First International Symposium on Adverse Health Effects from Wind Turbines
The Global Wind Industry and Adverse Health Effects: Loss of Social Justice?
Picton, Prince Edward County, Ontario, Canada
October 29-31, 2010

Session I

No Rules, No Caution, No Accountability

Abstract and bio on slide 2 is reproduced from the Symposium Program

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John Harrison, Ph.D.
IT'S PURE PHYSICS

Abstract: The setback of wind turbines from homes and other sensitive receptors is determined by national and local regulations. These regulations specify a maximum noise level at the receptor and make use of sound propagation models. The models account for spherical spreading of the sound generated by the turbine, refraction of sound by wind speed and temperature gradients, absorption of sound energy by the atmosphere and the ground, and reflection of sound by the ground. In practice, the resulting setbacks result in considerable annoyance, sleep deprivation and consequent health problems for a significant proportion of people living among the turbines. The talk will review deficiencies in the regulations and limitations in the modelling.

Bio: Dr. Harrison has conducted research, taught physics and engineering physics courses and participated on many national and international committees. He has made presentations regarding wind turbine noise to community groups, the International World Wind Energy Conference (2008) and the annual conference of the Canadian Acoustics Association (2009). He is a member of the Ministry of the Environment Stakeholder Focus Group on Wind Turbine Noise.

WIND TURBINE NOISE

John Harrison – Queen's University

SOUND

The ear and brain detect: pressure waves.
loudness and pitch of sound.

Engineers use dBA scale to describe sound as perceived.

Background at night in a rural area:	25 dBA
Recommended bedroom level:	25 dBA
Living room:	40 – 45 dBA
A busy office:	60 – 65 dBA
Heavy street traffic:	90 dBA

An increase of 3 dBA is noticeable.
An increase of 10 dBA is perceived as a doubling.

REGULATION

Noise limits: intended to protect our environment and health.

Vary from 35 dBA (Germany and NZ) to 50 dBA

Significance:

25 dBA	Background		
28 dB	1.25x as loud	25% louder	Detectable
35 dB	2x as loud	100% louder	Germany and NZ
40 dBA	3x as loud	200% louder	Ontario
50 dBA	5x as loud.		

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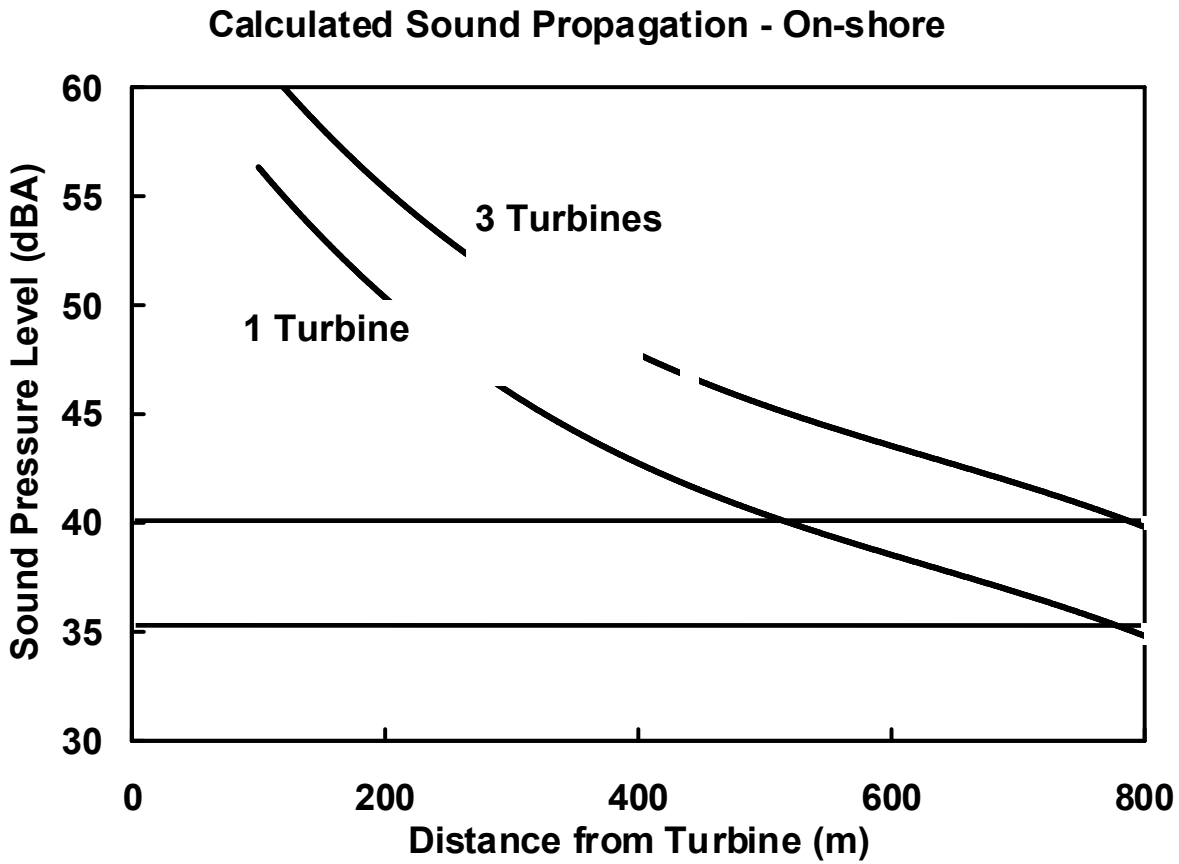
What do these limits mean?

