ISO 1996.

When focussing on the night time period to reduce extraneous noise there is evidence of excessive amplitude modulation and low frequency noise that, using multiple assessment methodologies, indicates annoyance will be caused.

Individual AM events have an impulsive characteristic that according to ISO1996 would warrant a penalty to the measured sound levels prior to assessing compliance with the specified rating limit (43 dB, $L_{Aeq(15min)}$).

A significant low frequency characteristic was found in the 160 Hz 1/3 octave band that shows amplitude modulation of more than 10 dB at levels that are clearly audible.

Furthermore, a tonal penalty of 4 dB was determined for a 165 Hz tone within the 160 Hz 1/3 octave band. If each penalty was to apply cumulatively the total penalty could exceed 12 dB.

The permitted rating sound level of 43 dB, $L_{Aeq(15min)}$ was exceeded on multiple occasions during the survey period at night when extraneous noise was minimised, without corrections for sound characteristics.

Overall, a minimum cumulative adjustment penalty of 6 dB should apply for the different audible characteristics observed that effectively means the permitted noise limit becomes 37 dB, $L_{Aeq(15min)}$.

Prepared by

W Les Huson BSc MSc CPhys MInstP MIoA MAAS

TABLE OF CONTENTS

INTRODUCTION

A noise survey was completed between 12 September 2025 and 5 October 2025 at V95 PNX2 for the purpose of assessing noise primarily associated with the Slieve Callan Wind Farm.

The Slieve Callan Wind Farm has 29 Nordex N90 2.5MW wind turbines. The nearest wind turbine is approximately 620m to the south of V95 PNX2.

MEASUREMENT EQUIPMENT

Sound level meter/logger:
SVANTEK 977D s/n 99744
Date next calibration due: April 2026

Field Calibrator:
CEL 120/1 s/n 2221119 No calibration drift was evident during the survey period.
Date next calibration due: 15 August 2026

ILFN recorder s/n 17006, located inside the eastern dwelling at V95 PNX2.

MEASUREMENT LOCATION

The measurement location is shown in Figure 1 having coordinates 29U 481419 E, 5856750 N (WGS84).

North

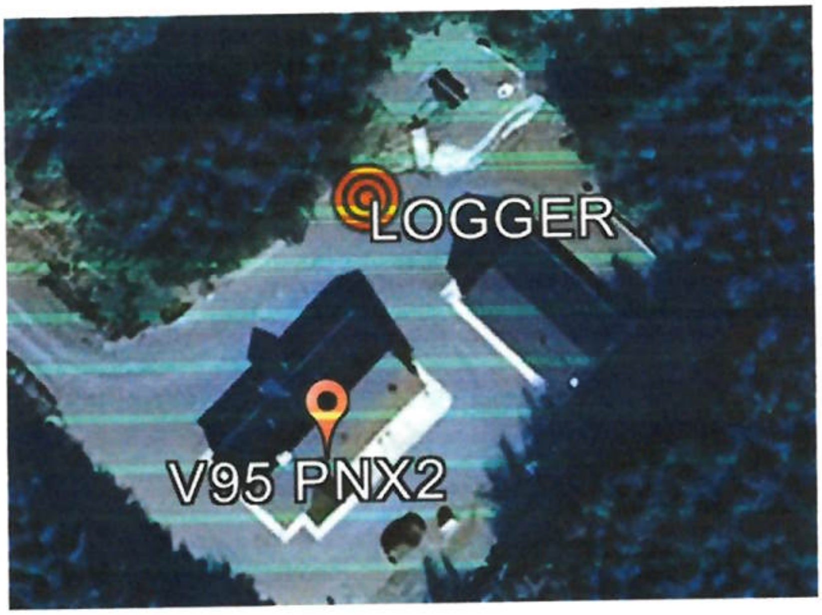


Figure 1: Noise Logger Location, approximately 12m from nearest building

Figure 2 shows the measurement location in relation to the nearest wind turbines of the Slieve Callan Wind Farm. Images courtesy Google Earth.

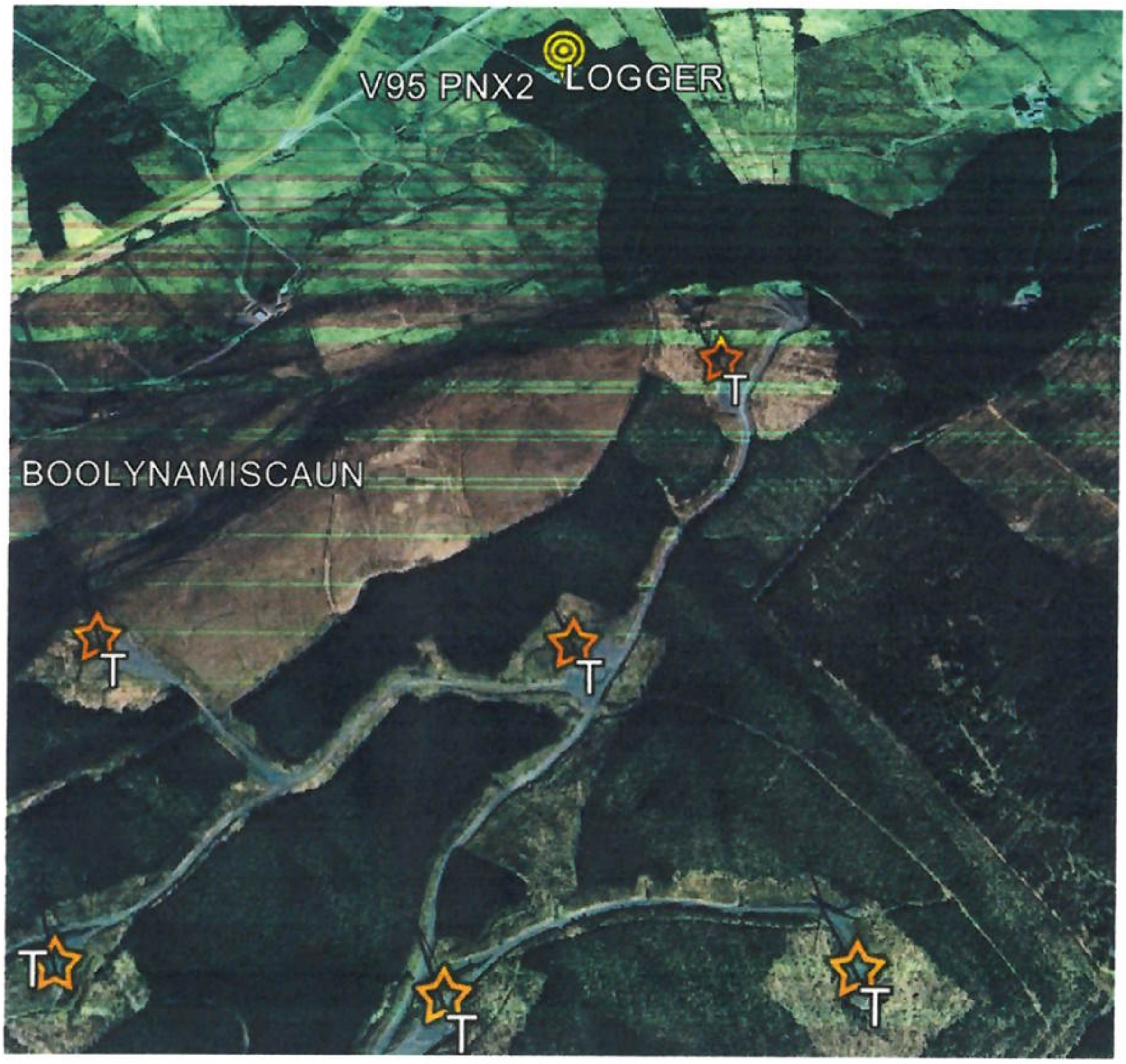


Figure 2 The nearest wind turbine is approximately 620m from dwelling

Figure 3 Photograph facing south of the logger installation and the nearest wind turbine.

NOISE LIMIT

Part of the development approval (An Bord Pleanala PL 03.237524, 22 August 2011) that relates to noise for the Slieve Callan Wind Farm is as follows:

"13. During the operational period, noise levels resulting from the operation of the wind turbines, when measured at the nearest inhabited house, shall not exceed 43dBA (15 minutes Leq). All sound measurements shall be carried out in accordance with ISO Recommendation R 1996 'Assessment of Noise with respect of Community Response' as amended by ISO Recommendations R 1996 1."

Development approval part 13 requires that the contribution of the operation of the Slieve Callan Wind Farm must not result in sound levels that exceed 43 dB(A) at any time. The 43 dB(A) noise limit is measured as an Leq value over a 15-minute interval, being the sound from the wind farm only, corrected for any characteristic of the noise such as tonality, impulsiveness, amplitude modulation or elevated low frequency.

The original ISO Recommendation R 1996, titled "Assessment of noise with respect to community response", was a foundational document for environmental noise regulation published in 1971. This recommendation has since been revised and replaced multiple times by the ISO 1996 series of International Standards.

The current standard is ISO 1996-1:2016, *Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures*. This version, confirmed in 2021, remains the current guidance and focuses on:

- Defining basic quantities for describing noise in community environments (e.g., equivalent continuous sound pressure level, sound exposure level).
- Describing basic assessment procedures to predict potential long-term annoyance responses from various noise sources (road traffic, aircraft, industrial, etc.).
- Providing adjustments to measured or predicted levels (called "rating levels") to account for specific sound characteristics like impulsiveness, tonality, amplitude modulation, and low-frequency content, which can increase annoyance.

ISO 1996-1 does not specify mandatory limits for environmental noise; instead, it provides the framework and principles upon which national authorities can develop their own standards and regulations.

In this instance, the authorities have set a rating value of 43 dB, $L_{Aeq(15min)}$ for the Slieve Callan Wind Farm. If sound characteristics warrant a 5 dB penalty to measurements then the compliance noise limit becomes 38 dBA (43 dBA minus 5 dB penalty).

The scope for the current ISO1996 describes the assessment methodology as follows:

"The sounds are assessed either singly or in combination, allowing for consideration, when deemed necessary by responsible authorities, of the special characteristics of their impulsiveness, tonality, and low-frequency content, and for the different characteristics of road-traffic noise, other forms of transportation noise (such as aircraft noise), and industrial noise."

ISO 1996-2:2017 *'Acoustics — Description, measurement and assessment of environmental noise Part 2: Determination of sound pressure levels'*, Annex C (and related parts of ISO 1996-1), address low-frequency noise (LFN) by recommending methods to capture sound in lower frequency bands (like 1/3 octave bands) and by using metrics like the difference between C-weighted (dBC) and A-weighted (dBA) levels (C-A).

LFN significantly affects C-weighting but less so A-weighting, indicating potential annoyance even if A-weighted levels are low, with detailed assessment often involving indoor measurements and comparison to country-specific annoyance criteria.

Application of ISO 1996-1 and ISO 1996-2 to LFN

- Frequency Analysis: The standard guides users to analyse sound in specific low-frequency bands (e.g., 1/3 octave bands below 250 Hz or even lower) to identify dominant LFN components.

- C-A Weighting Difference: A simple indicator is the difference between the C-weighted sound pressure level (dBC) and the A-weighted level (dBA). A large difference (e.g., 15 dB or more) suggests significant low-frequency content that can cause annoyance, even if the dBA level is within limits.

- Indoor Measurements: LFN is often more perceptible indoors. Annex C discusses procedures for indoor measurements, acknowledging the need to account for building transmission loss, which varies with frequency.

- Comparison with Thresholds: Measured LFN levels (often dBC or band-specific) are compared against established annoyance thresholds or target values, which can differ by country (e.g., UK, Finland) and time of day (day/night).

- Focus on Annoyance: The objective is to assess impact. Annex C highlights that high C-A differences or specific low-frequency levels (like 44 dB at 160 Hz) outdoor can indicate annoyance, even if A-weighted levels are low.

ISO 1996-2:2017 (Annex C) shifts focus from overall A-weighted noise to detailed frequency analysis, using the C-A difference screening and indoor measurements to characterize and assess the annoyance potential of low-frequency sound components.

DATA ANALYSIS

$L_{Aeq,15\text{-}min}$ sound levels were measured throughout the survey period and the results are presented on a day-by-day basis in Figures 4 to 27. Above each LAeq chart is a spectrogram covering the frequency range below 35 Hz for each corresponding day measured indoor.

ISO1996 defines low frequency as "sound containing frequency components of interest within the range covering the one-third octave bands 16 Hz to 200 Hz". This covers the frequency range from 13.9 Hz to 222.7 Hz.

Infrasound is generally considered to be sound containing frequencies below 20 Hz.

The infrasound and low frequency spectrograms show when the Slieve Callan Wind Farm was operating.

A spectrogram illustrates the frequency distribution of an acoustic signal, with colour coding used to denote variations in sound pressure level.

The vertical axis represents frequency, ranging from 0 Hz to 35 Hz.

Time is expressed along the x-axis in thousands of seconds with each spectrogram starting at midnight (UTC) for the next 24 hours on a given day.

Wind turbine noise contains a range of low frequency sounds when operating.

The repetition of low frequency sound pulses is related to the speed of rotation of the wind turbine blades.

When the rotor of a wind turbine turns the blades produce pulses at blade pass frequency and harmonics (the repetition rate that blades pass the tower and multiples of that repetition rate are called harmonics).

These harmonics present on a spectrogram as horizontal lines below 6 Hz, being multiples of the blade pass frequency (0.8 Hz, 1.6 Hz, 2.4 Hz etc.).

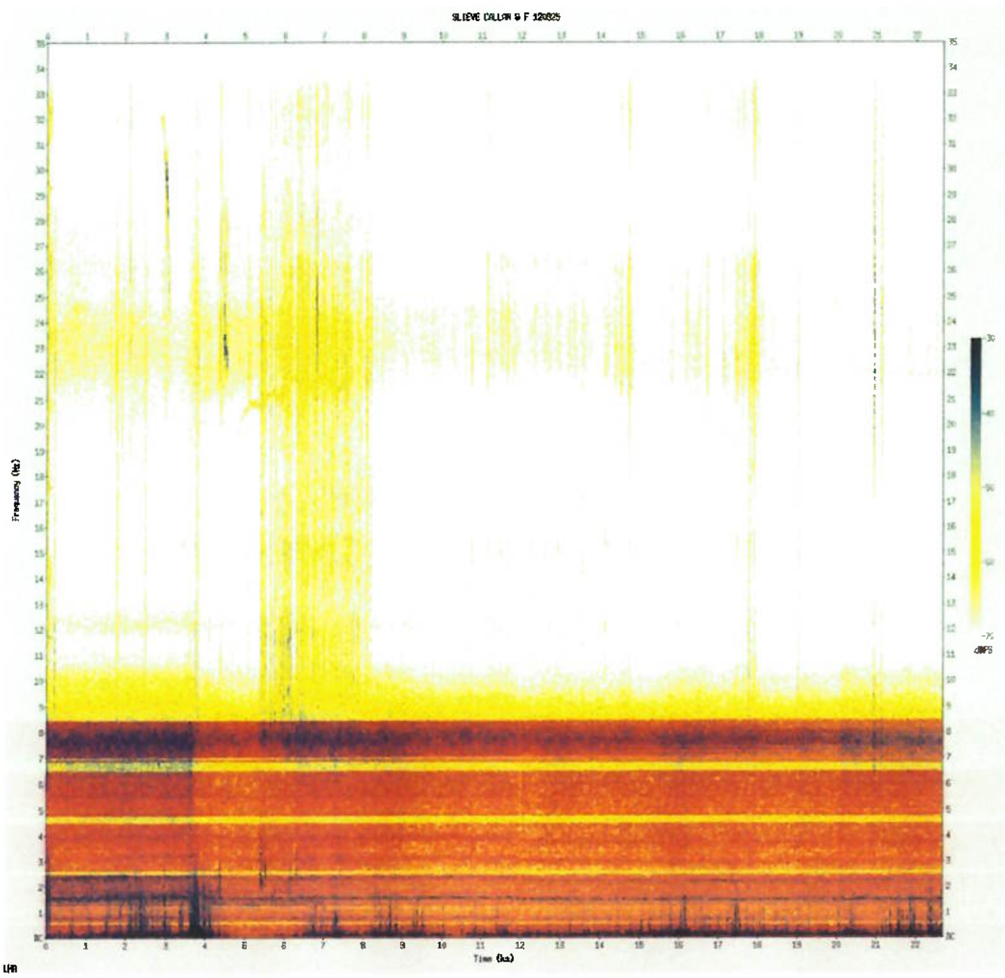
If the harmonics disappear then this indicates that the wind turbines have stopped spinning, either due to lack of wind or they have been intentionally stopped.

If these horizontal lines 'wobble' then this means that the wind turbine rotors are changing rotation speed slightly and the wind turbines would not be operating to produce maximum electrical power.

If a horizontal line changes in colour then the amplitude of the tone or pulse repetition at that frequency is changing in level (loudness).

The first and last figures (Figure 4 and Figure 27) show spectrograms covering less than 24 hours with Figure 4 starting at 7 pm, ending at midnight and Figure 27 ending at 3 pm.

Note: the spectrograms are in UTC but the LAeq charts are in summer time (UTC + 1hour).



