Acoustic Noise Generated by Wind Turbines

Presented at the Lycoming County, PA
Zoning Board Hearing on 12/14/2005

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Overview

- Measurements at distance of 0.55 miles from wind farm in Meyersdale, PA
  - Sound level measurements
  - Sound recordings
- Analysis of the frequency composition of the noise generated by wind turbines
- Analysis of the ambient noise level as a function of wind speed
- Discussion of the wind turbine noise characteristics

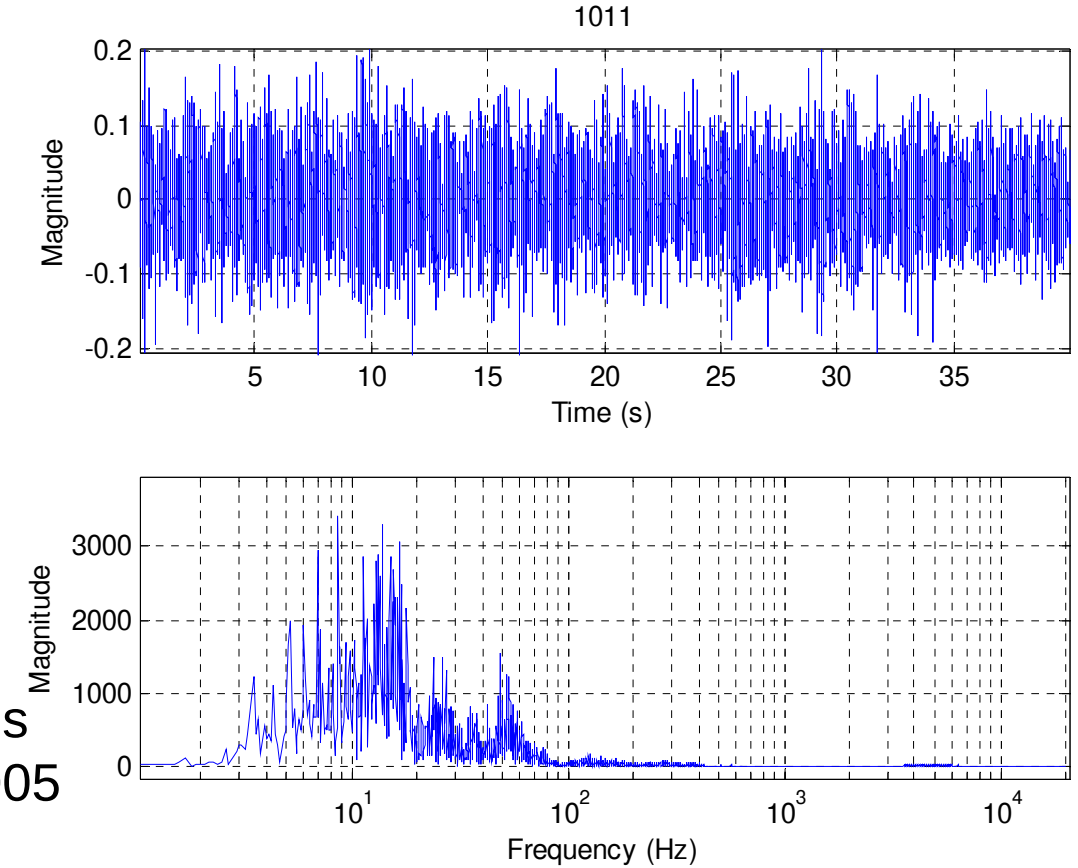
Meyersdale Wind Generation Facility

- Located in Somerset County near Meyersdale, in southwestern Pennsylvania
- Consists of 20 wind turbines,
- Rated power of turbines: 1.5-MW
- Tower height: 375’

Test Equipment

- Extech Datalogging sound level meter (Model#407764)
- Marantz Professional portable solid state recorder (Model PMD670)
- Omni-Directional microphone with frequency response 60Hz – 12kHz and sensitivity – 70 dB