On-Shore: Consider a typical 2 MW turbine. Sound spreads and is absorbed by air and ground cover.



Calculation shows 40 dBA at 500 m

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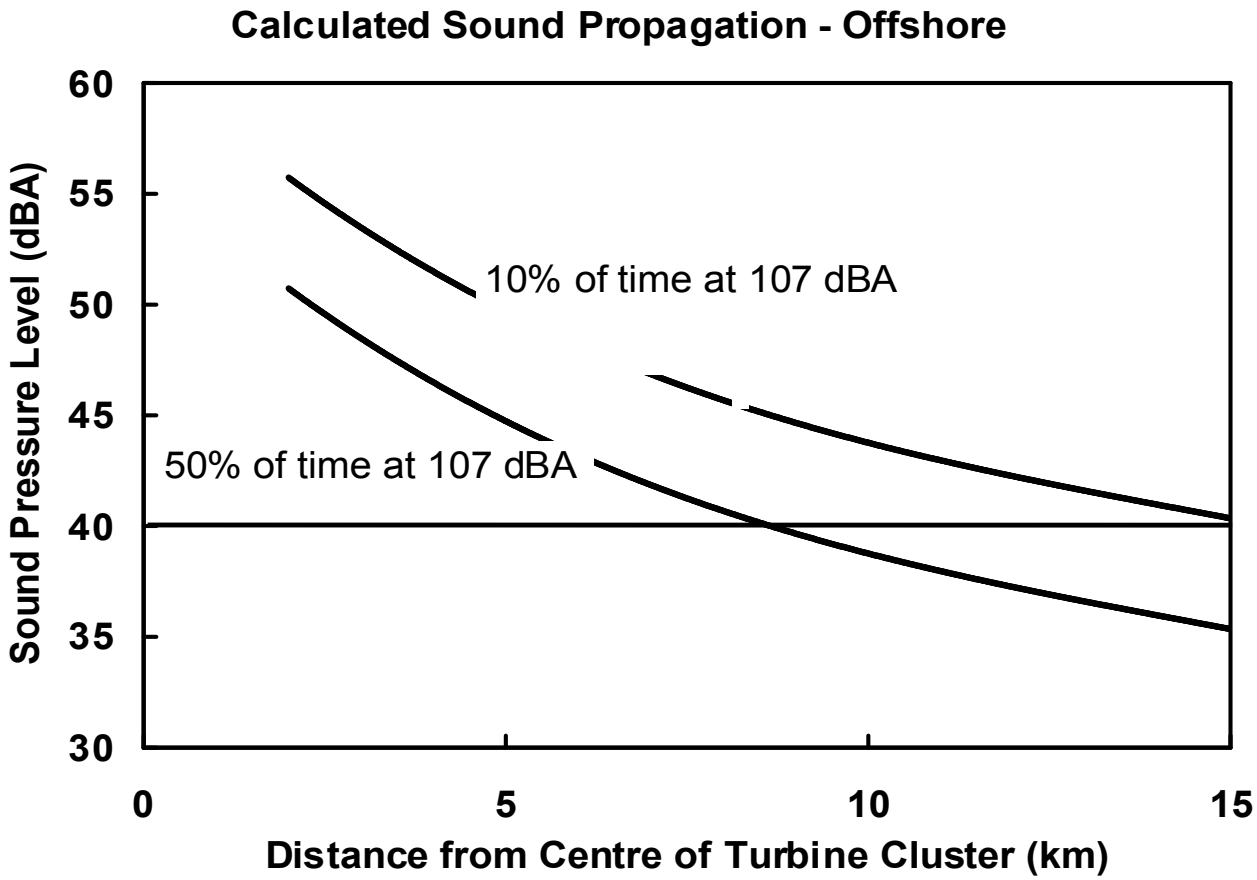
Off-Shore: Cluster of 64 turbines, each with a sound power level of 107 dBA.