V95 PNX2 12 September 2025

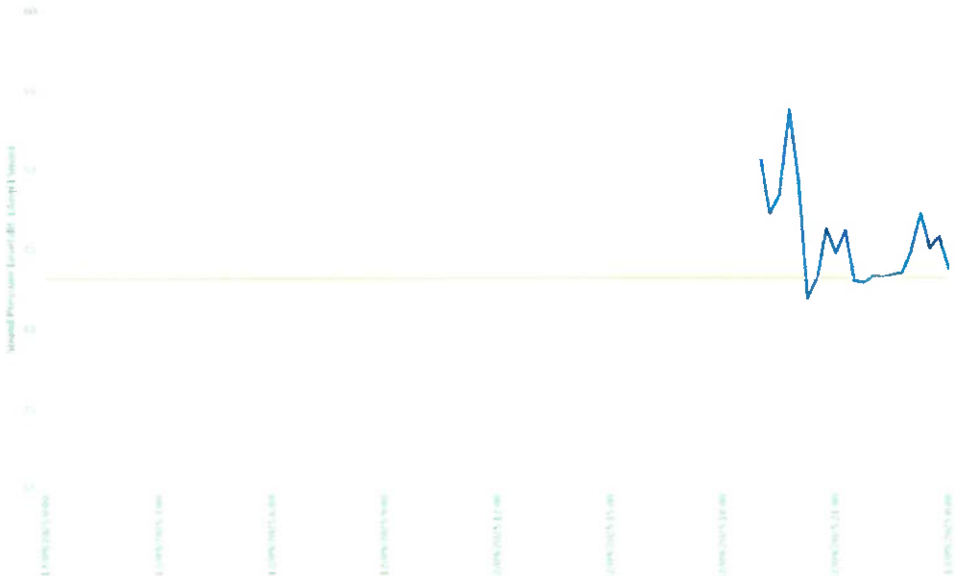
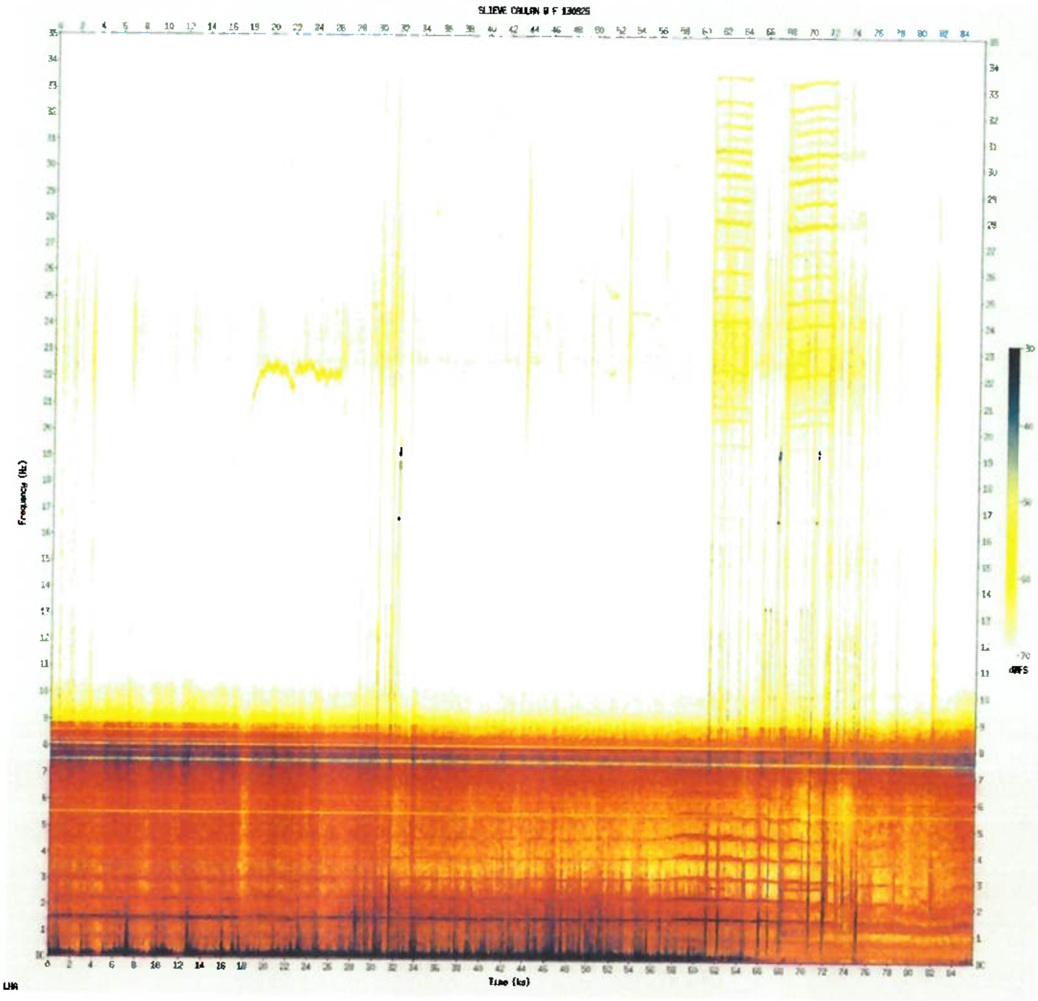


Figure 4



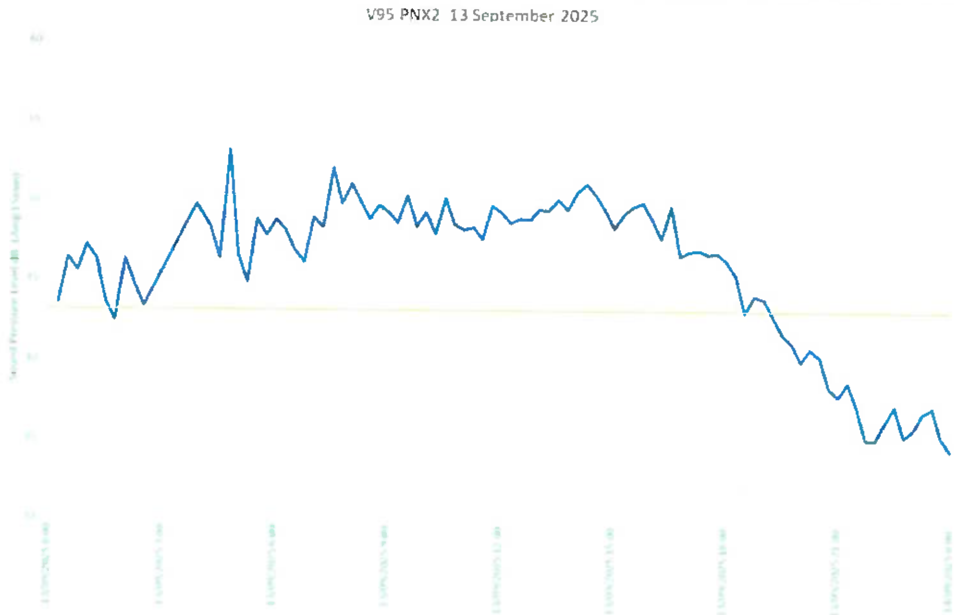
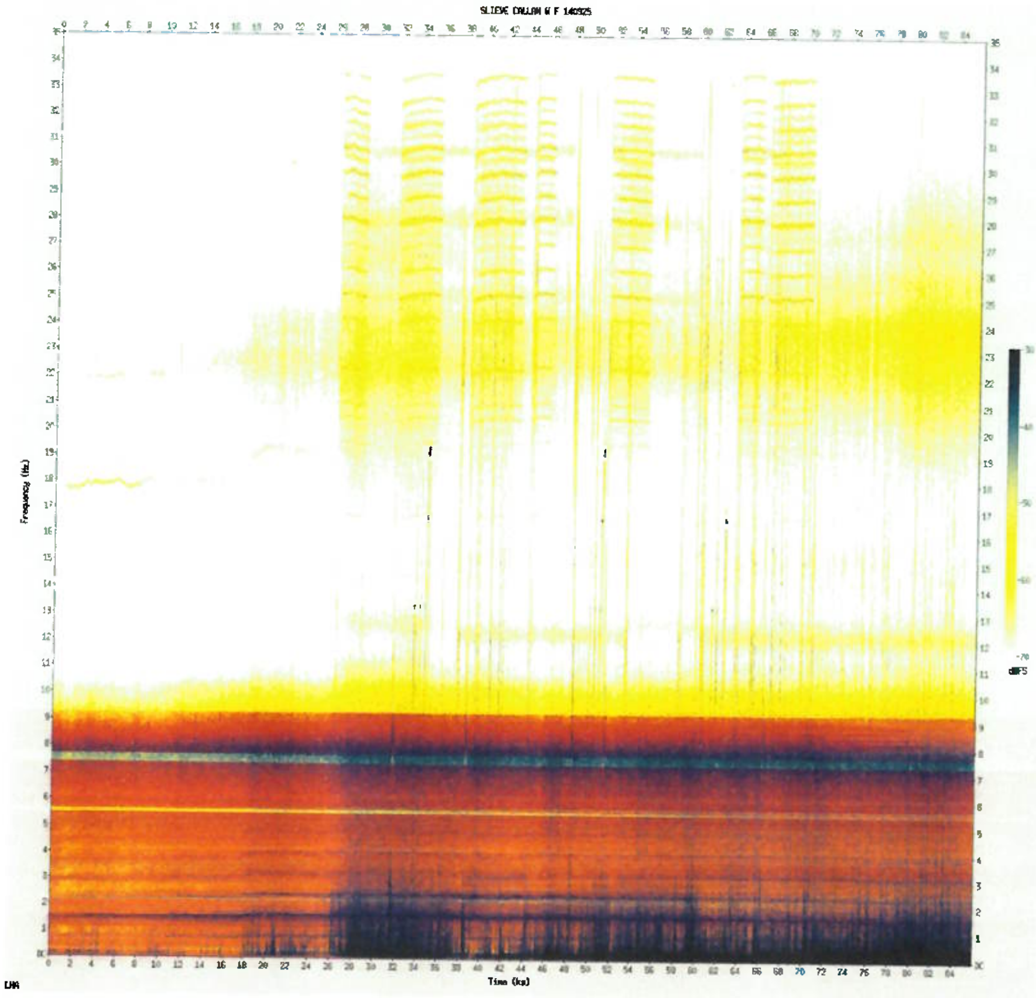


Figure 5



V95 PNX2 14 September 2025

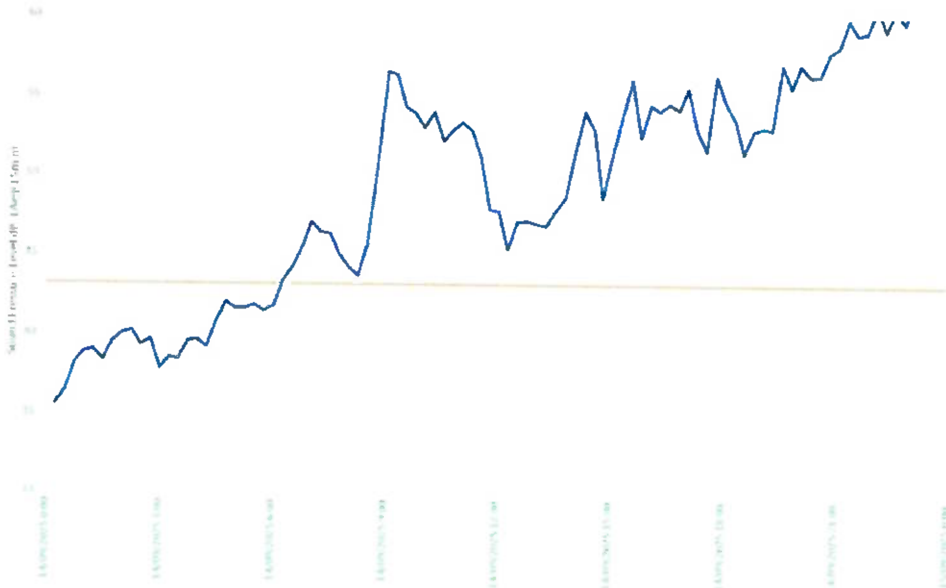
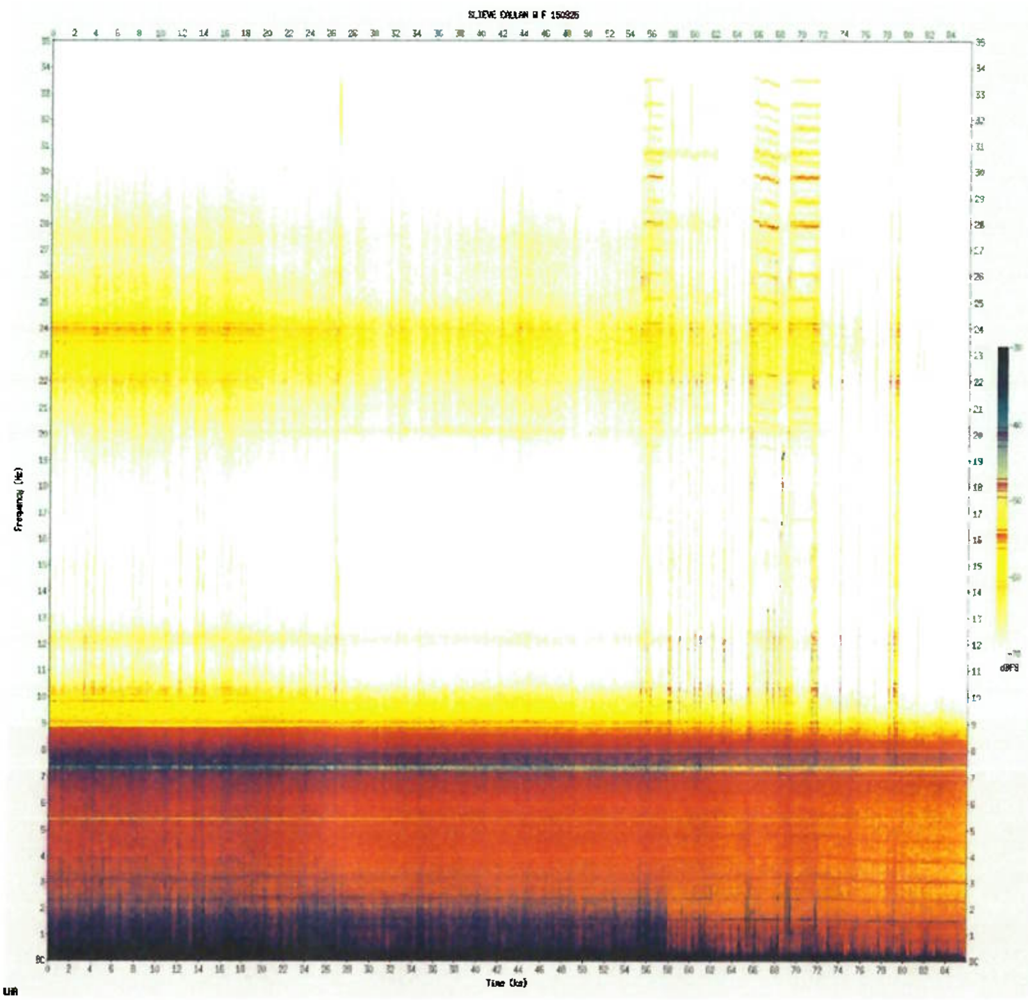


Figure 6



V95 PNX2 15 September 2025

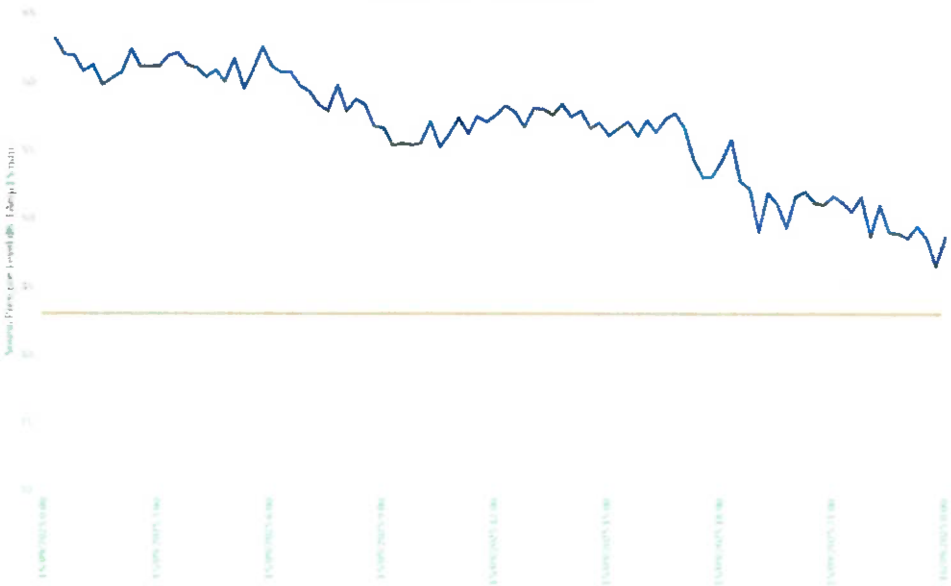
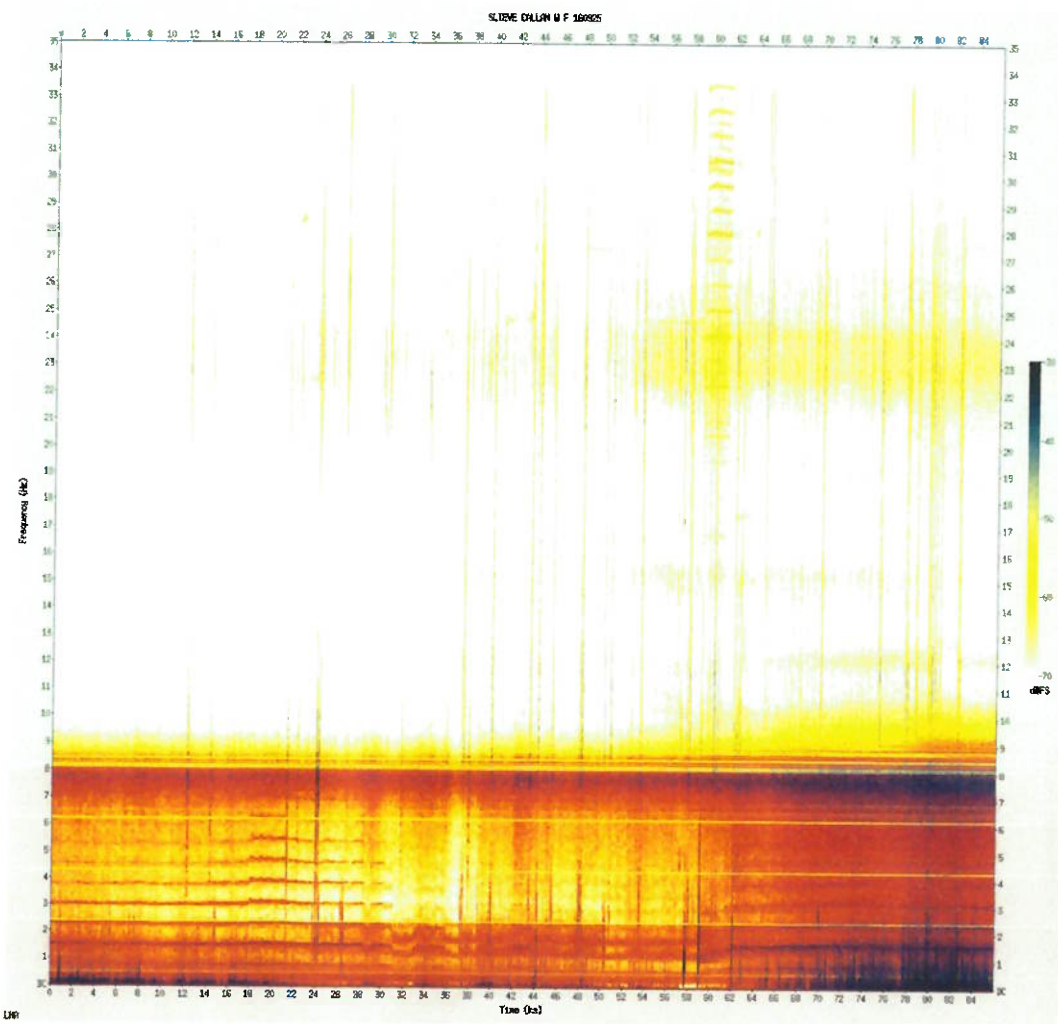