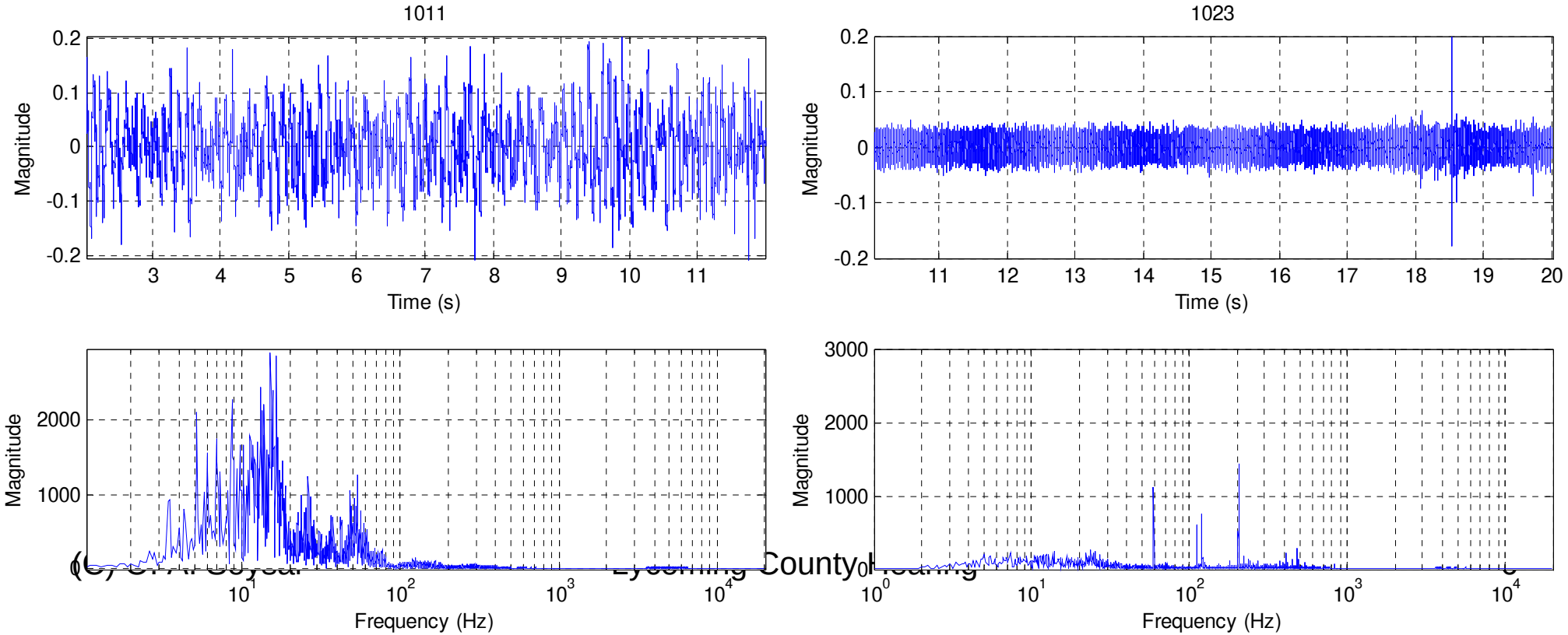
Meyersdale, PA
Sound recordings



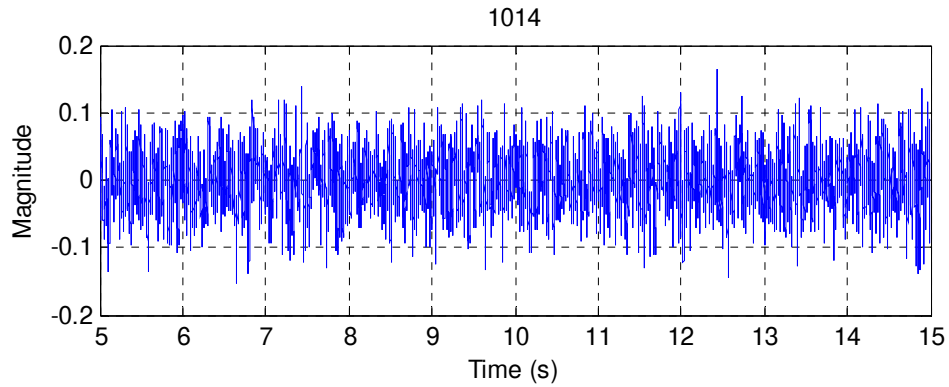
Distance to windmills: 0.55 miles
Recording date: October 29, 2005
Time: 11:16