In worst case, need a setback of 15 km.

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RECOMMENDED SETBACKS

1.5 km	French Academy of Medicine
1.5 km	UK Noise Association
2 km	Dr. Nina Pierpont (NY State)
1.6 km	Dr. Amanda Harry (UK)
1.5 km	Dr. Chris Hanning (UK)
1.5 km	Acoustic Ecology Institute (USA)
2 km	Frey and Hadden (UK)

30 dBA in bedroom (WHO)
25 dBA in bedroom (ISO)
Near background (Sierra Club)

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TURBINE NOISE

Aerodynamic emission (Low frequency component)
Periodic (amplitude modulation)
Hearing and visual association

It seems to be accepted that turbine noise is very difficult to accommodate to.

Field Study: 233 residents in Wisconsin: Noise is a household problem?

Noise Level (dBA)	Agree
<35	32%
35 - 40	52%
>40	44%

Field Study: 1095 respondents in rural Sweden:

Noise (dBA)	Annoyed and Very Annoyed
35 - 40	9%
40 - 45	29%

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Field Study 586 respondents in rural Netherlands:

Noise (dBA)	Annoyed and Very Annoyed
35 - 40	20%
40 - 45	25%

Miedema and Vos (2004)

Traffic/industrial noise: 2 – 4% annoyed at ~ 40 dBA

RECONCILIATION

Health and other authorities recommend 1.5 km and up.

Various jurisdictions allow 500 to 800 metres.

This causes annoyance and serious health concerns.

INTRUSION

Typically, night ambient is 25 dBA in rural regions.

Regulations allow 10 – 25 dBA intrusion;
2 to 5 times louder.

Reduce the noise limit to 35 dBA

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AMPLITUDE MODULATION

Characteristic “swoosh – swoosh – swoosh”.

Guidelines use L_{eq} - an average over time.