Figure 7



V95 PNX2 16 September 2025

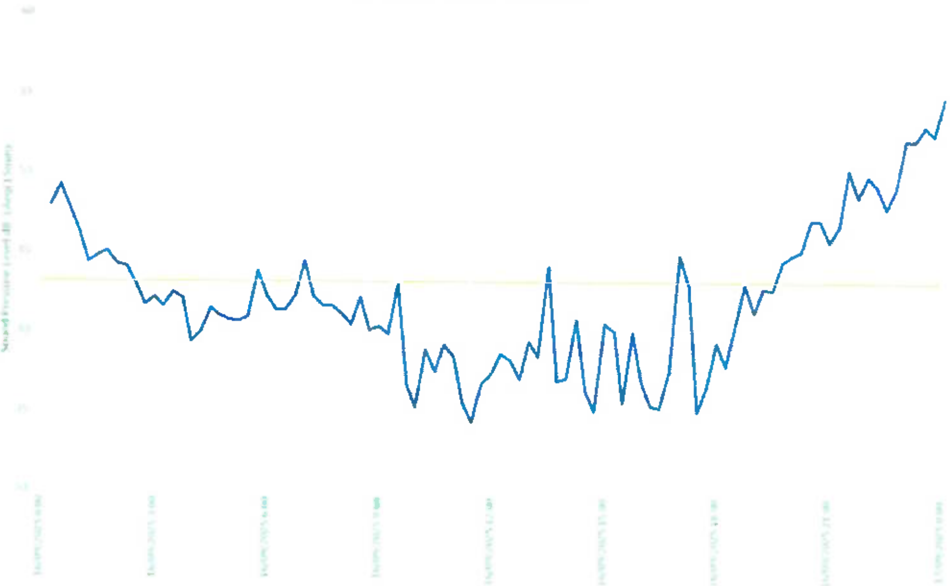
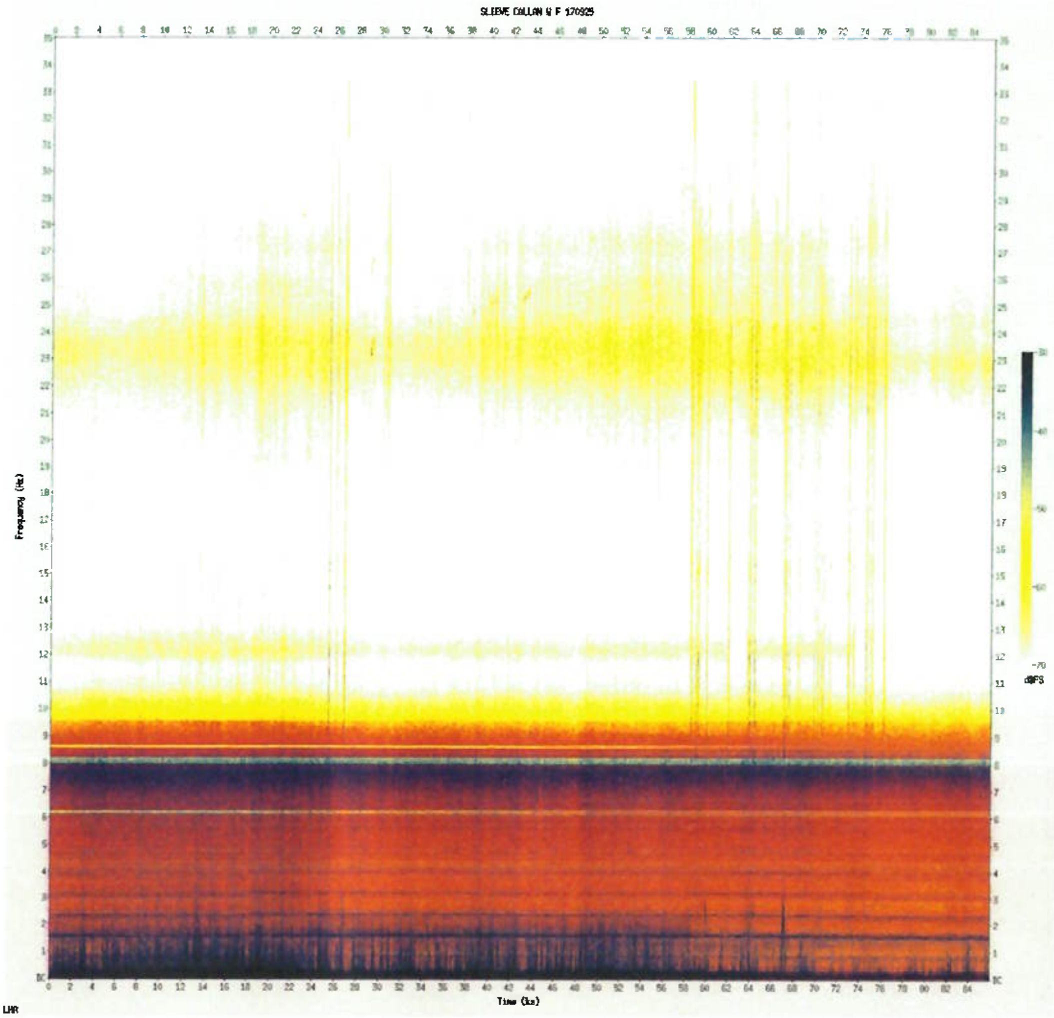
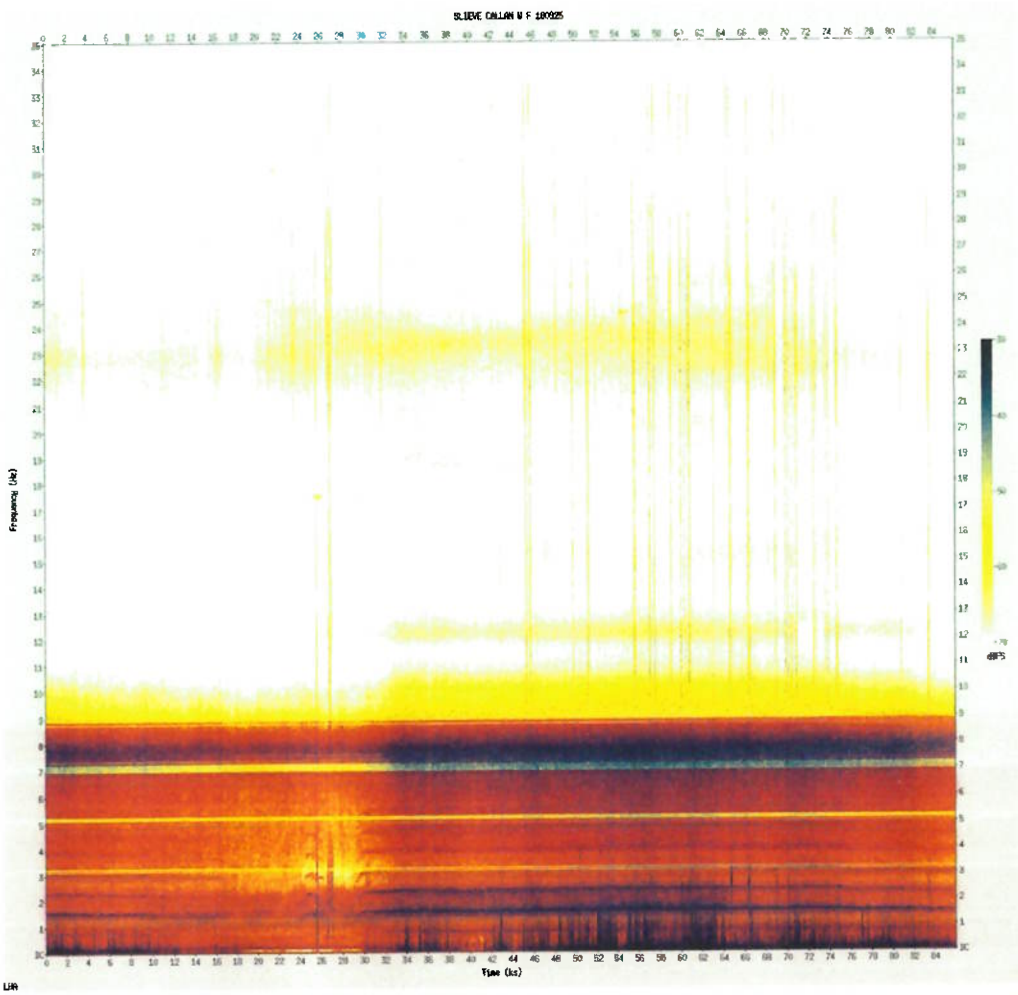


Figure 8


SLIEVE CALLAN 17092S
Frequency (Hz)
Time (ks)
dBFS


V95 PNX2 17 September 2025

Figure 9



V95 PNX2 18 September 2025

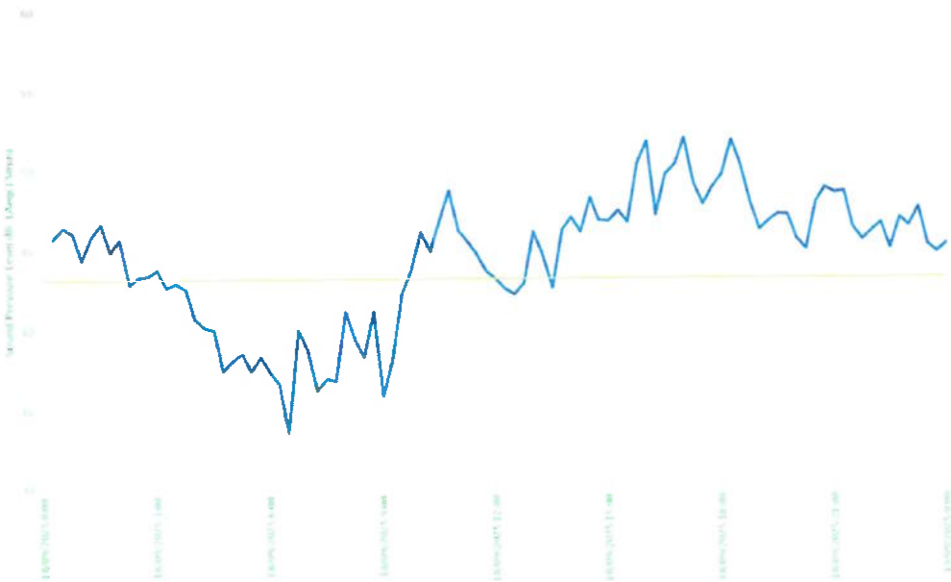
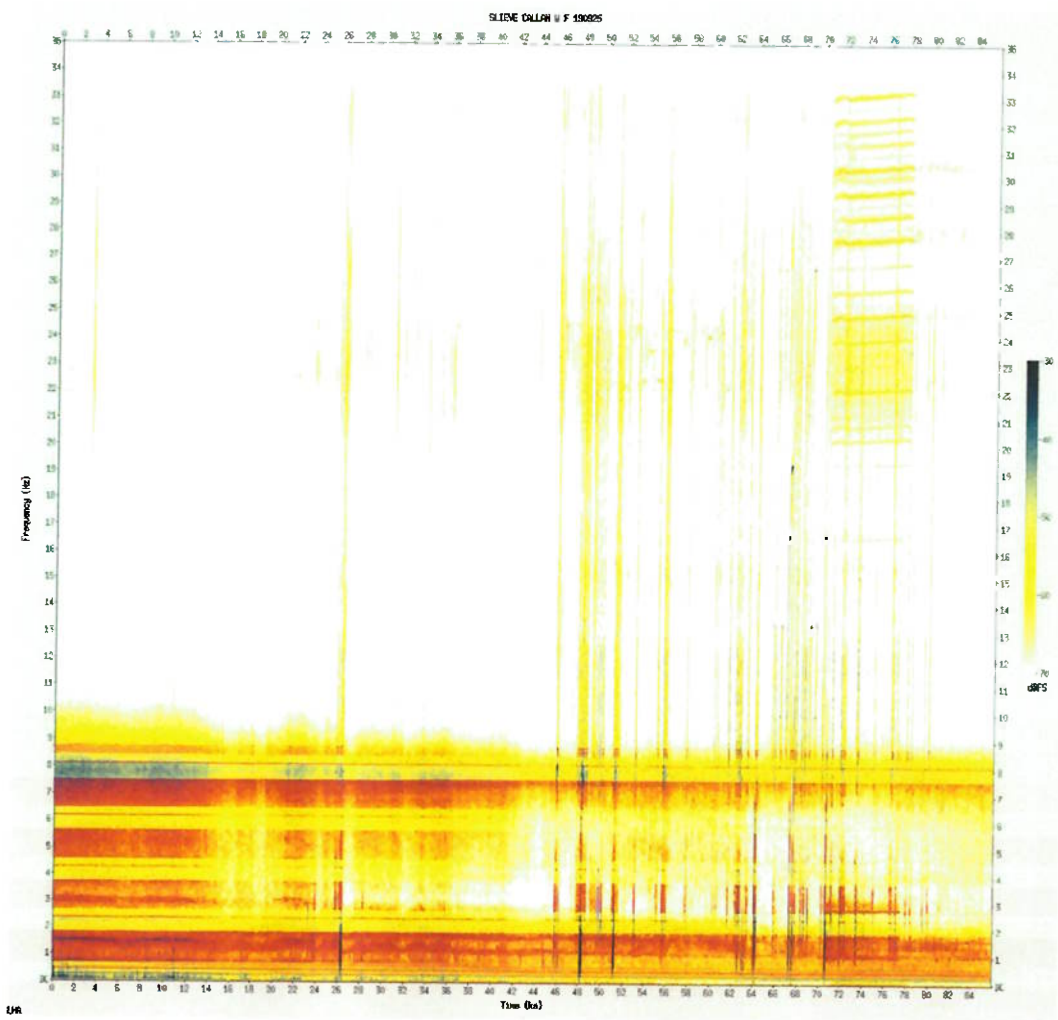


Figure 10



V95 PNX2 19 September 2025

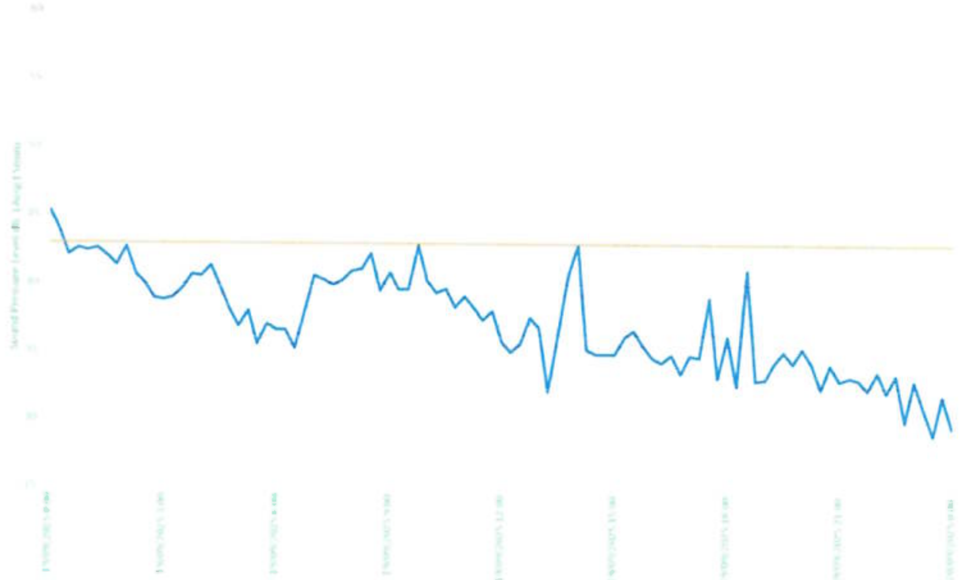
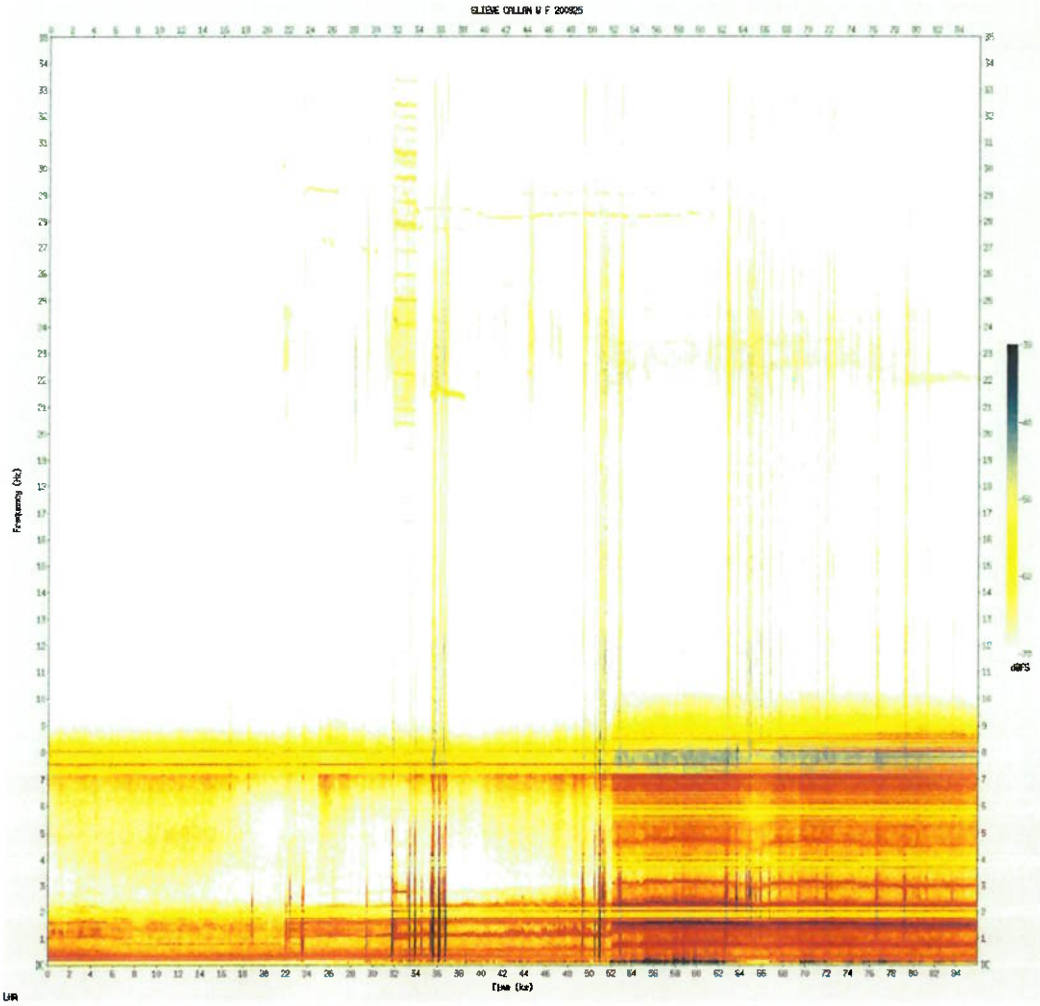