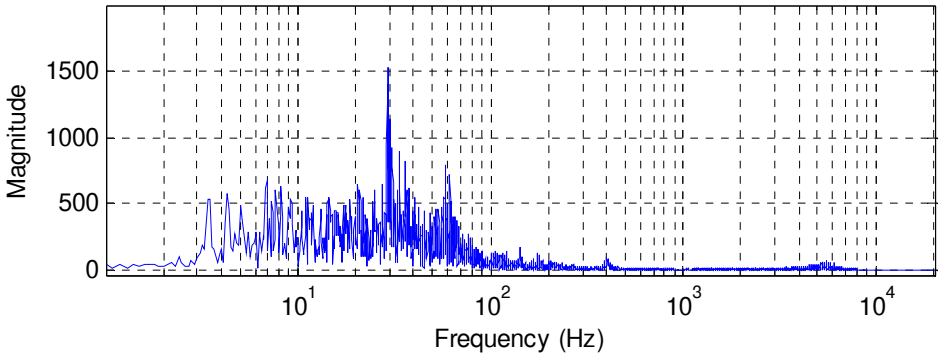
Meyersdale, PA

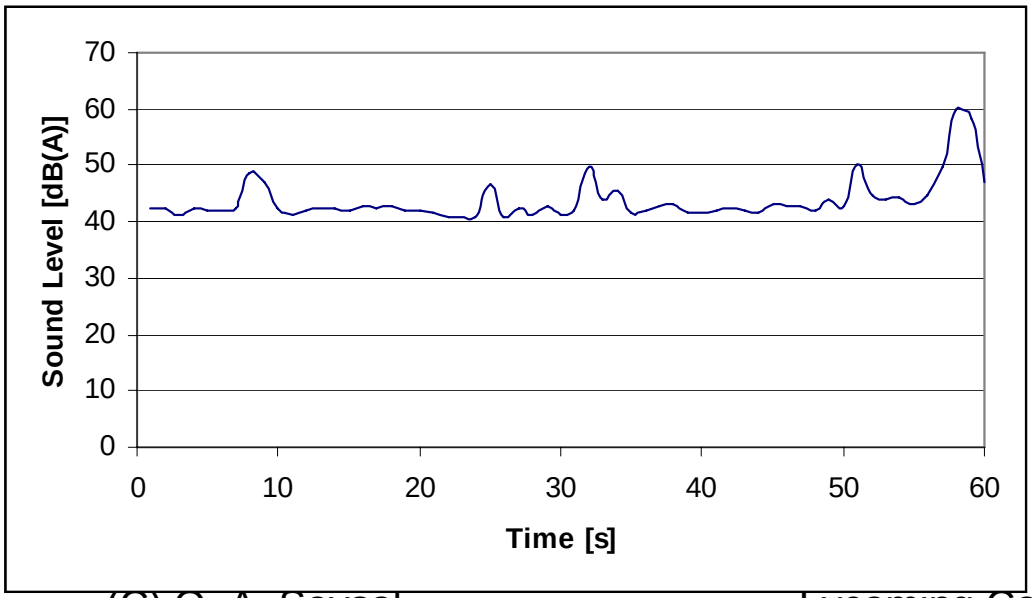
Frostburg, MD

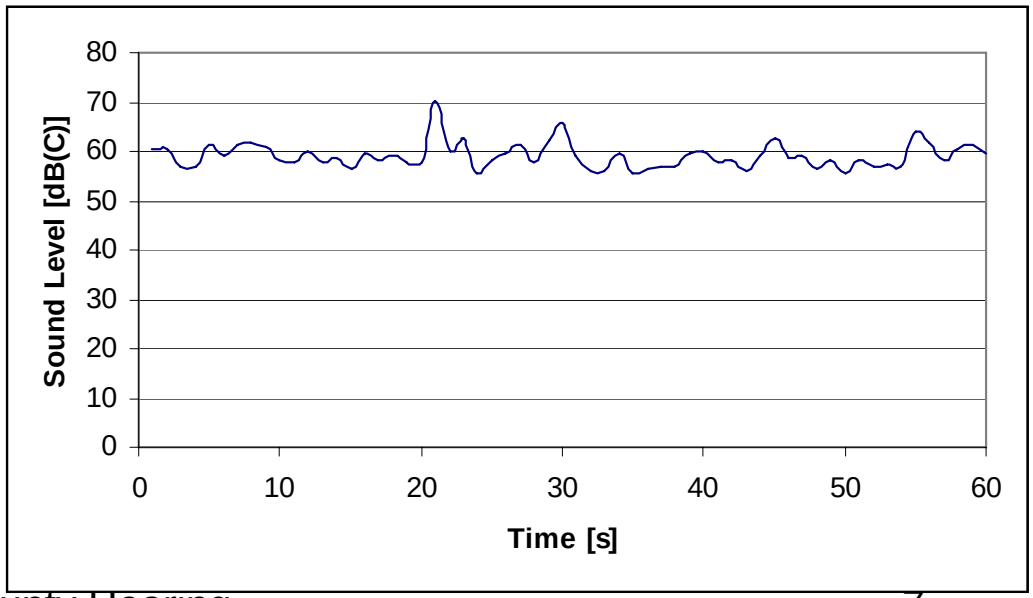


Sound recording and sound level measurements at Meyersdale, PA
Recording date: November 2, 2005
Time: 4:02PM

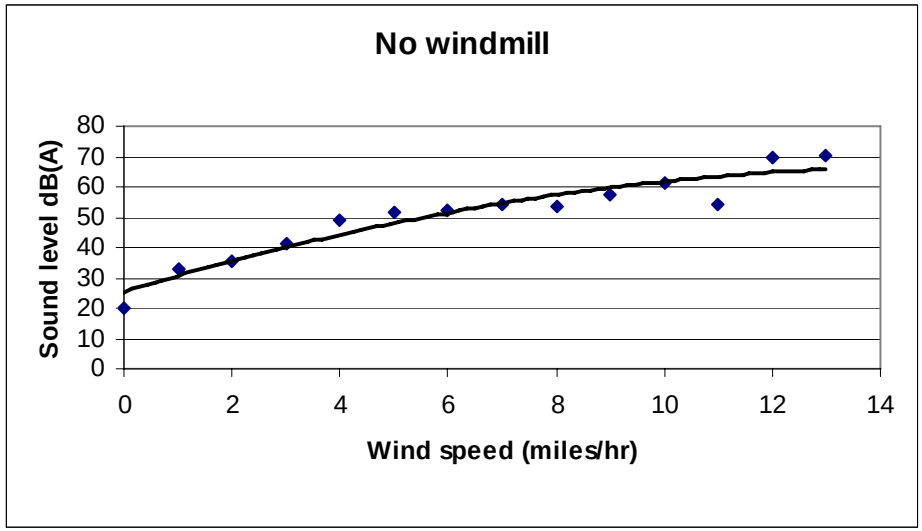


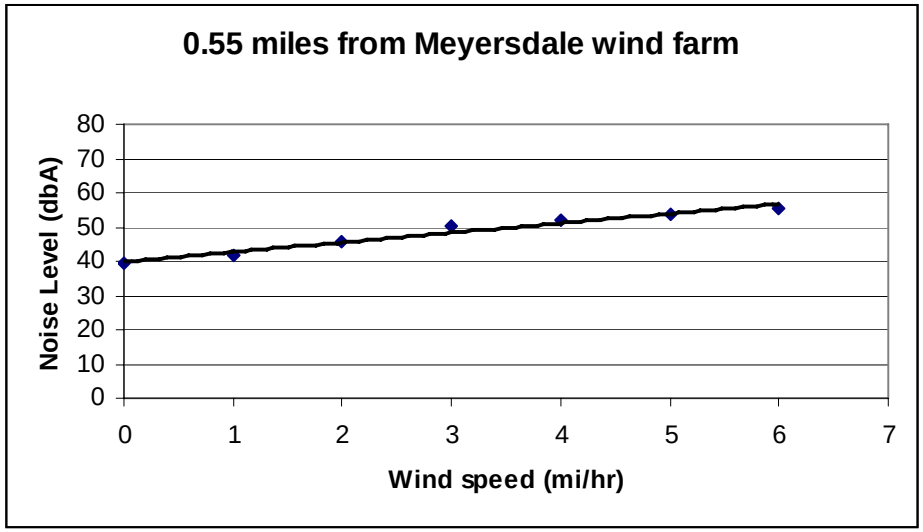






Ambient Noise versus Wind Speed





Wind speed measured in ground level, at the same location as the sound level measurement

Lycoming County Zoning Ordinance Noise Protection Levels

Frequency Band (Cycles/second)	Maximum Permitted Sound-Pressure Level (dB)	Corrected max. level as per Table 5130.B due to periodic character of noise (dB)
0 – 150	67	62
150 – 300	59	54
300 – 600	52	47
600 – 1,200	46	41
1,200 – 2,400	40	35
2,400 – 4,800	34	29
Above 4,800	32	27