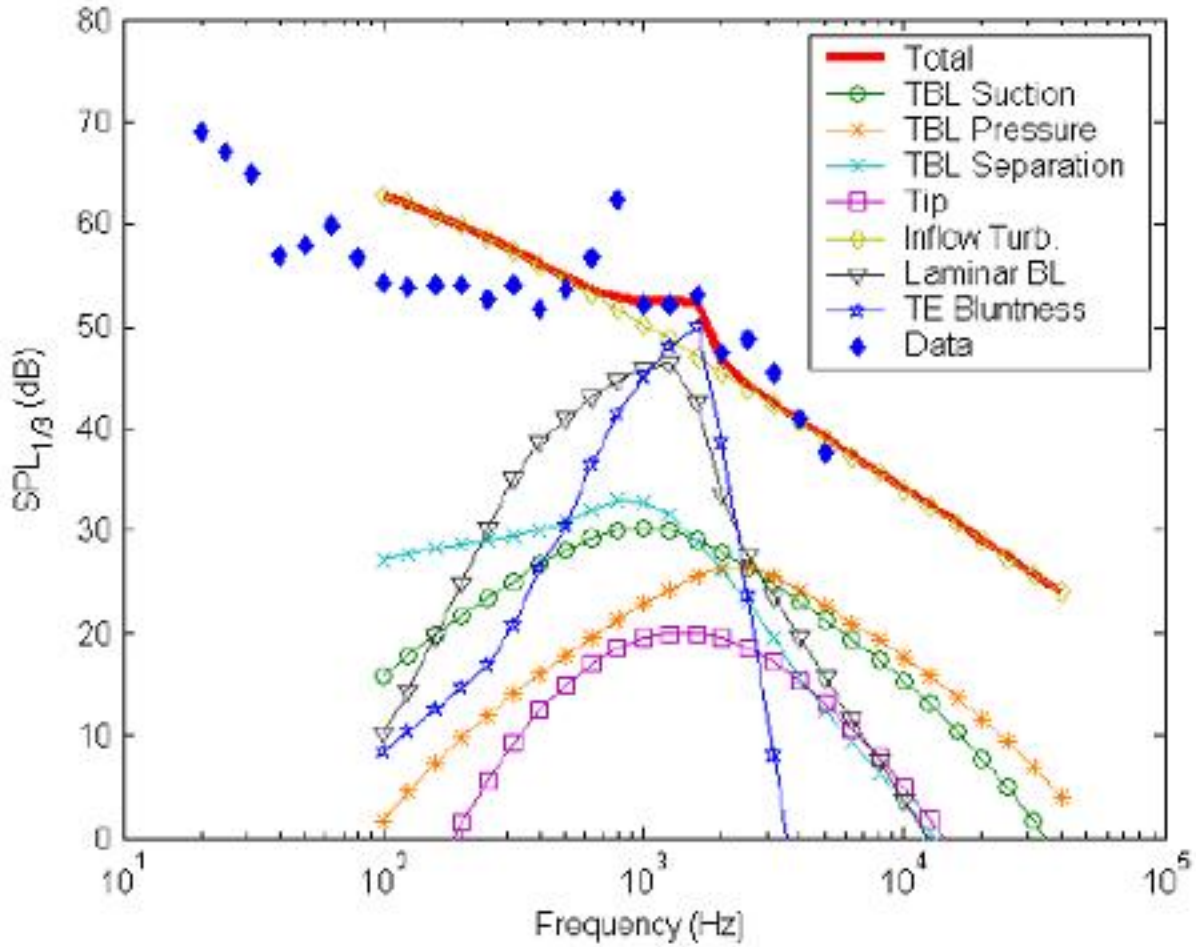
The ear does not average!!

To quote Dr. Leventhall: “A time-varying sound is more annoying than a steady sound of the same average level and this is accounted for by reducing the permitted level of wind turbine noise”.

Only NZ allows a penalty for this.

Apply a 5 dBA Penalty for Amplitude Modulation

TURBULENT INFLOW



Predict Turbulent Inflow Noise

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UNCERTAINTY

No measurement and no prediction is 100% correct!

Turbine manufacturers give 1 dBA uncertainty

ISO-9613 gives 3 dBA uncertainty

Add 4 dBA Penalty for Uncertainty

SUMMARY

Presently, 40 dBA limit means a setback of 500 metres.

Consider effect of: lower intrusion; cyclic noise penalty; uncertainty; multiple turbines

Cyclic (+5 dBA)	Uncertainty (+4 dBA)	3 Turbines (+5dBA)	35 dBA Limit (metres)
			800
√			1200
√	√		1500
√	√	√	

Population Densities (people/sq.km):
Germany-230; Denmark-130; Netherlands-400
USA-31; Canada-3; Ontario-12;

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ONTARIO VERSUS NEW ZEALAND

Energy Efficiency Authority;

Massey University;

Executive of Community Boards;

Ministry of Health:

Local Government NZ;

Ministry of the Environment;

NZ Acoustical Society;

NZ Wind Energy Authority;

NZ Institute for Environmental Health;

Resource Management Law Association;

University of Auckland.