Figure 11



V95 PNX2 20 September 2025

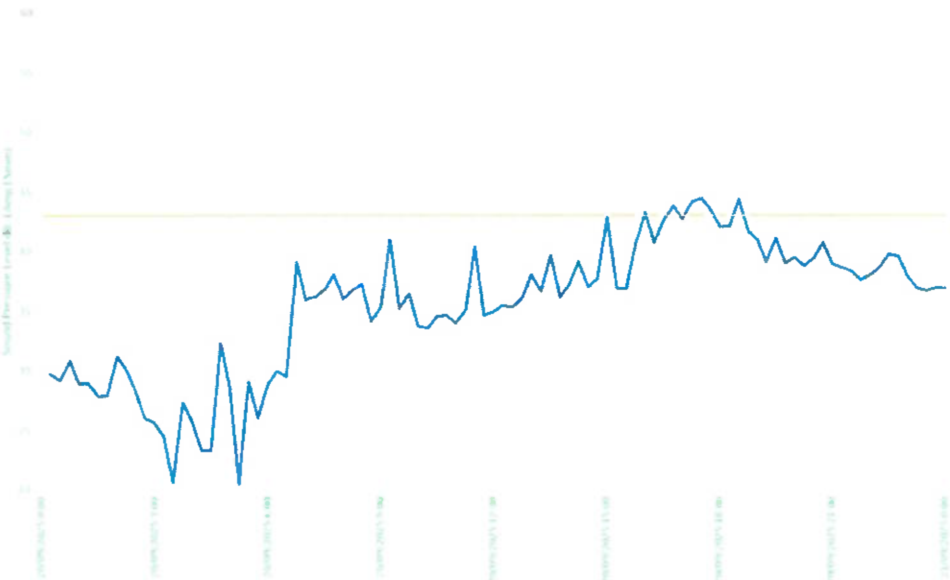
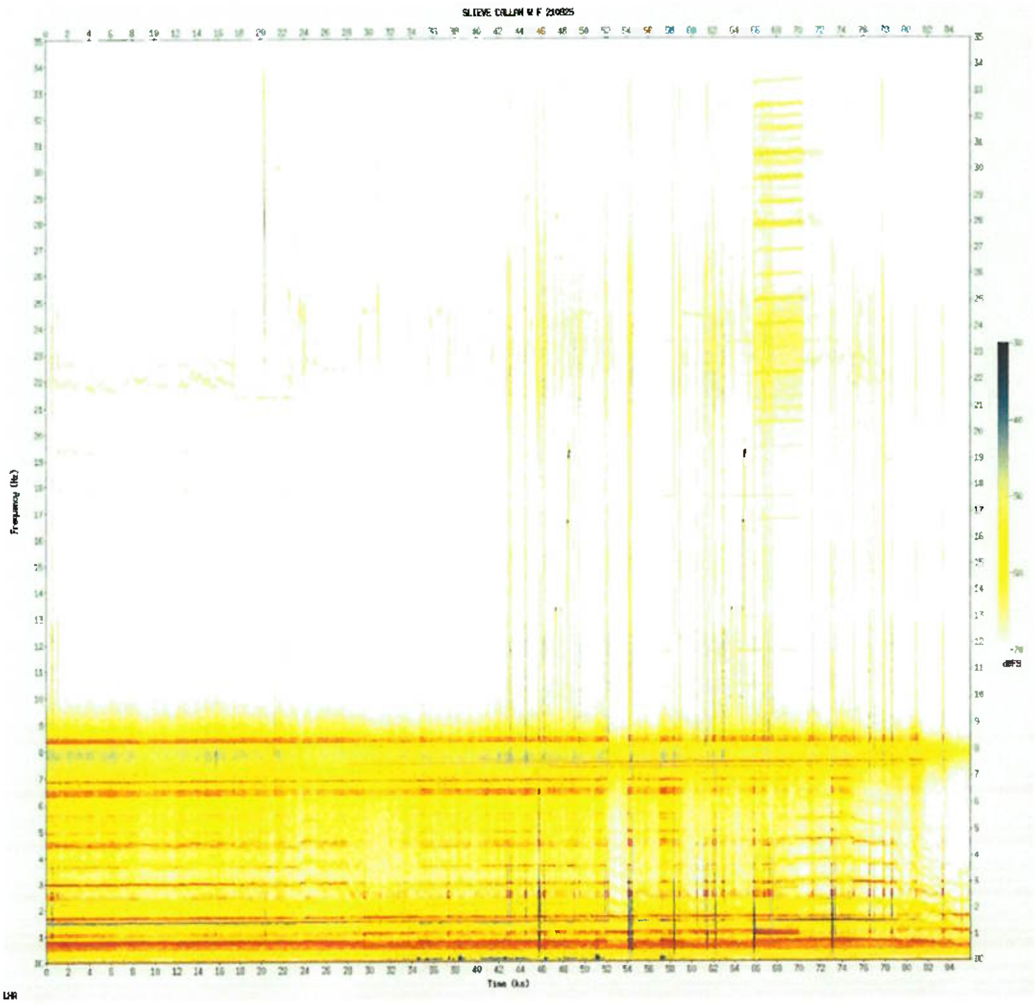


Figure 12


SLIEVE CALLAN M F 210925
Frequency (Hz)
Time (ks)
dBFS

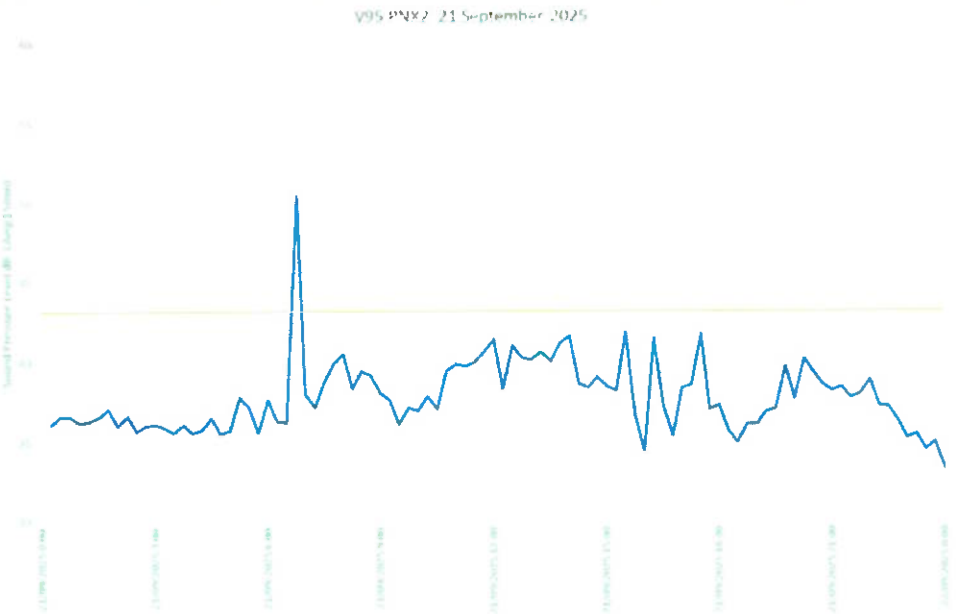

V95 PNX2 21 September 2025

Figure 13

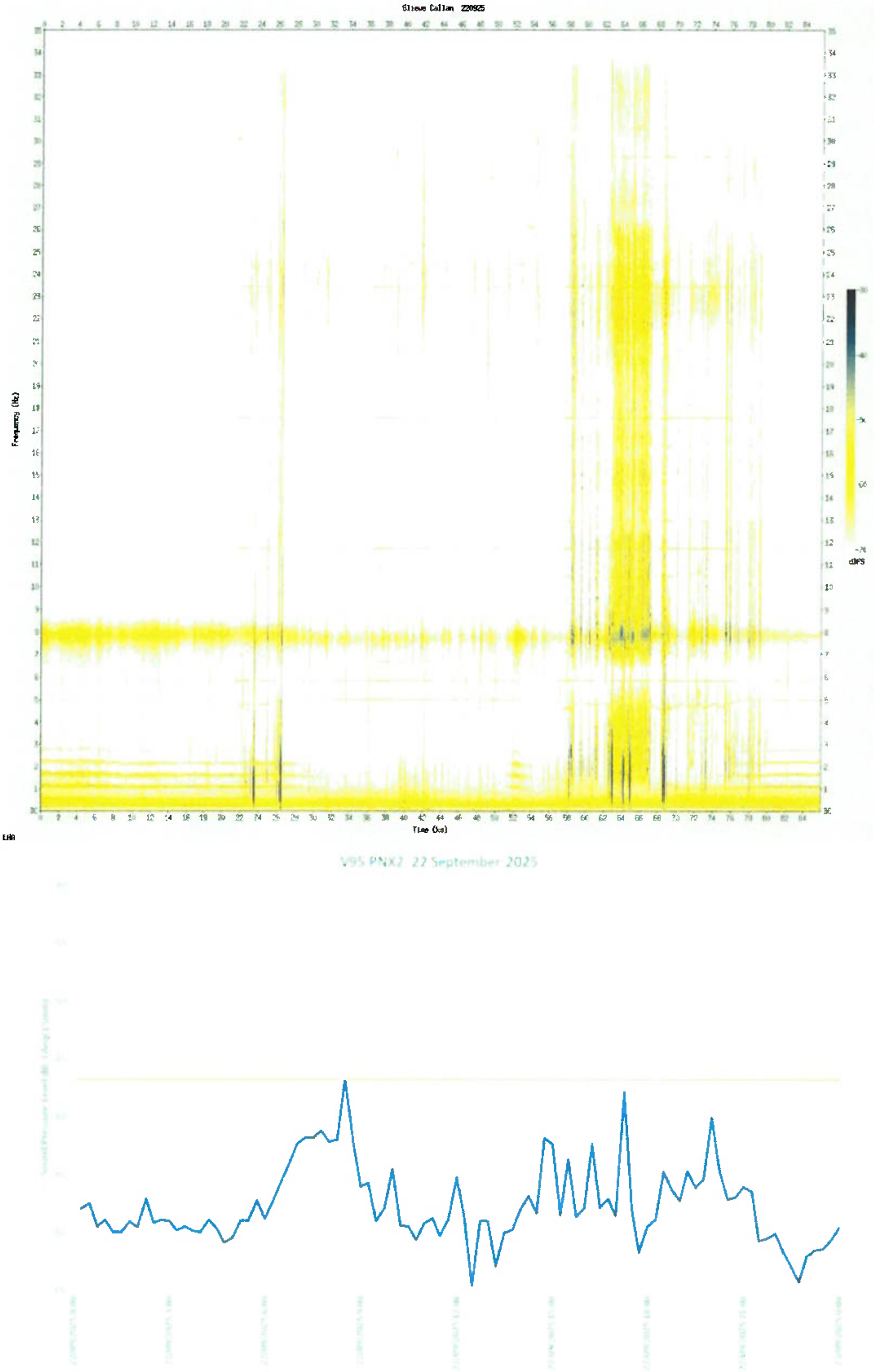
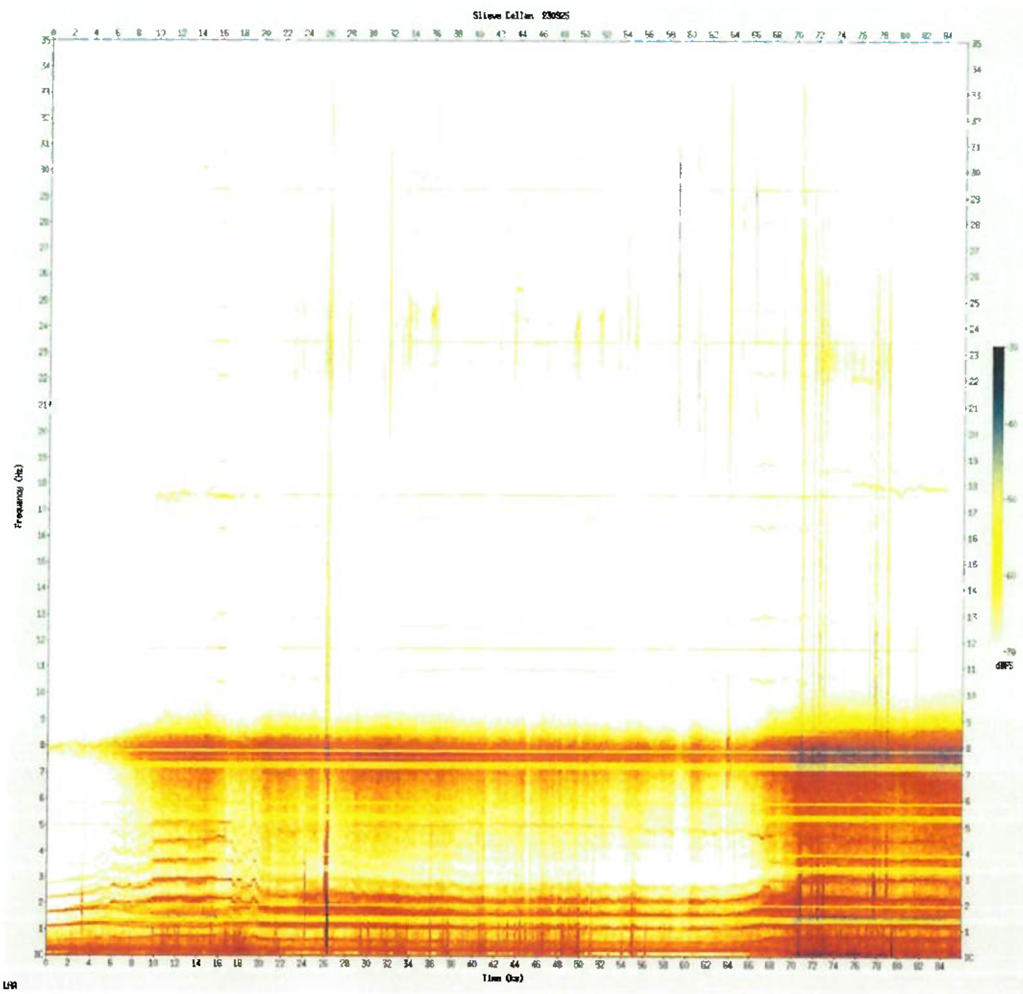

Slieve Callan 220925
Frequency (Hz)
Time (hrs)
dBFS
V95 PNX2 22 September 2025

Figure 14


Slieve Callan 230925
Frequency (Hz)
Time (hr)
dBFS

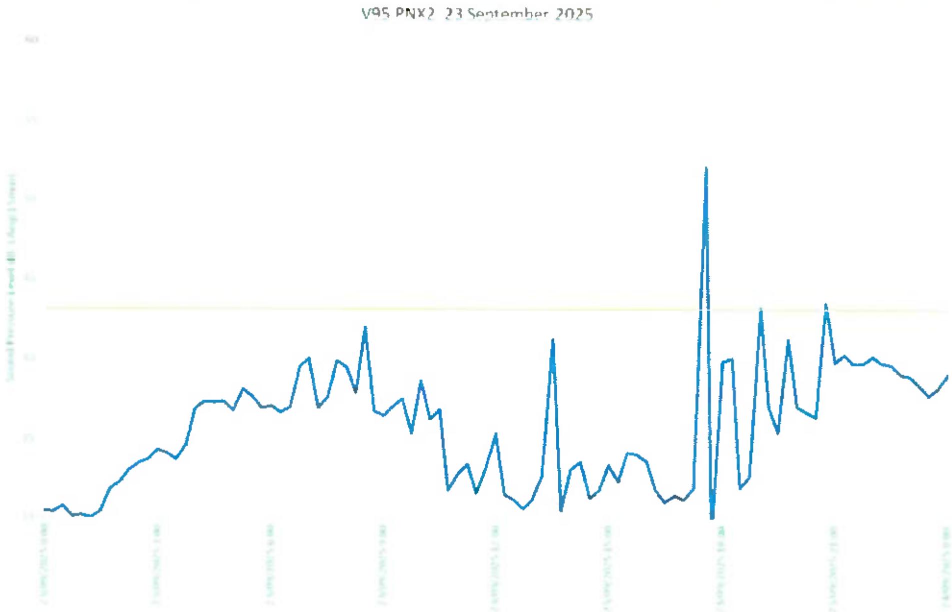
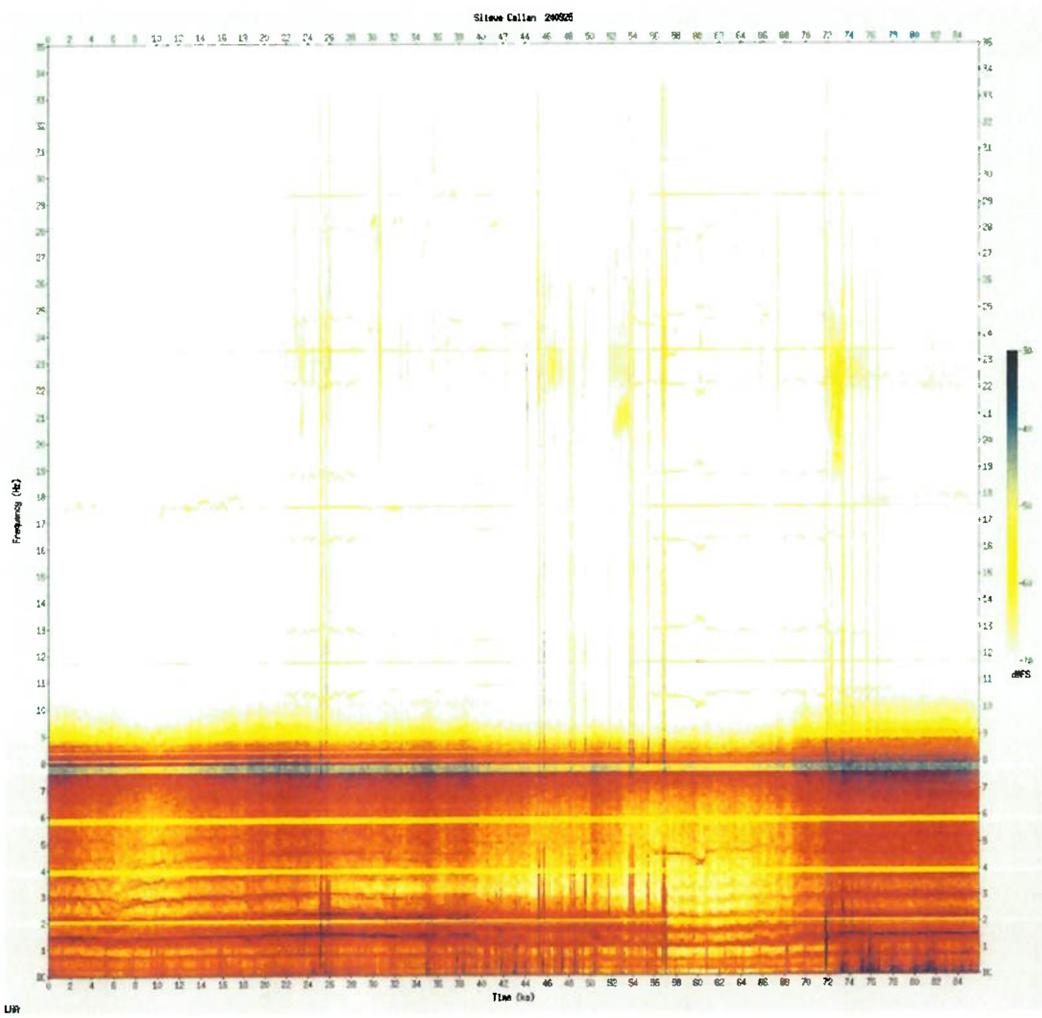