IEC 61400-Wind Turbine Generator Systems

Part 11 – Acoustic Noise Measurement Techniques

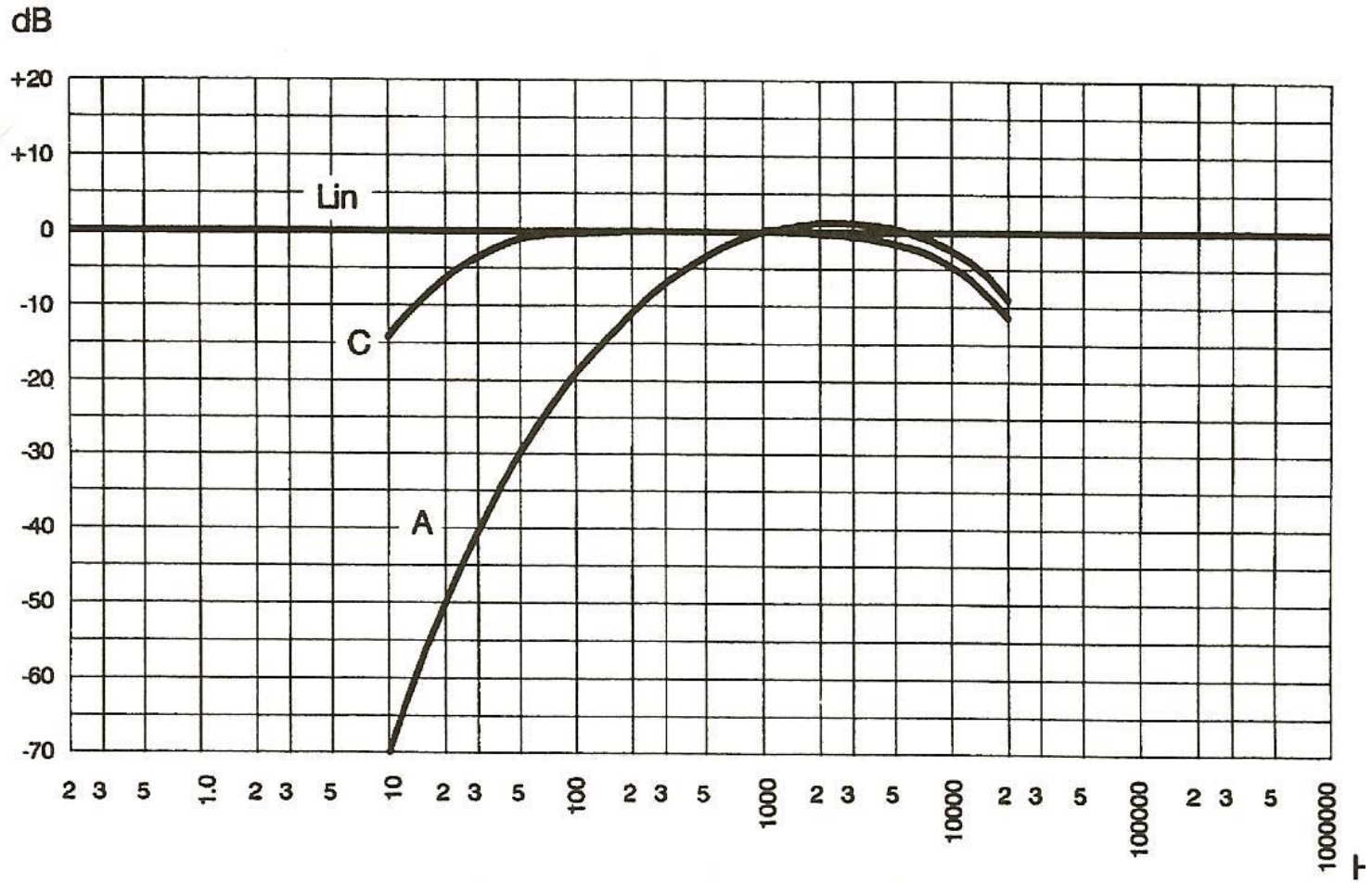
- Annex A – Other possible characteristics of wind turbine noise emission and their quantification (page 35)

A disturbance can be caused by low-frequency noise with frequencies in the range from 20 to 100 Hz. The annoyance caused by noise dominated by low frequencies is often not adequately described by the A-weighted sound pressure level, with the result that nuisance of such a noise may be underestimated if assessed using only an L_{Aeq} value.