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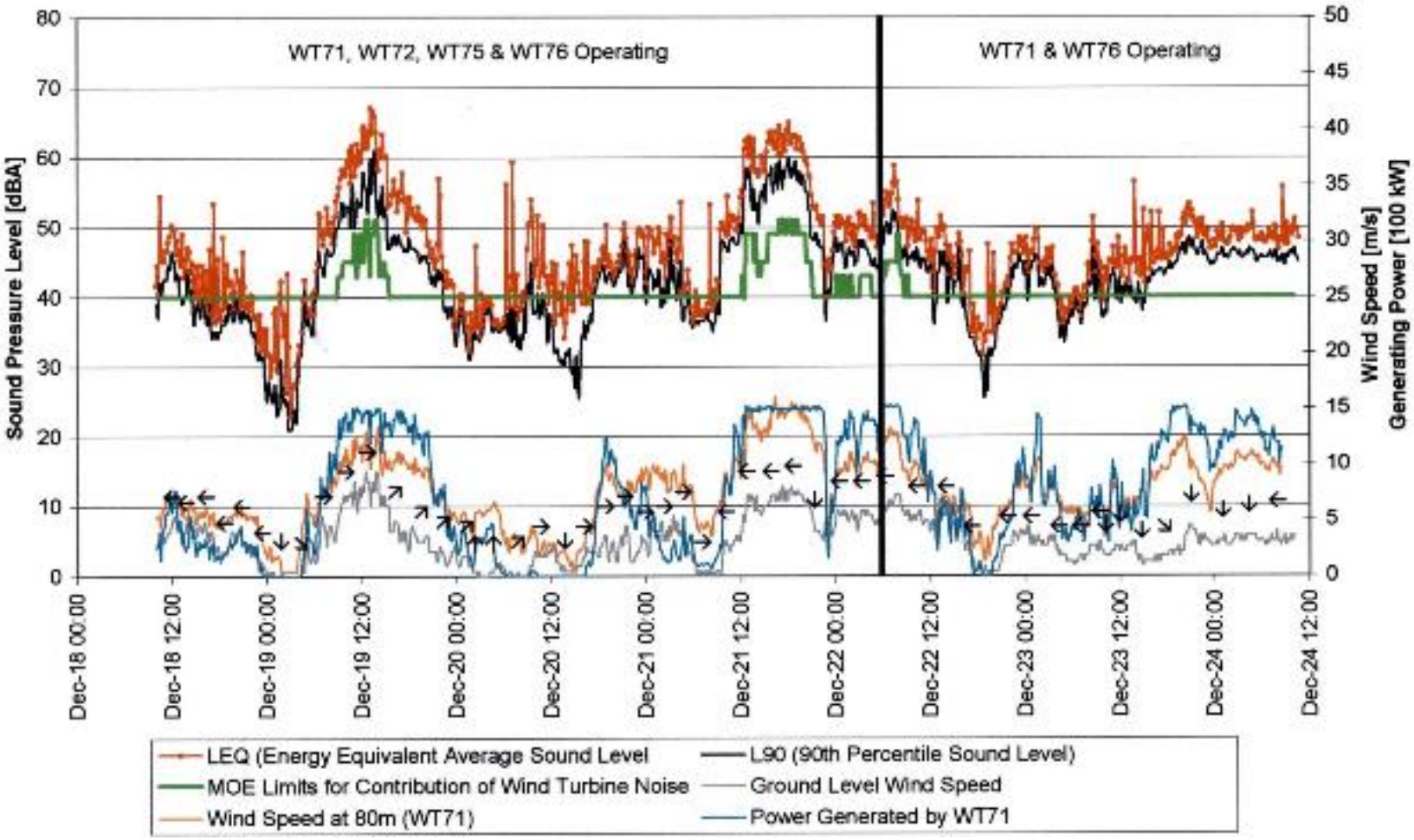
THE BOTTOM LINE!

Figure 2: Sound Levels Measured at the Lormand Residence.
Comparison to Wind Speeds and Criteria. Canadian Hydro, Melancthon EcoPower Center.



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