V95 PNX2 23 September 2025

Figure 15



V95 PNX2 24 September 2025

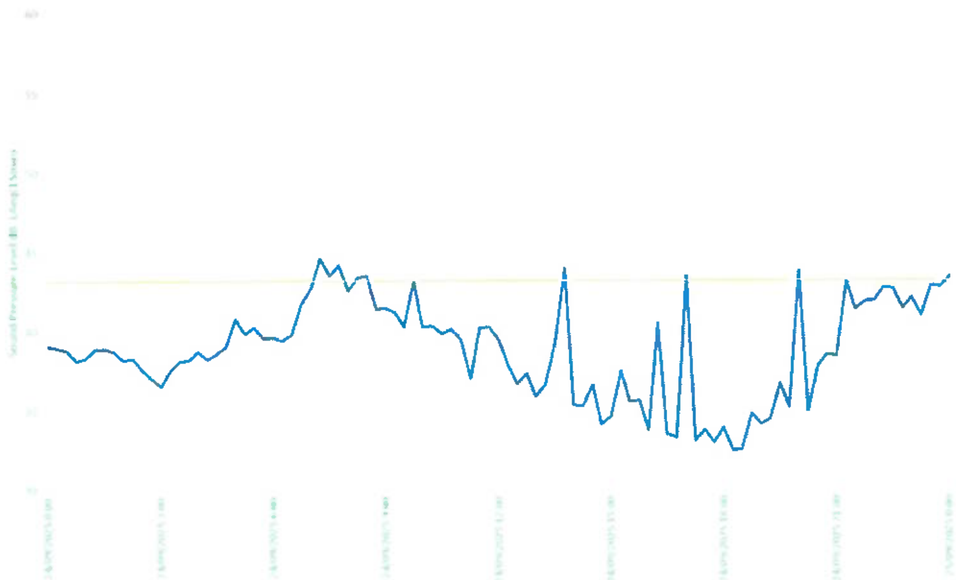
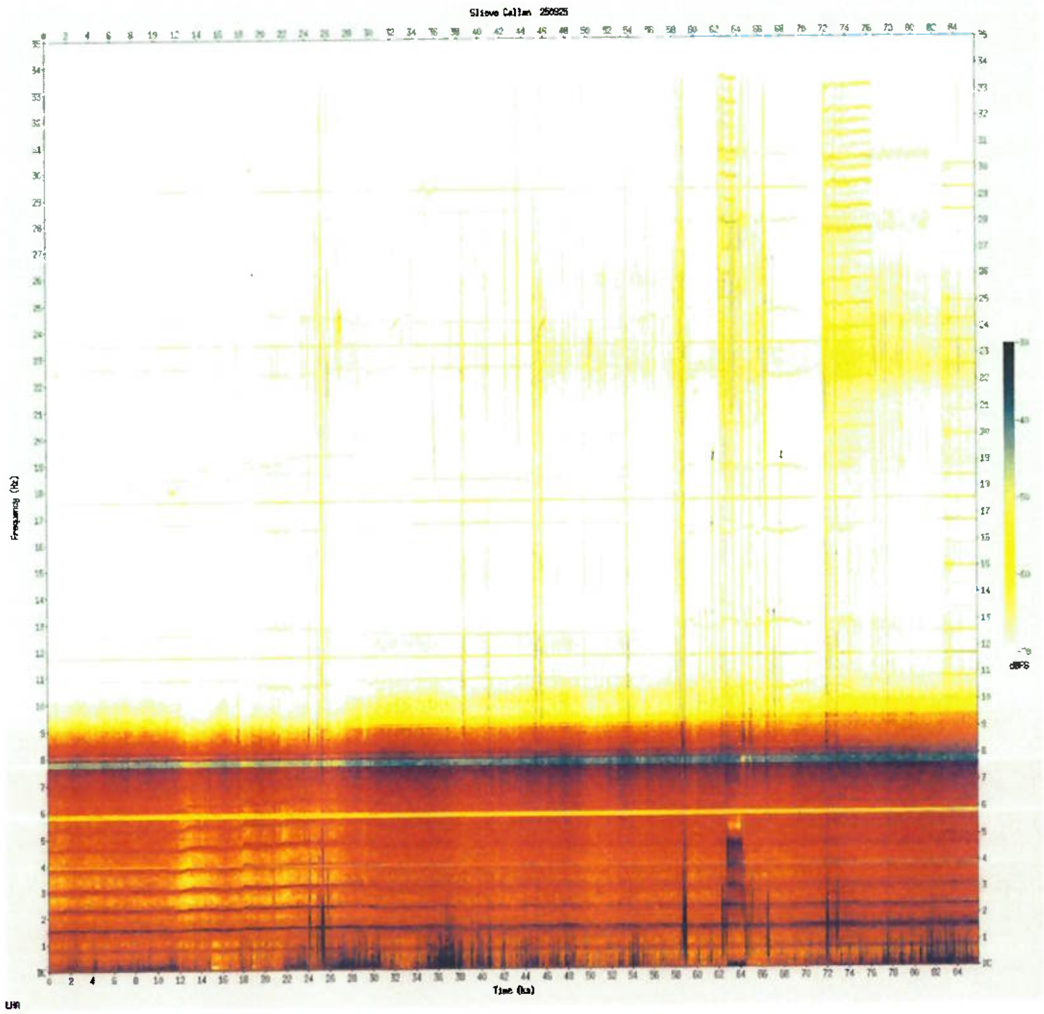


Figure 16



V95 PNX2 25 September 2025

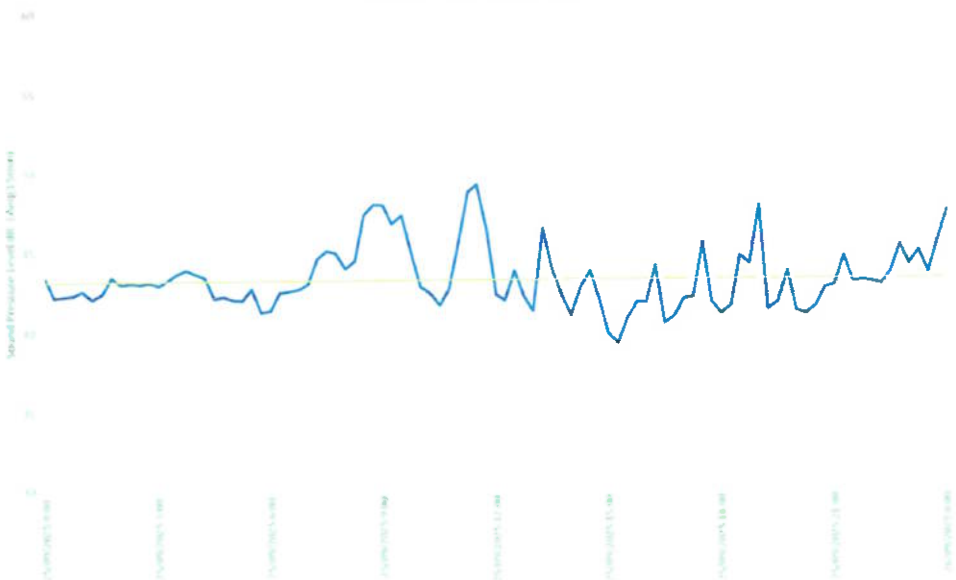


Figure 17

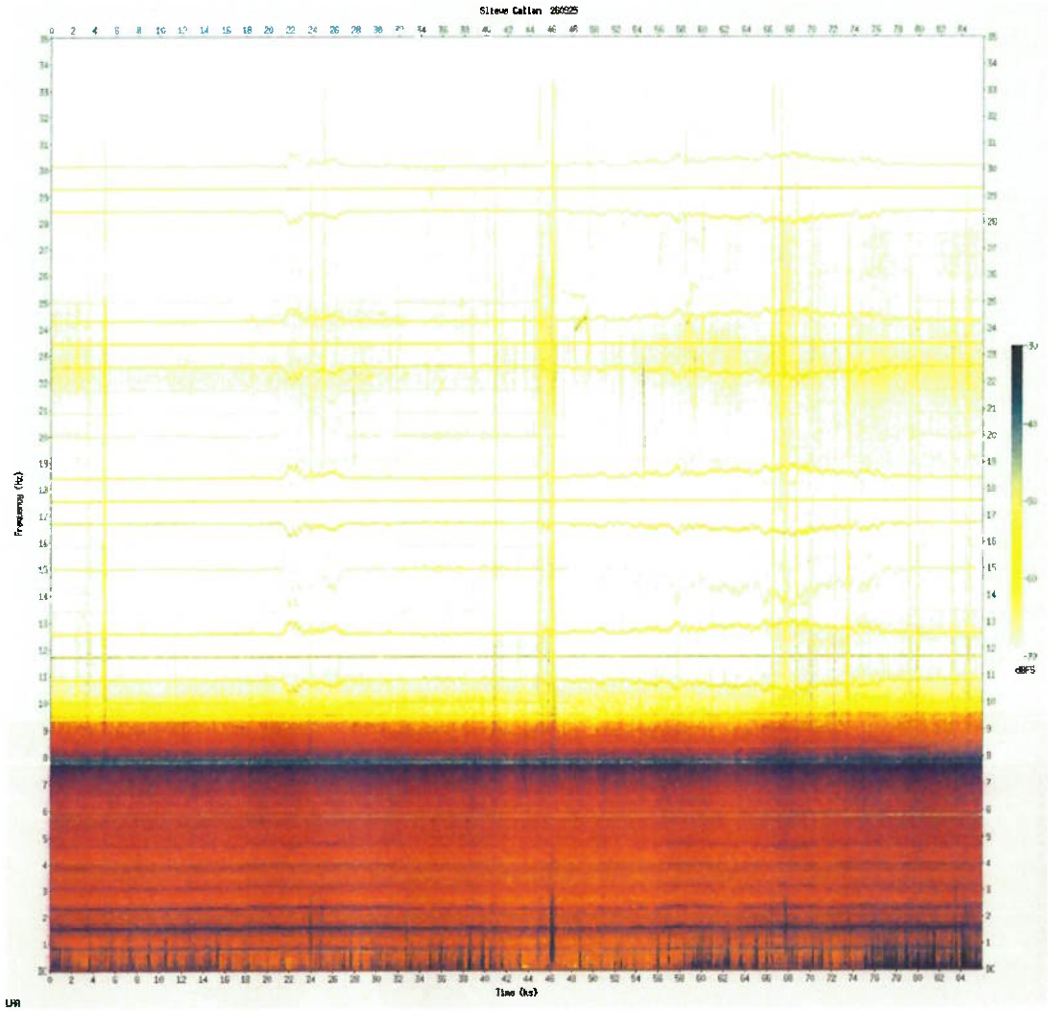
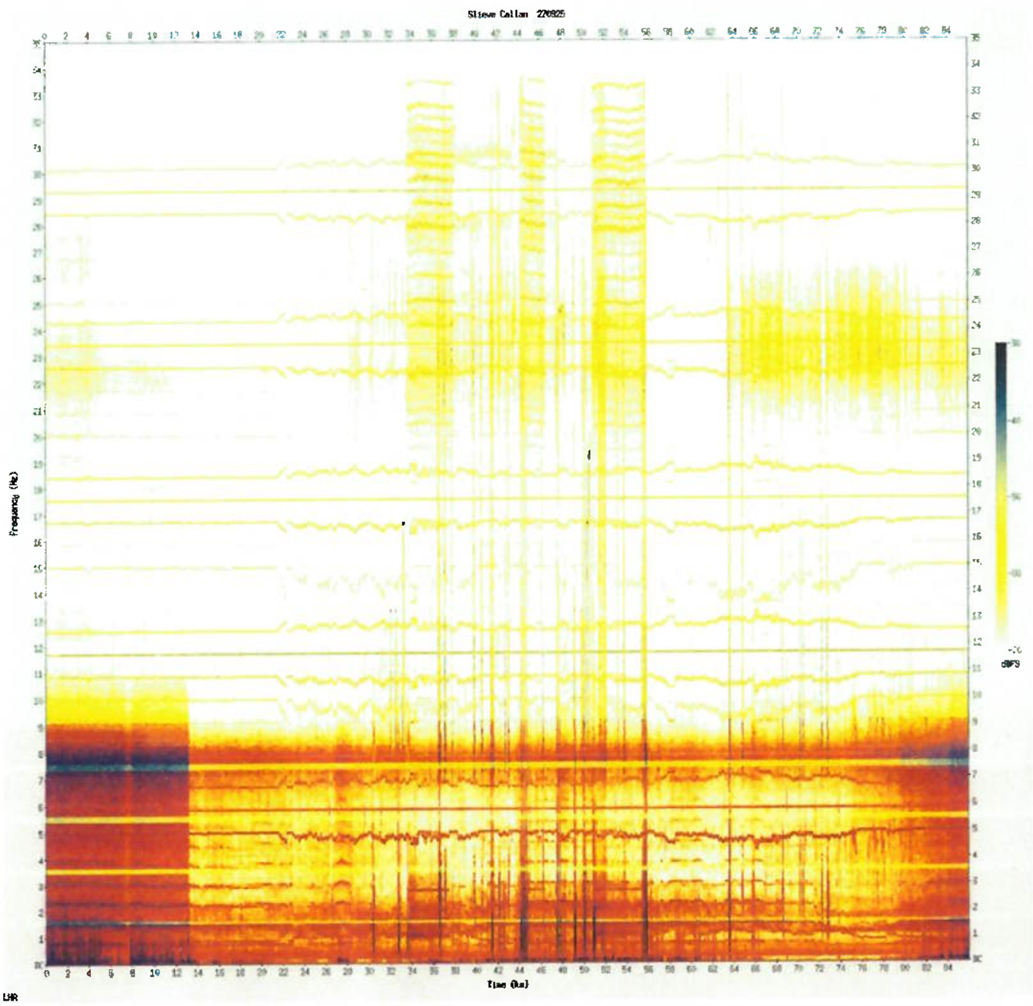


Figure 18


Slieve Callan 270925
Frequency (Hz)
Time (hs)
dBFS

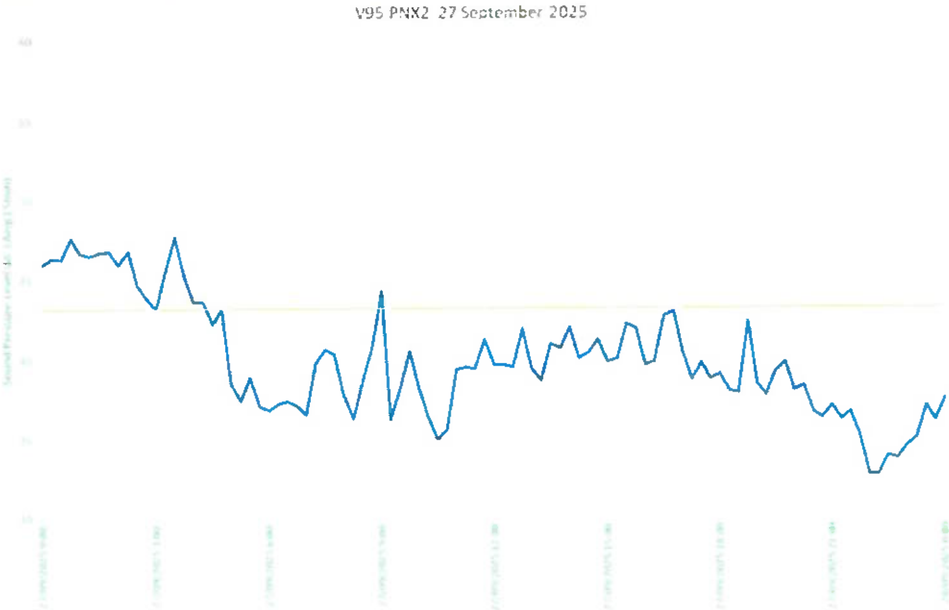
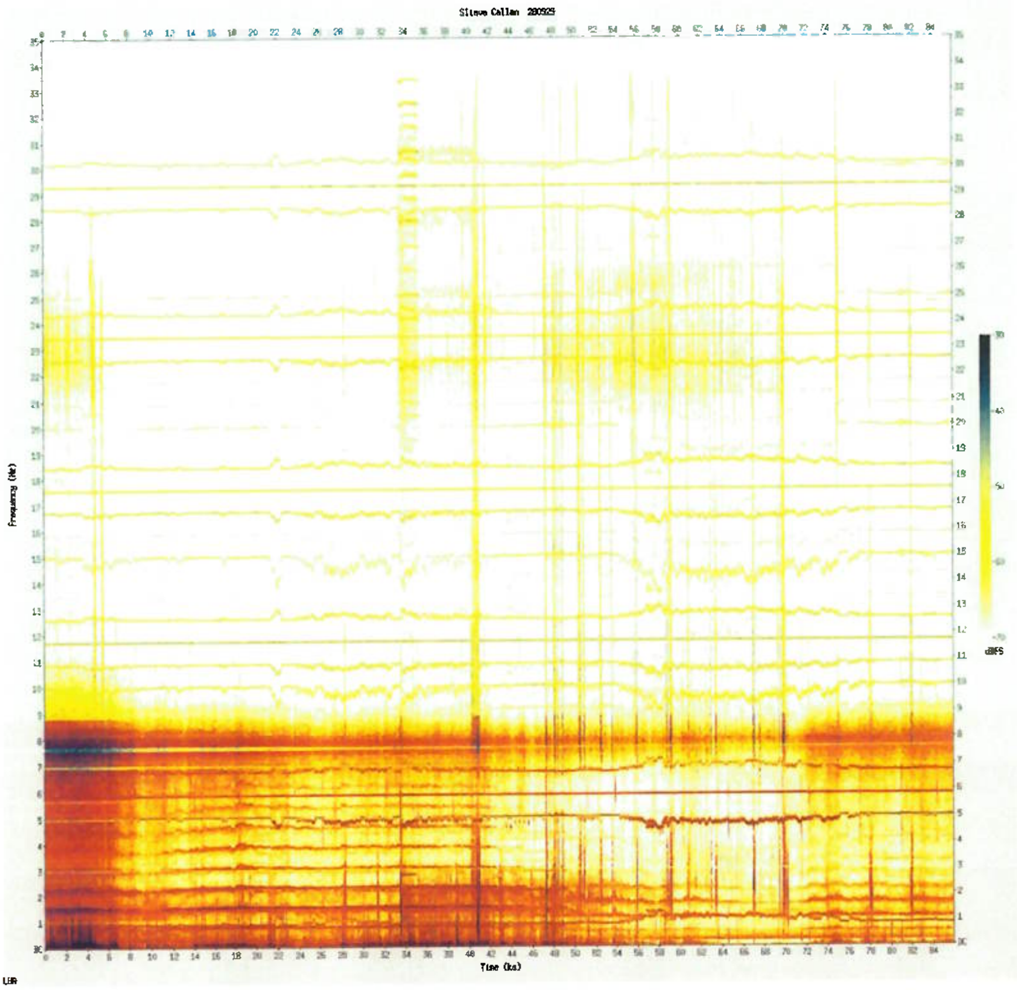