It may be possible to decide whether the noise emission can be characterised as having a low-frequency component. This is likely to be the case if the difference between the A and C-weighted sound pressure levels exceeds approximately 20 dB.

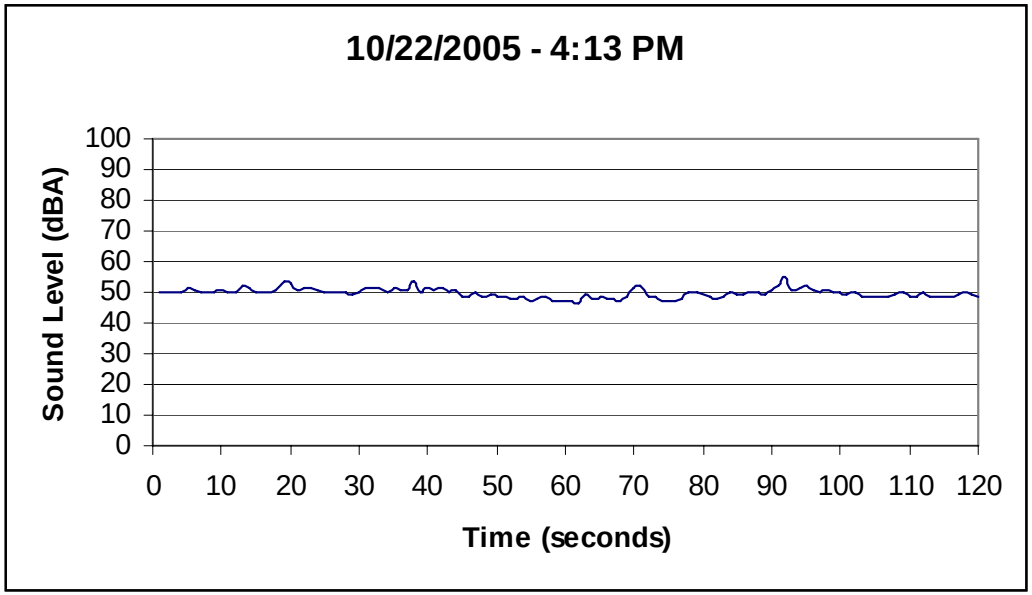
In these circumstances, low-frequency noise may be quantified by extending the one-third octave band measurements described in the main body of the text, down to 20 Hz. For one-third octave bands, the 20, 25, 31,5 and 40 Hz bands should additionally be determined.