V95 PNX2 27 September 2025

Figure 19



V95 PNX2 28 September 2025

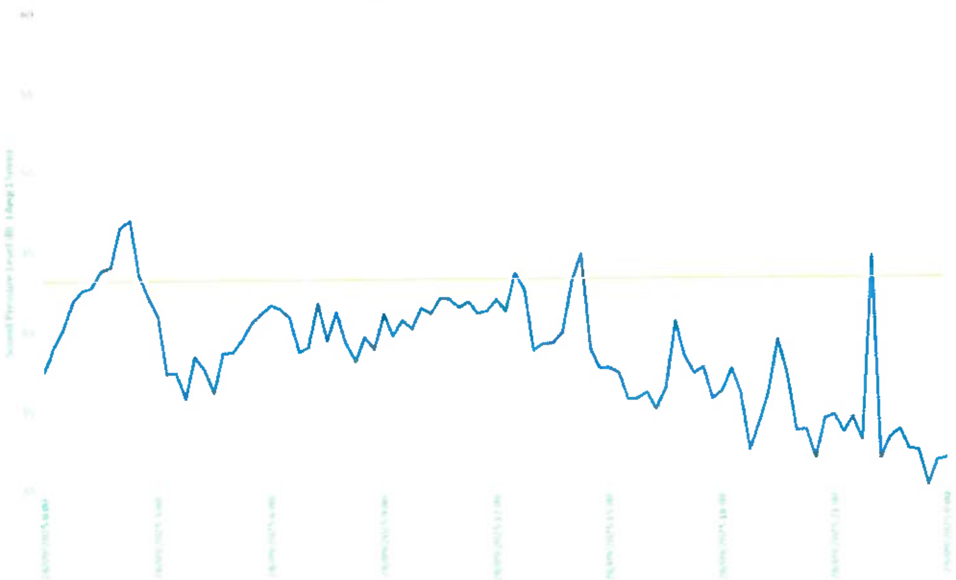
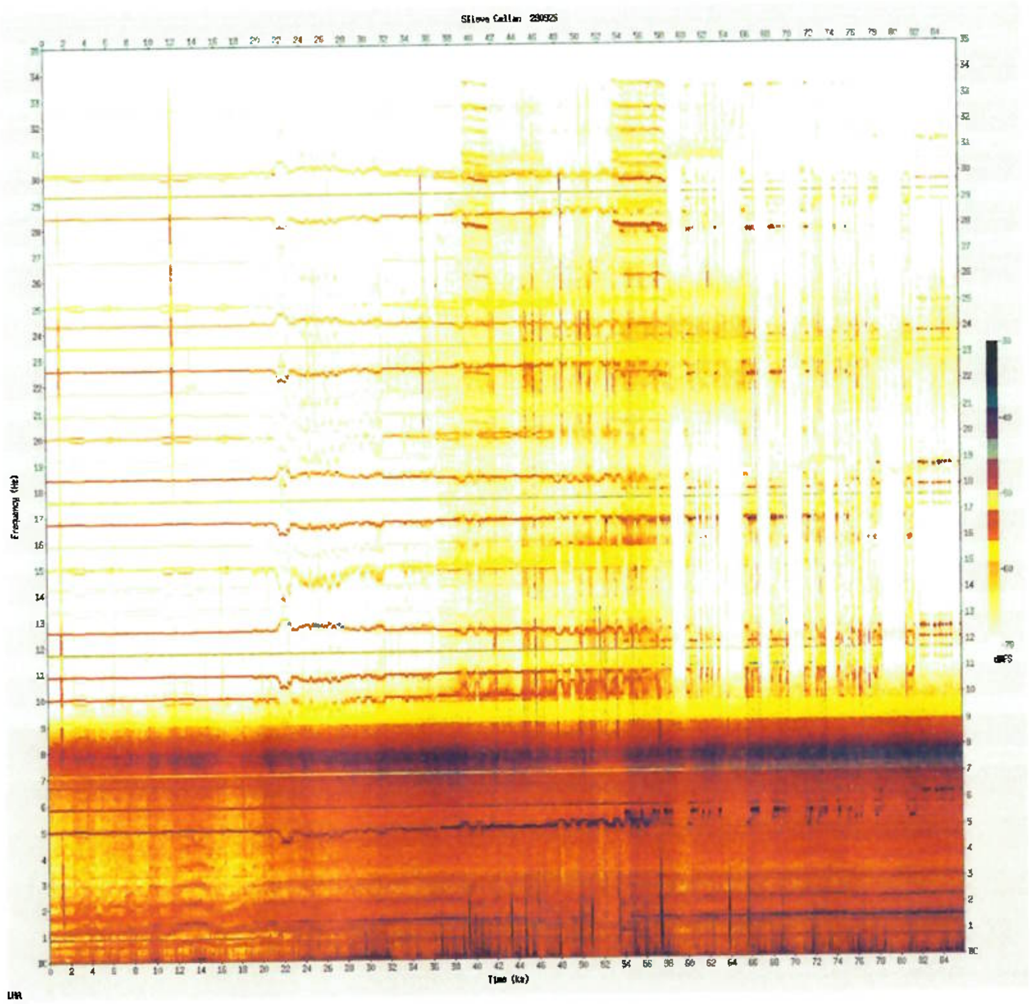


Figure 20



V95 PNX2 29 September 2025

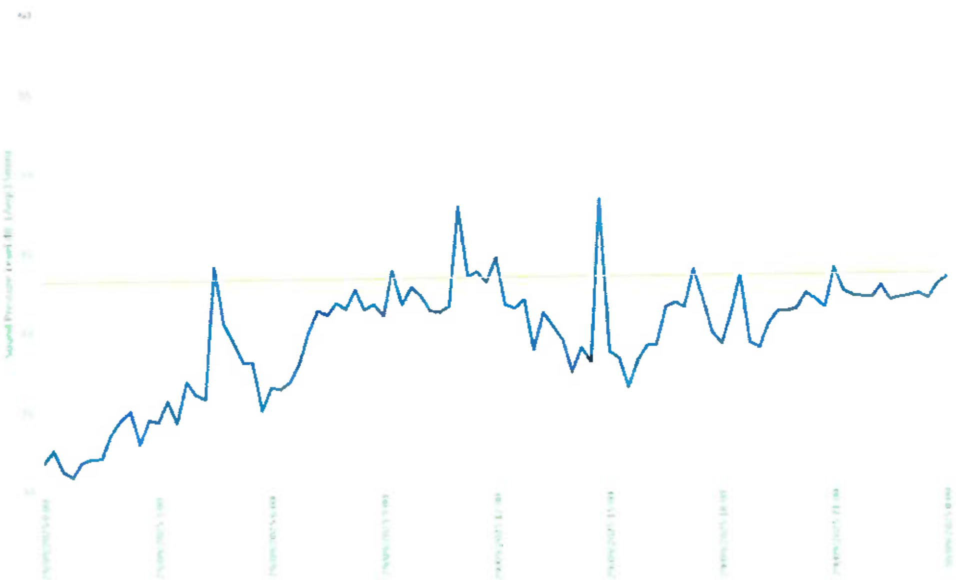
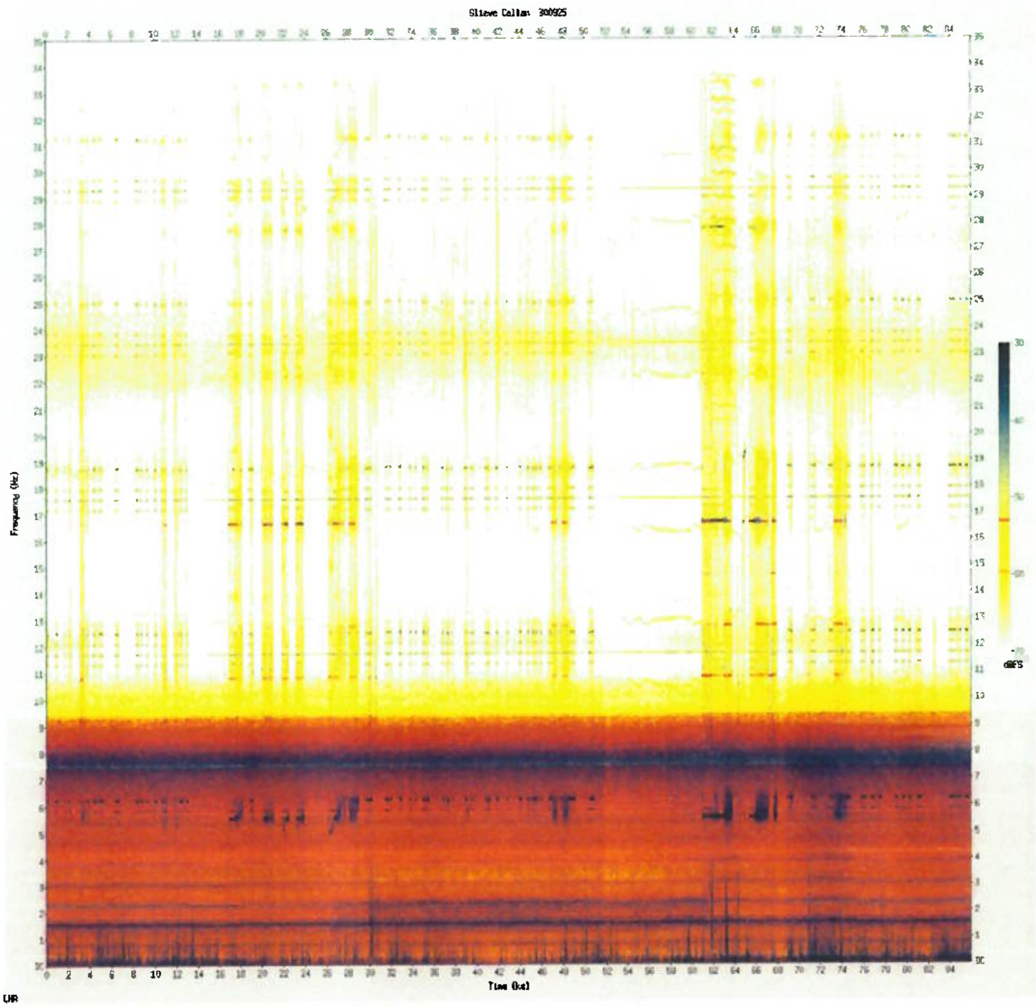


Figure 21



V95 PNX2 30 September 2025

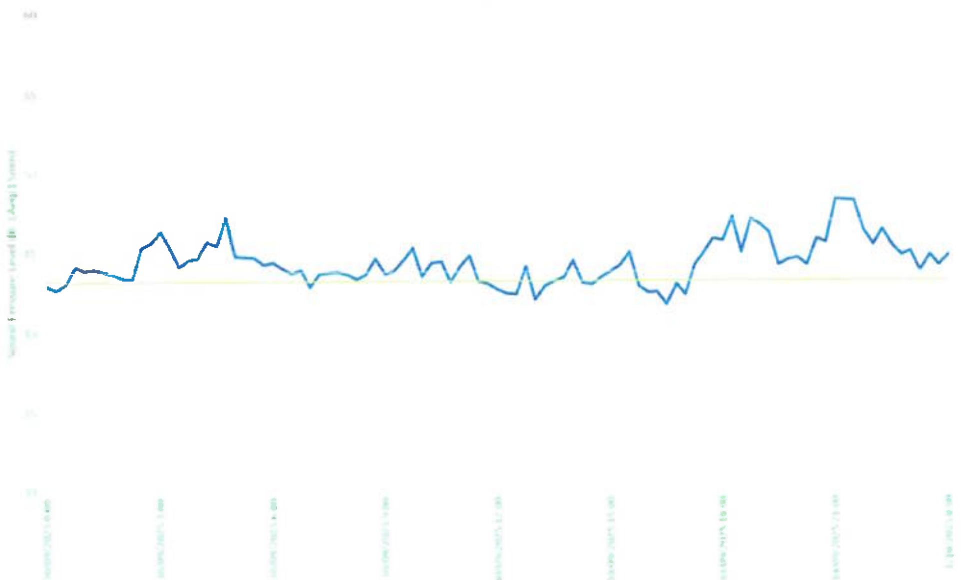
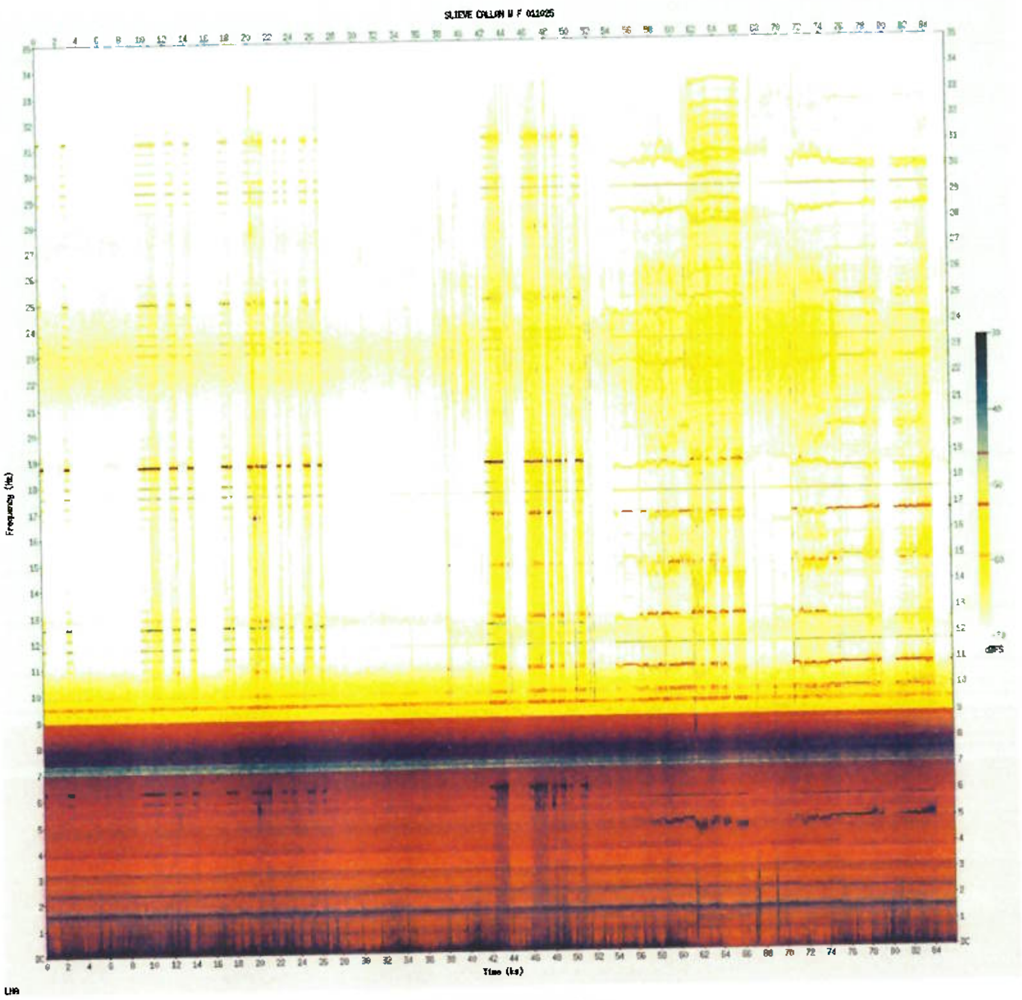


Figure 22



V95 PNX2 1 October 2025

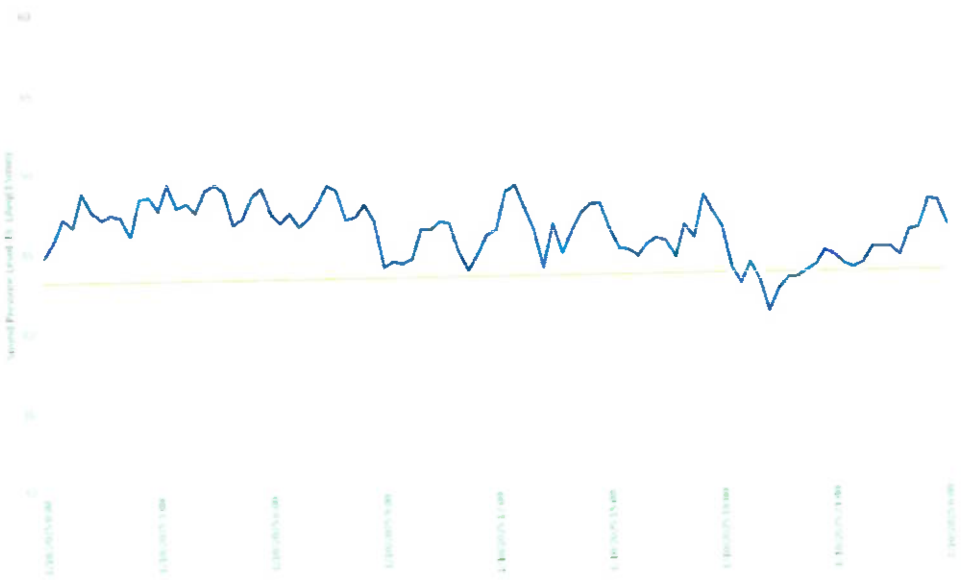
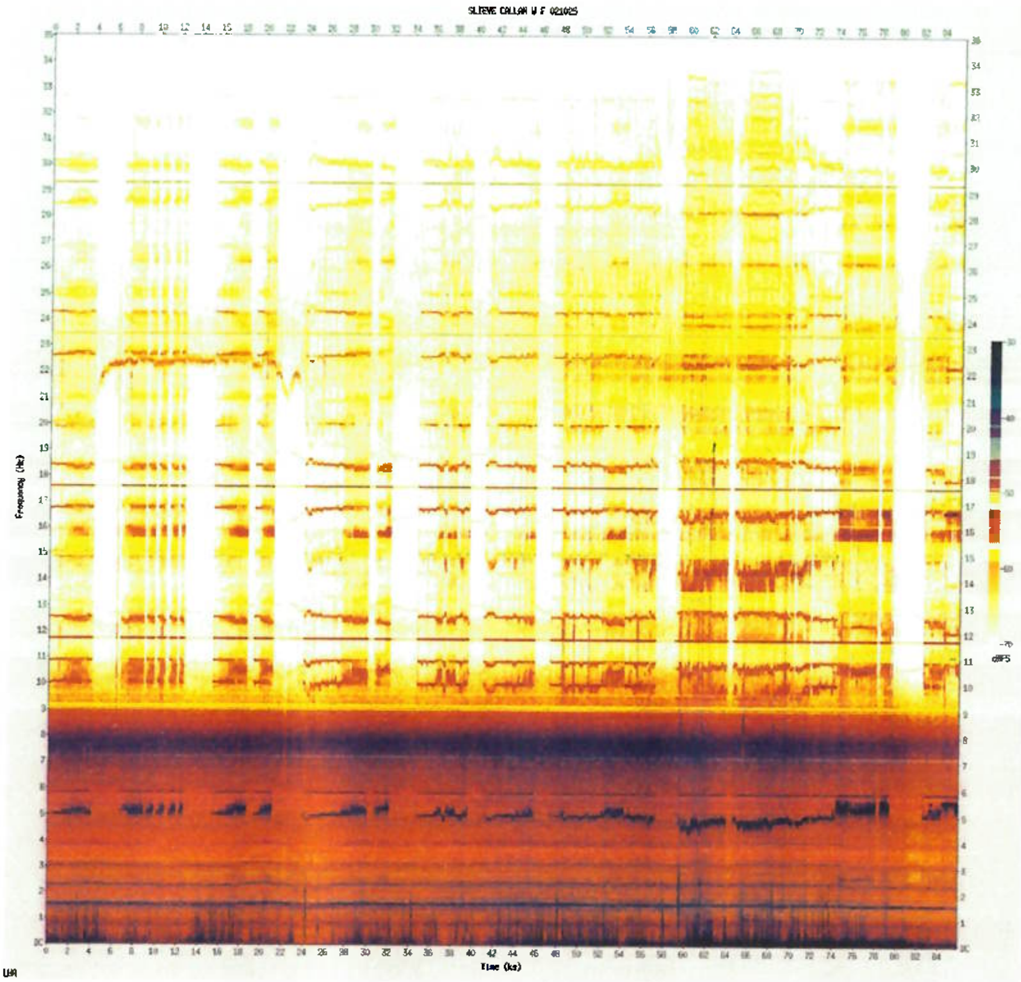