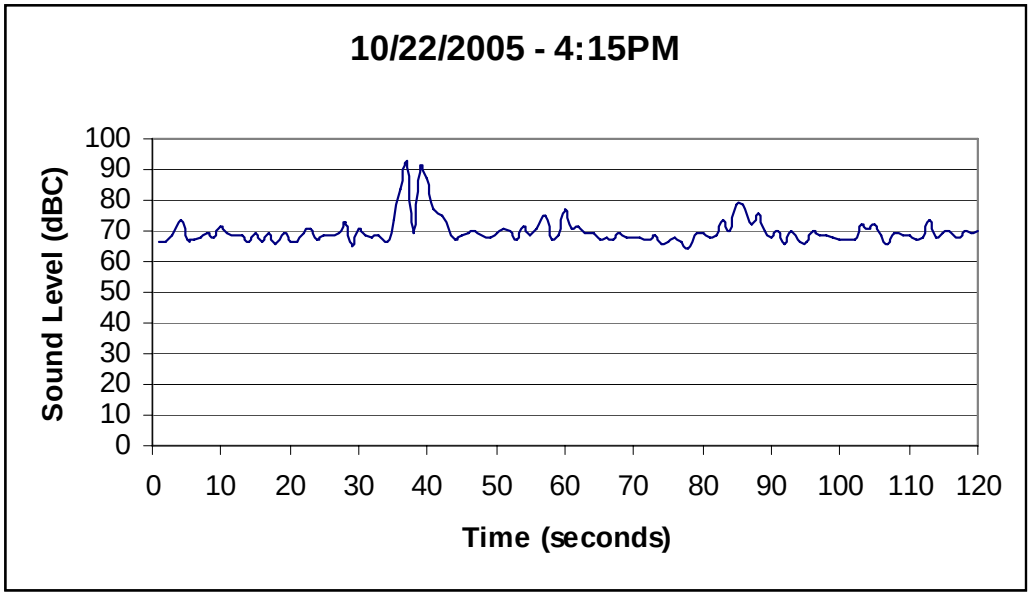
dB Weighing

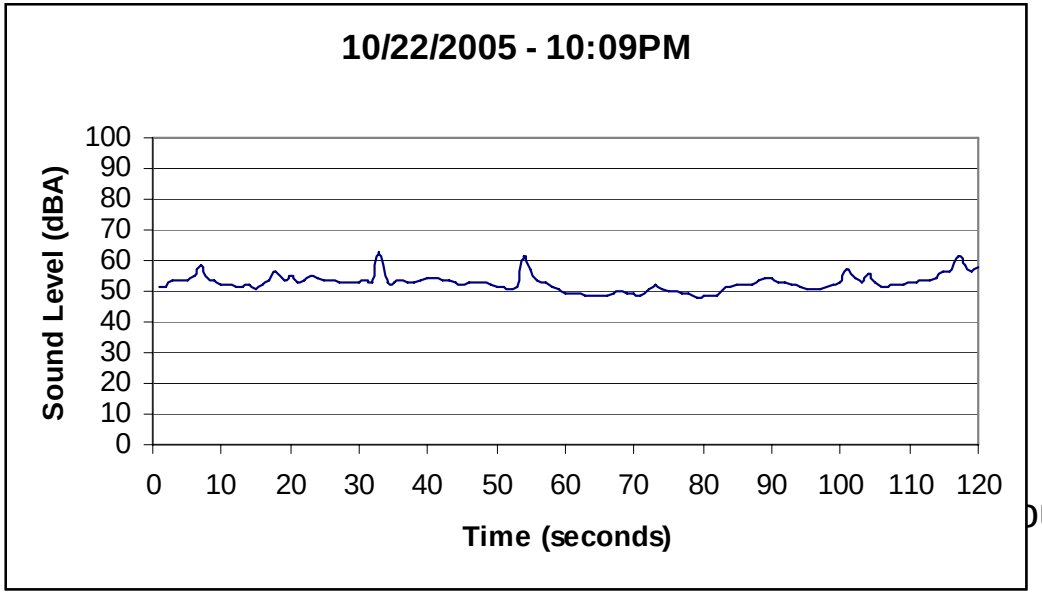

dB
+20
+10
0
-10
-20
-30
-40
-50
-60
-70
Lin
C
A
2 3 5 1.0 2 3 5 10 2 3 5 100 2 3 5 1000 2 3 5 10000 2 3 5 100000 2 3 5 1000000
H

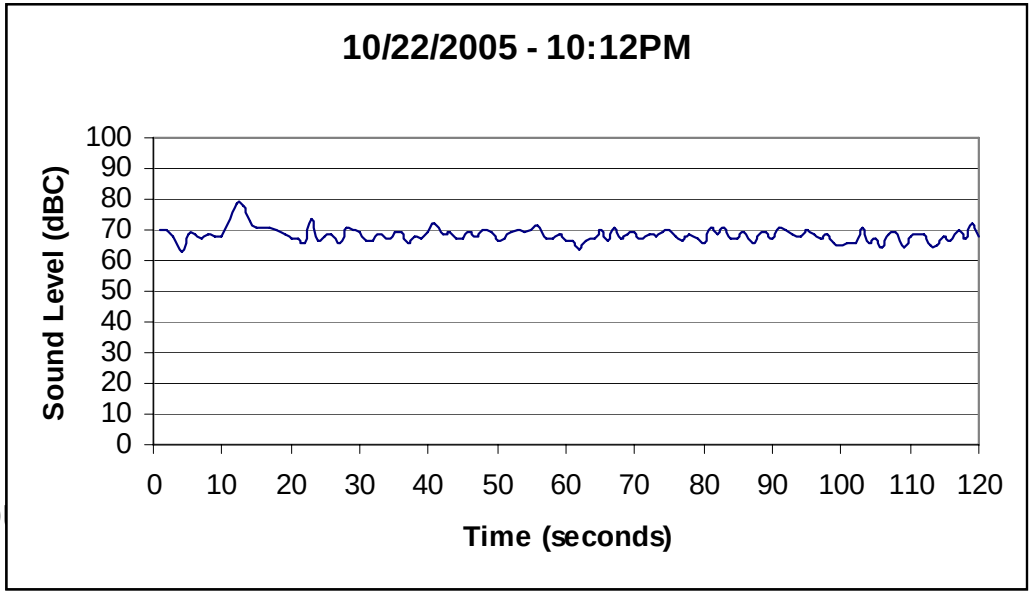
Sound Level Measurements in Meyersdale, PA;

Distance to wind farm: 0.55 miles

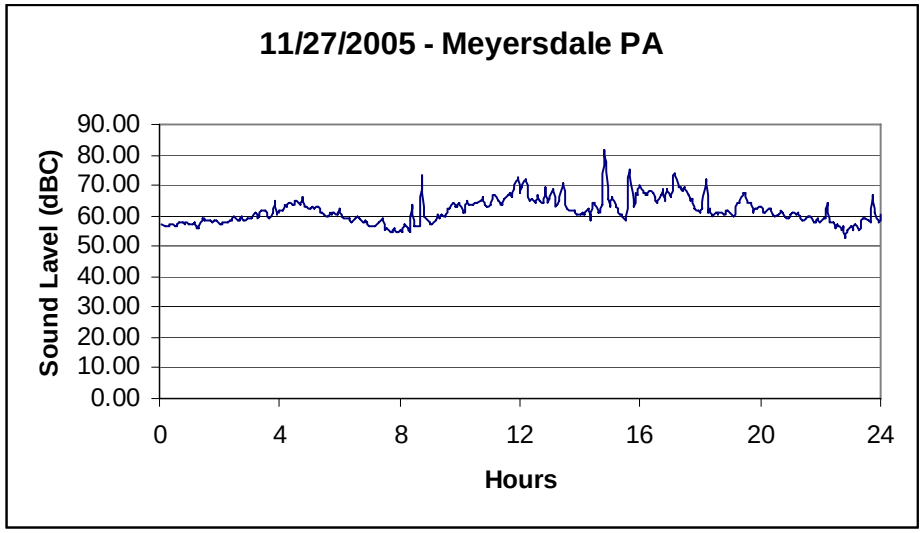


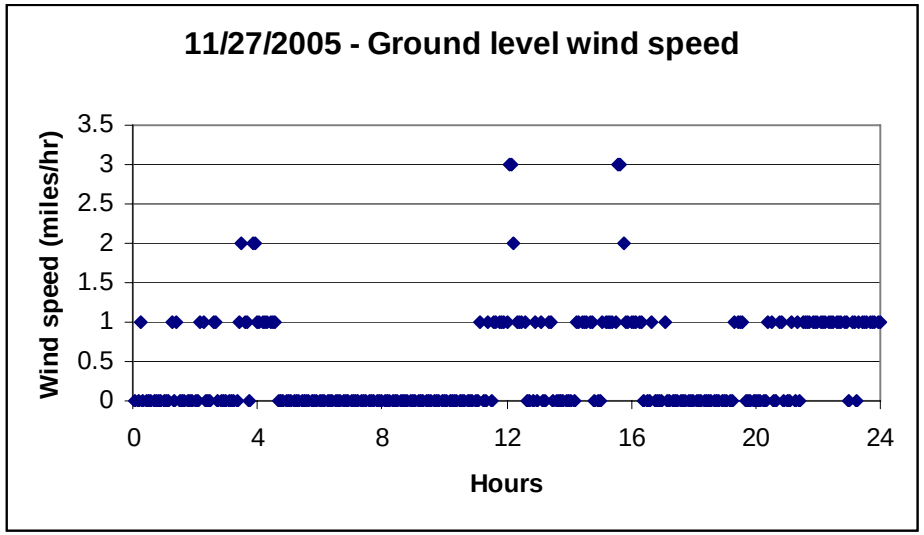






One-day Noise Measurements





Subjective Issues

- A listener's ability to hear noises depend on many subjective factors
- The turbine noise is distinguished from the random background noise because of its periodic characteristic
- Wind speed in the ground level usually do not correlate to the wind speed at the height of the turbine
- A lower level masking noise in the ground level affect the listener's ability to hear the turbine noise

Conclusions

- Recorded wind mill noise contains dominant low frequency components below 100 Hz
- Recordings clearly show the noise is distinguished from the background noise due to its periodic characteristic
- The noise level difference between A and C weighing is approximately 20 dB
- A weighing does not represent adequately the wind turbine noise
- C weighing noise level measurements indicate that the noise level at 0.55 mile distance exceeds the Lycoming County Zoning ordinance