Figure 23


SLIEVE CALLAN U F 021025
Frequency (Hz)
Time (ks)
dBFS

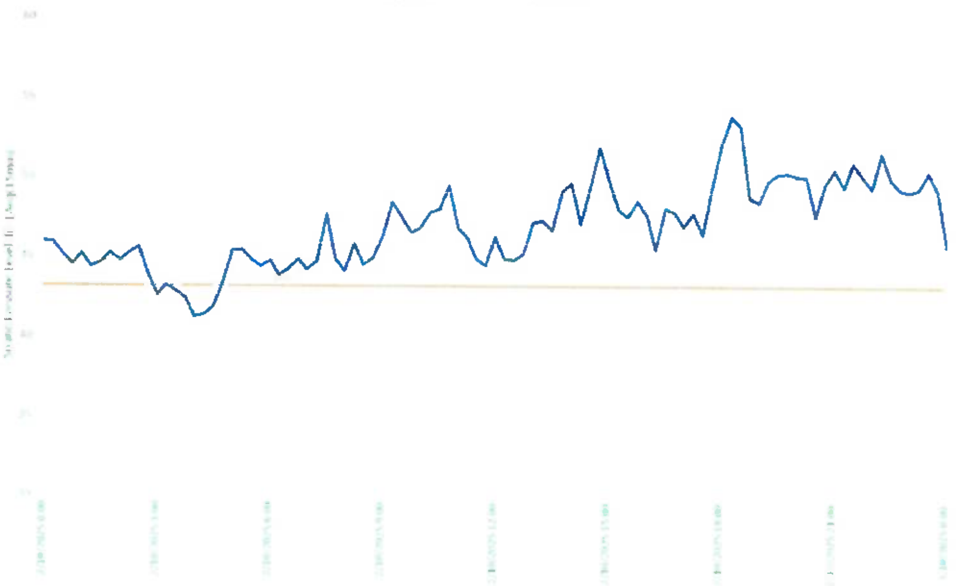
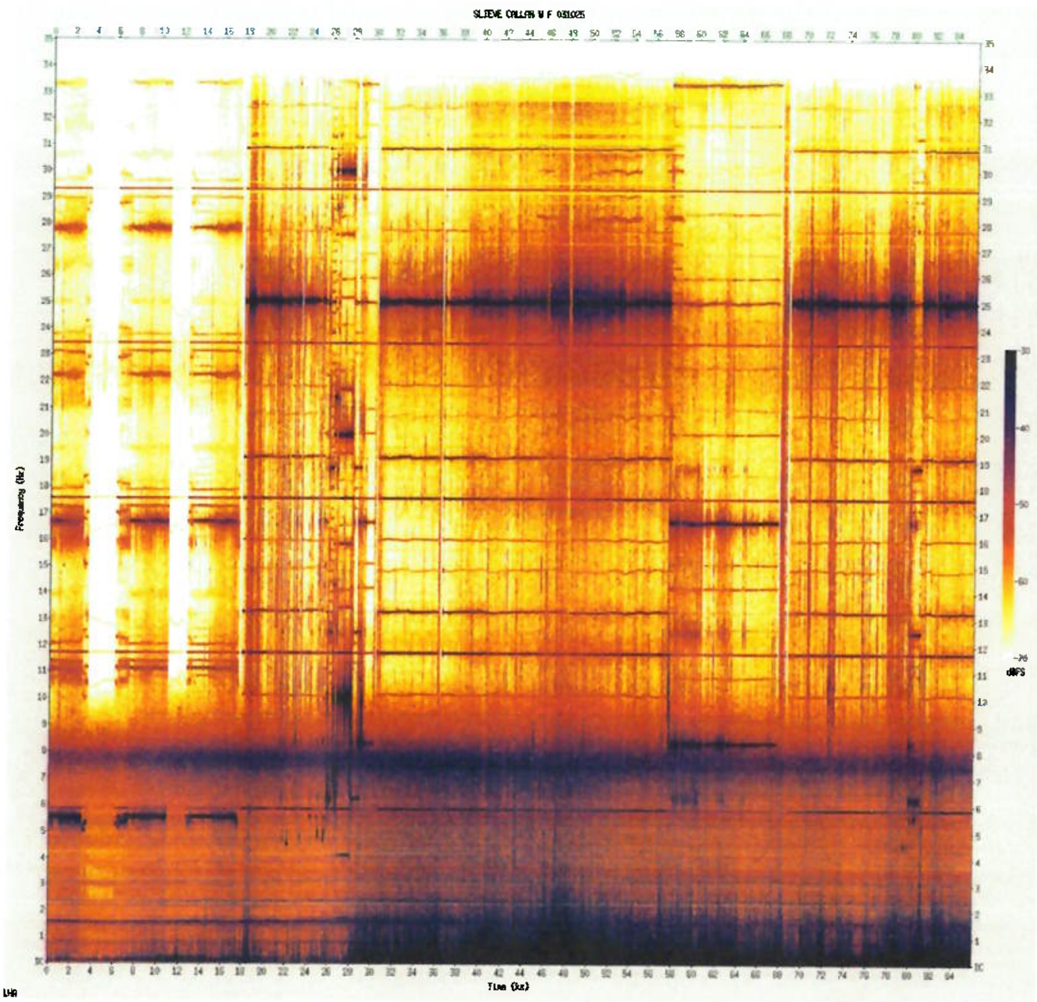

V95 PNX2 2 October 2025

Figure 24


SLIEVE CALLAN W F 031025
Frequency (Hz)
Time (hrs)
dBFS

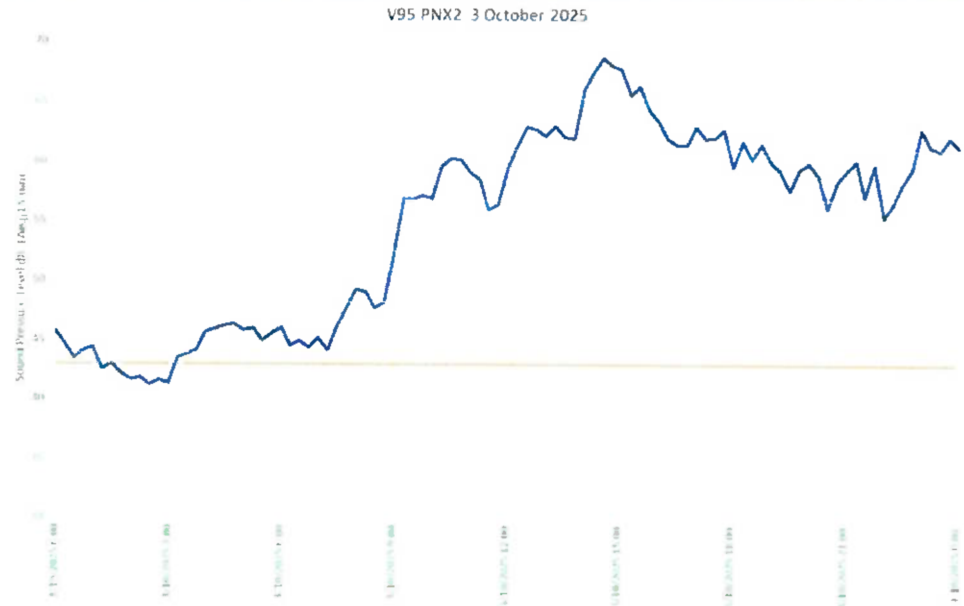
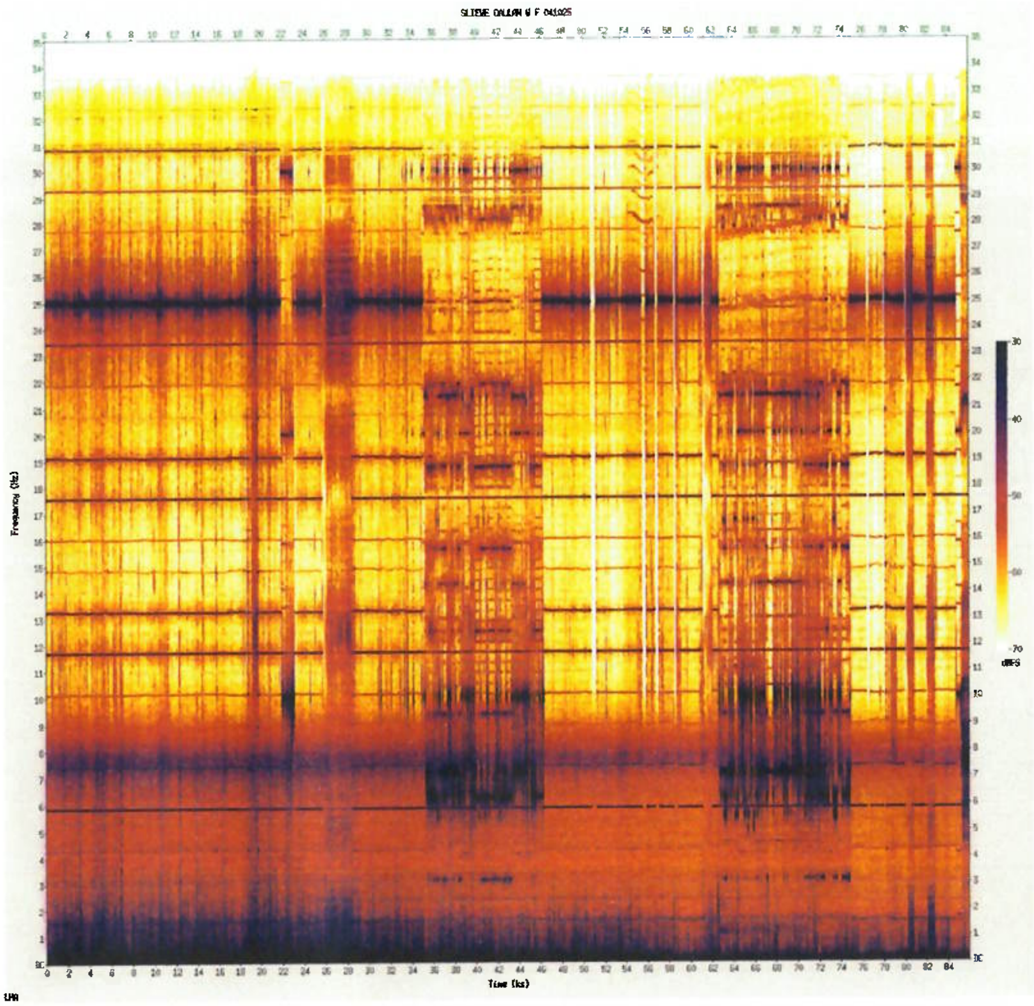

V95 PNX2 3 October 2025

Figure 25



V95 PNX2 4 October 2025

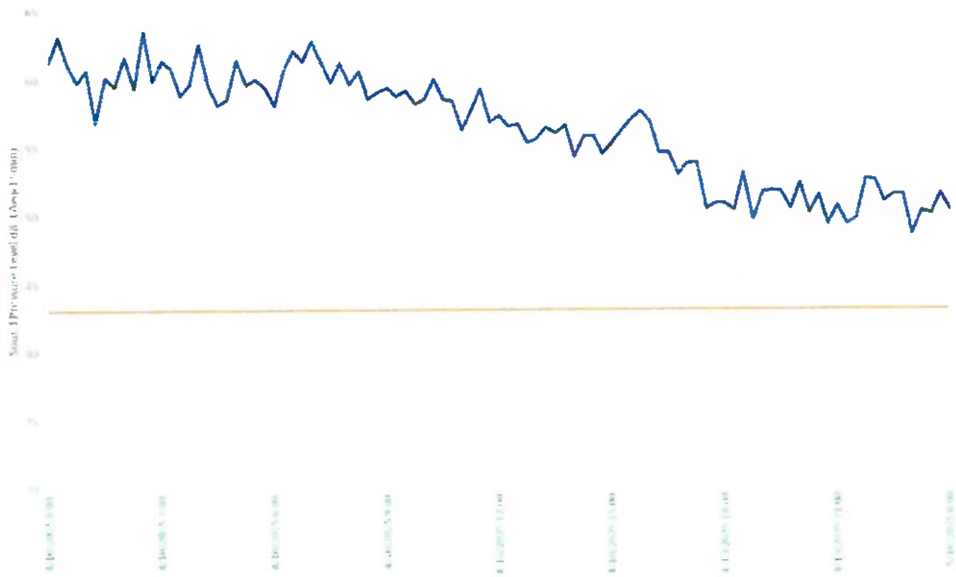


Figure 26

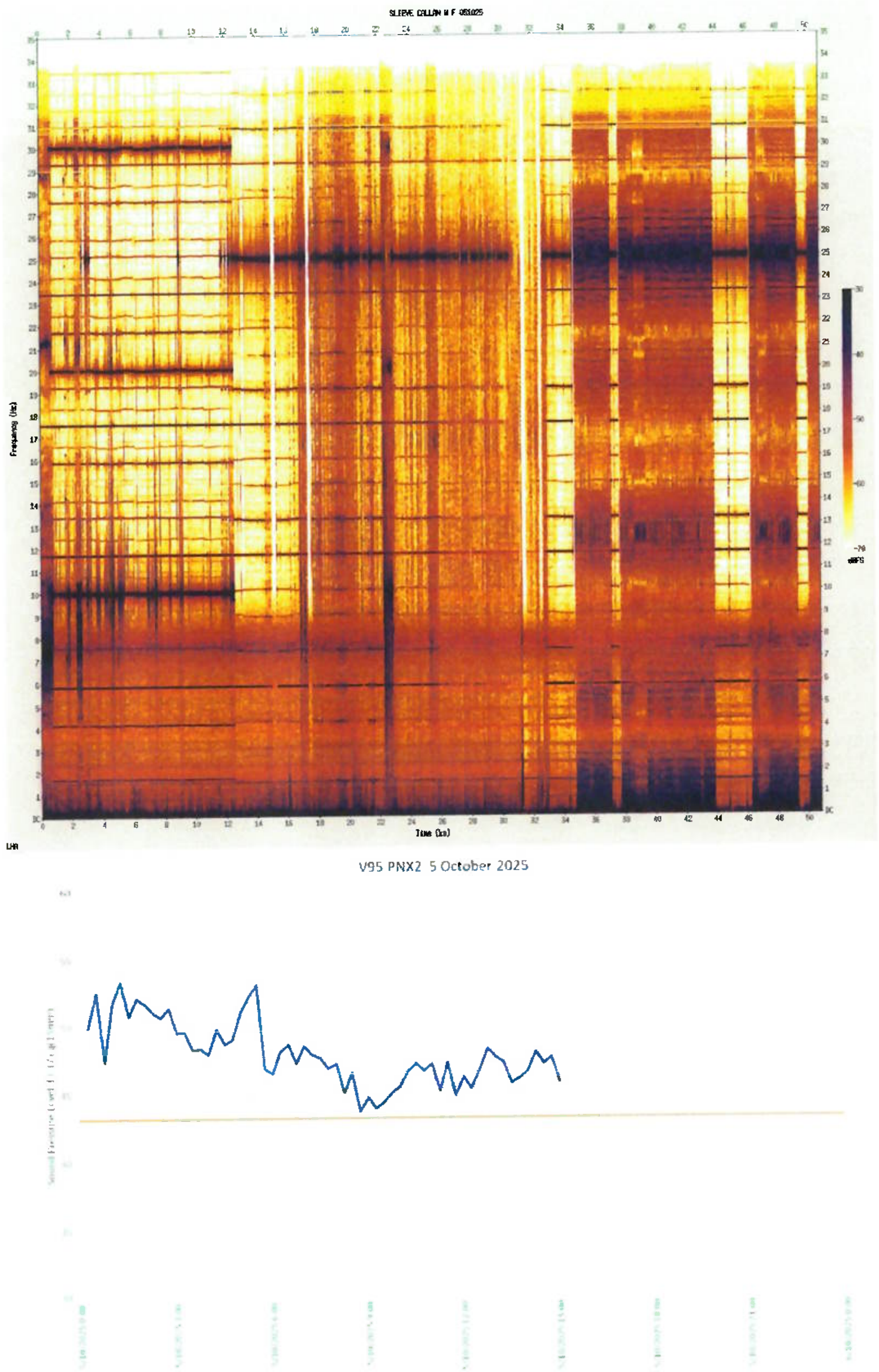


Figure 27

ANALYSIS OF SPECIAL AUDIBLE CHARACTERISTICS

The external logger (SVAN977D) was set to collect data in one-third octave bands for three weightings of A, C and Z, sampled at the rate of 100 ms. WAV files were also collected by the logger continuously at the rate of 12 kHz separated into 30-minute duration files. The ILFN logger recorded WAV files continuously at the rate of 500 Hz separated into 20-minute duration files. The data was also summarised into $L_{Aeq(15min)}$ samples, as required by the permit.

Detailed analyses excluded periods of rain.

Amplitude Modulation

'Normal' AM, expected to be an unobtrusive impost from a wind turbine operation, is when the peak to trough variation in A-weighted sound level does not exceed 3 dB.

For example, if the repetitive 'swish' sound from the rotating blades of a wind turbine reaches a maximum value of, say, 32 dB(A) in an ambient sound of 30 dB(A), when the 'swish' noise is not present (between each 'swish'), then the AM is 2 dB.

AM can also occur within a frequency range where, for example, a tone might change regularly in loudness.

The following analysis has checked each 10-second period throughout the period from 10 pm to 11 pm on 15 September 2025. An example is shown in Figure 28 representing the 53rd 10-second sample of de-trended A-weighted sound level measured after 10 pm on 15 September 2025.

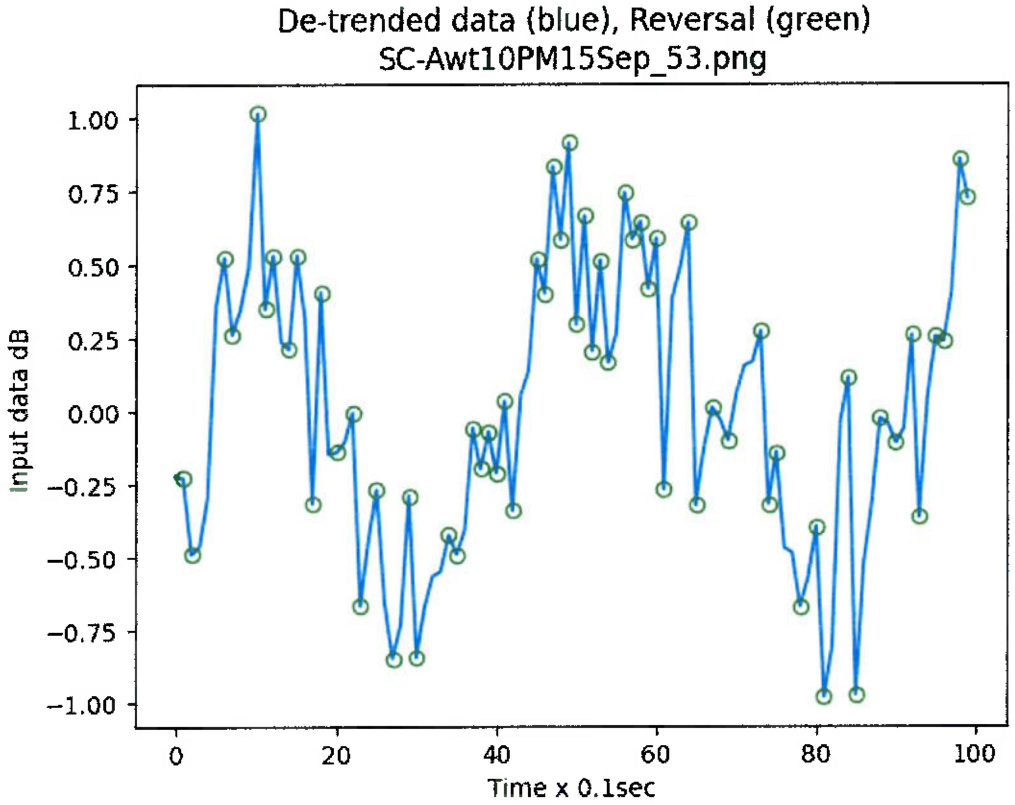


Figure 28

In the example of Figure 28 there are no AM values that exceed 3 dB.

An AM value is the level change between each successive reversal and the maximum AM value is shown in Figure 28 to be about 2 dB. A reversal denotes a peak or trough.

The recorded audio was listened to and it was noted that wind noise from tree foliage was masking A-weighted modulation, however, there was a distinct tone that varied in level.

Tonality and AM

Figure 29 shows a spectrogram that illustrates the audible tone which is centred around 165 Hz.

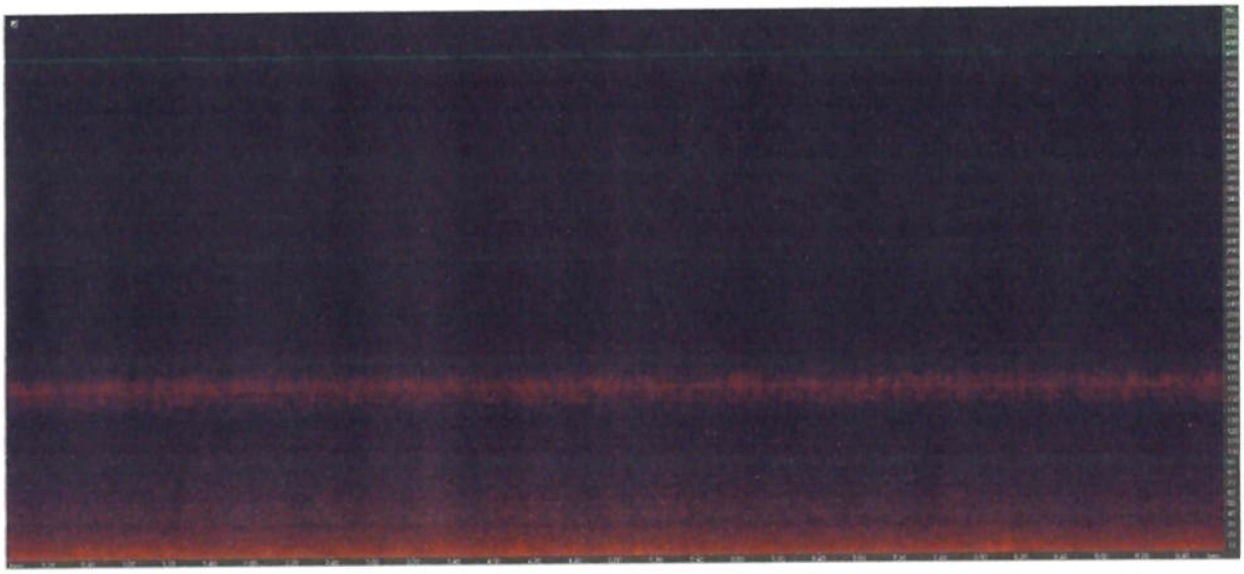


Figure 29

Figure 30 shows an example 10-second sample of the variation in sound level of the 160 Hz 1/3 octave band.

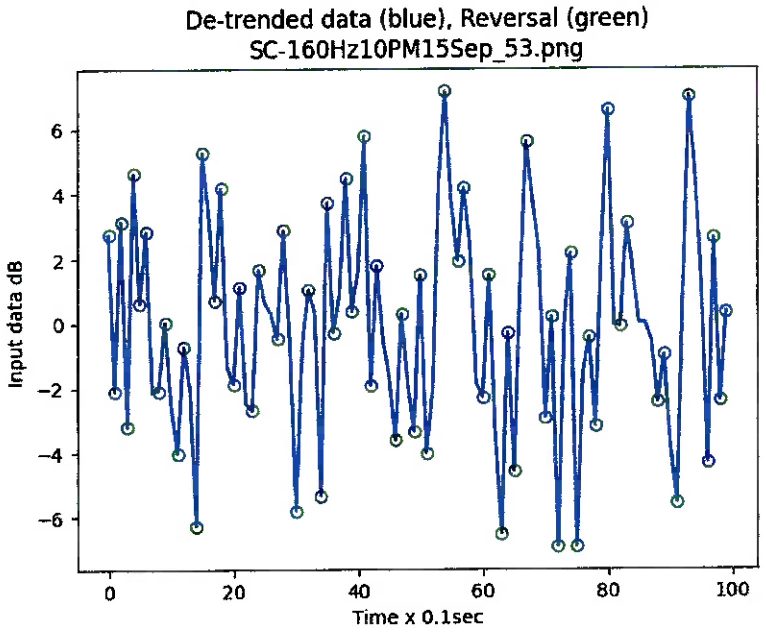


Figure 30

AM of the 160Hz 1/3 octave band regularly exceeds 10 dB peak to trough.

An analysis of the 165Hz tone was completed in accordance with ISO/PAS 20065 that is referenced in ISO 1996.

An average delta L (tonal audibility) of 8.7 dB was calculated for the 165 Hz tone that warrants a tonal adjustment of 4 dB. However, the tone also exhibits strong AM that would suggest an additional adjustment.

The blade pass frequency (BPF) for the Nordex wind turbine when operating at full power is approximately 0.8 Hz. The combined blade pass frequency for two Nordex wind turbines depends on whether the rotations synchronise. If synchronised then the BPF remains at 0.8 Hz. If out of phase (fully asynchronous) then the BPF becomes 1.6 Hz. Observable BPF depends on the number of wind turbines in proximity to the measurement location.

The maximum number of times that AM, caused by the swish sound from many wind turbines, occurs depends on the relative synchronisation.

Figure 29 shows the number of times that A-weighted AM, caused by the swish sound from many wind turbines in the morning (2.40 am to 3 am) of 23 September 2025, exceed 3 dB when measurements were less influenced by extraneous noise.

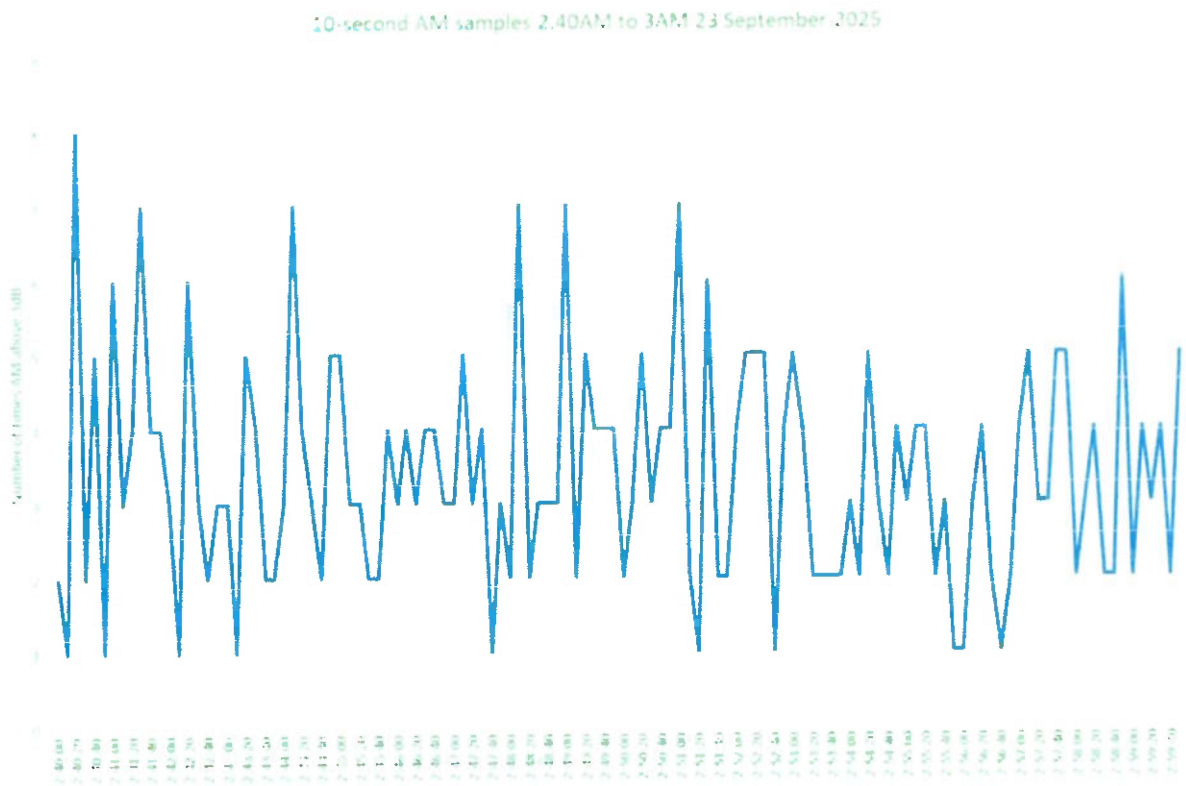


Figure 29

The number of times that an AM value has exceeded 3 dB does not indicate the level of those exceedances. For example; occasions of a 'whump' or 'thump' type sound common to wind turbines that present as intermittent high levels of AM cannot be gleaned from Figure 29 but the regularity of AM values higher than 3 dB is evident.

Figure 30 shows an example 10-second A-weighted AM sample where there are AM values greater than 6 dB that warrant the application of a penalty.

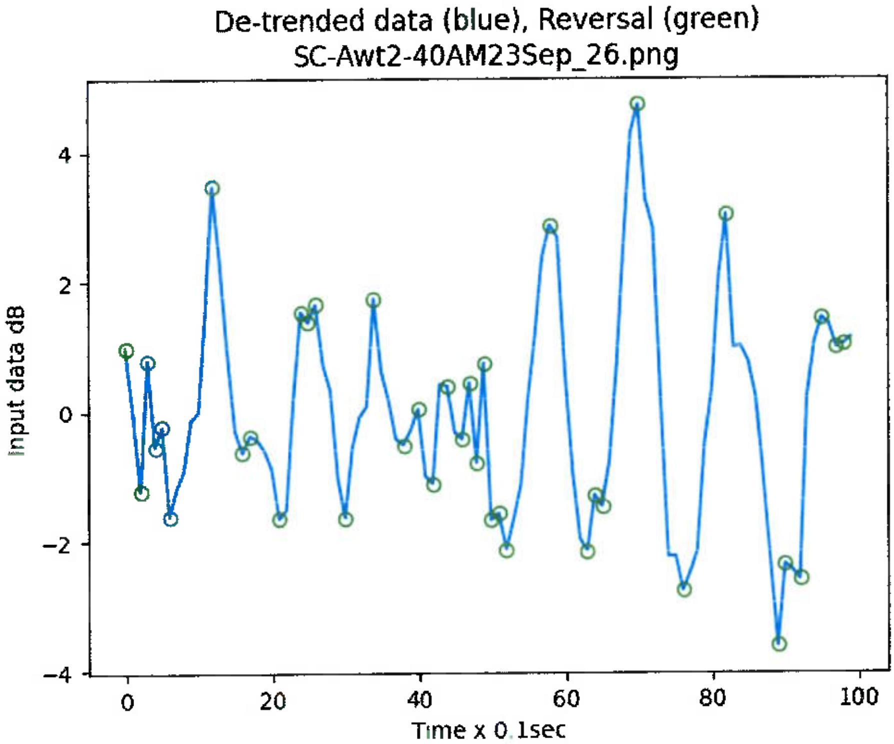


Figure 30

Impulsiveness

The rate of change of sound level associated with each peak classifies most AM events as having an impulsive character (sound level increase faster than 10 dB/second).

Impulsiveness warrants an additional penalty to measured LAeq sound levels.

Low Frequency Noise

Assessment of the adverse impacts of low frequency noise (LFN, typically 10-200 Hz, including infrasound below 20 Hz) vary internationally but generally focus on annoyance, sleep disturbance, and other health effects rather than just hearing damage. Traditional A-weighted measurements undervalue low frequencies.

Common methods include spectral analysis, weighting networks, and national or regional criteria curves, often applied indoors where complaints occur. These vary by country but share elements like third-octave band measurements and thresholds based on audibility or acceptability.

One common quick assessment method is to check if there is an unbalanced spectrum. This is where there is a high proportion of low frequency sound and this can be checked by comparing L_{Aeq} sound levels with the L_{Ceq} sound levels measured during the same period.

A difference of $L_{Ceq,10min}$ minus $L_{Aeq,10min}$ greater than 15 dB indicates significant LFN presence and Figure 31 presents the differences obtained during the survey period.

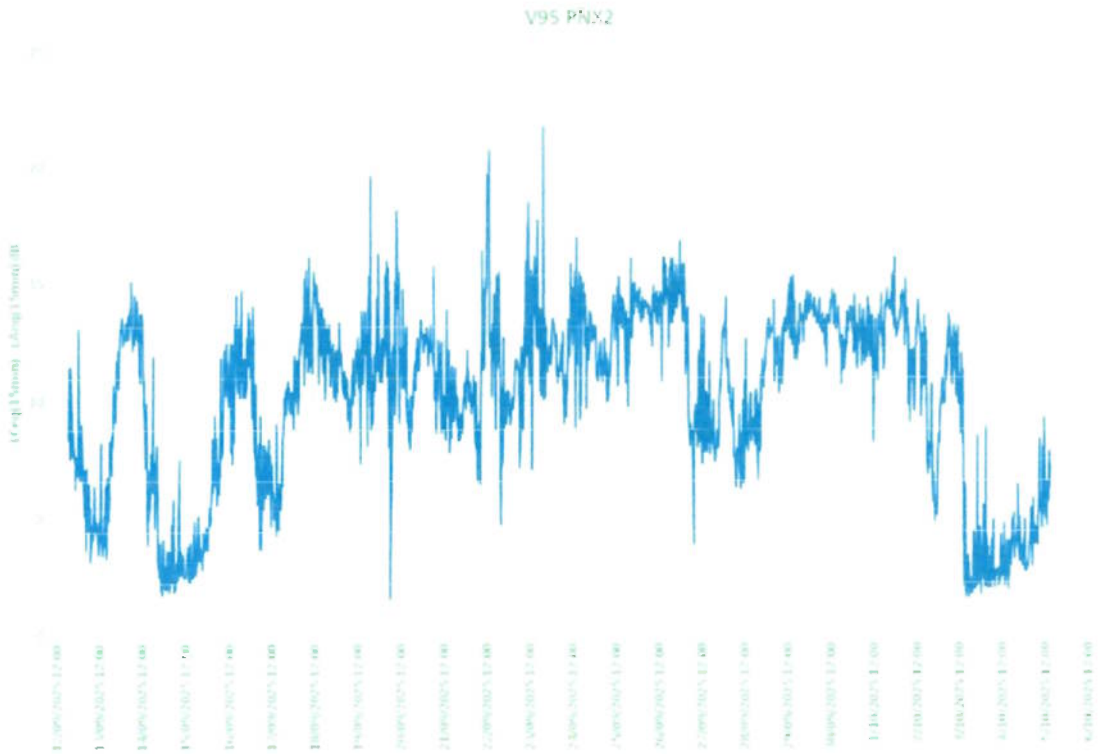


Figure 31

The difference between L_{Ceq} and L_{Aeq} can be influenced by extraneous noise from wind in trees that may indicate a false negative (indicating no LFN when there is strong LFN).

For example, although there is a high level of LFN in the 160 Hz 1/3 octave band the difference between L_{Ceq} and L_{Aeq} is well below 15 dB in the evening of 15 September 2025.

In cases such as this it is common to measure sound pressure levels in bands (e.g., 10-160 Hz) and compare values obtained to reference curves.

Exceedance of reference curves signal potential adverse impact, with additional penalties for tones (+5 dB) or fluctuations (AM). These methods are used in standards like DIN 45680 (Germany), which sets night-time limits (e.g., 95 dB at 10 Hz, 33 dB at 100 Hz) averaged over the loudest hour.

The UK use the DEFRA Procedure (NANR45) comparing against an indoor 1/3 octave curve (10-160 Hz, e.g., 92 dB at 10 Hz, 43 dB at 50 Hz, 34 dB at 160 Hz).

Downey and Parnell (Assessing low frequency noise from industry – a practical approach, ICBEN 2017) suggest a correction for outdoor to indoor attenuation so that DEFRA NANR45 can be applied to outdoor measurements. This method is used by the EPA in Victoria, Australia.

The outdoor threshold limit in the 160 Hz third-octave band using DEFRA NANR45, for which LFN indicates problematic disturbance, is 44 dB.

Figure 32 shows that the 160 Hz third-octave regularly exceeded 44 dB (red line) in the evening of 15 September 2025 and this indicates that low frequency annoyance is to be expected.

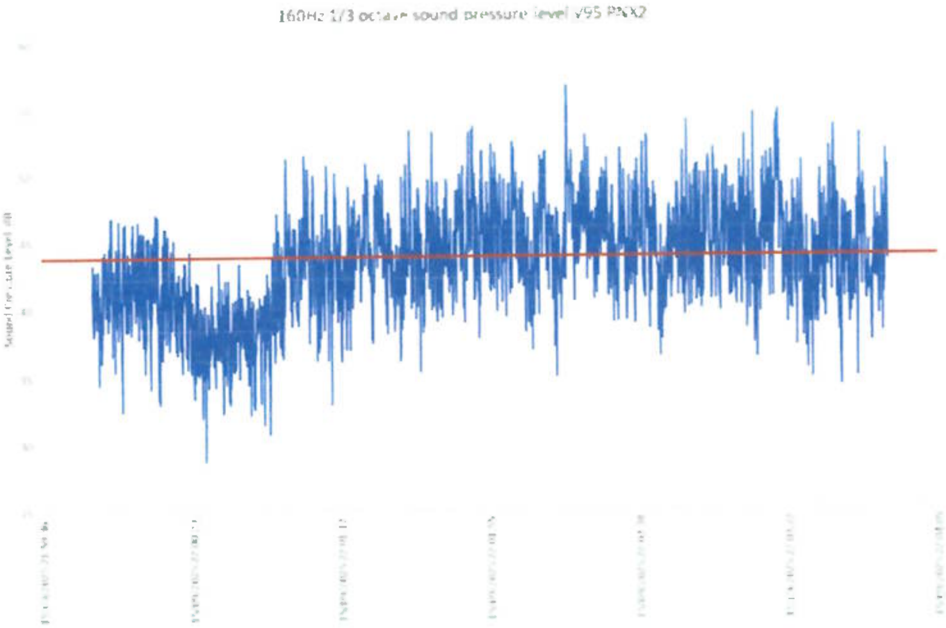


Figure 32

SUMMARY

The permitted rating sound level of 43 dB, $L_{Aeq(15min)}$ was exceeded on multiple occasions during the survey period.

When focussing on the night time period to reduce extraneous noise there is evidence of excessive amplitude modulation and low frequency noise that, using multiple assessment methodologies, indicates that annoyance will be caused.

Individual AM events have an impulsive characteristic that according to ISO1996 would warrant a penalty to the measured sound levels prior to assessing compliance with the specified rating limit (43 dB, $L_{Aeq(15min)}$).

A significant low frequency characteristic was found in the 160 Hz third-octave band that often shows amplitude modulation higher than 10 dB at levels that are clearly audible.

Furthermore, a tonal penalty of 4 dB applies to this 165 Hz tone within the 160 Hz 1/3 octave band when assessed using ISO 1996.

Overall, a minimum cumulative penalty of 6 dB should apply for the different audible characteristics that effectively means the permitted noise limit becomes 37 dB, $L_{Aeq(15min)}$.

However, if each penalty was to apply cumulatively the total penalty could exceed 12 dB which would change the permitted noise limit to 32 dBA.

Notwithstanding the non-compliance with authorised sound levels in the permit, it has been found that measured LFN sound levels are unacceptable and liable to cause annoyance.