Noise from Wind Farms and Environmental Impact Assessment

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Hayes McKenzie

- Formed in 1991
- 8 consulting staff in Salisbury and Machynlleth
- Approx 95% of work is in wind energy
- Covering:
  - Assessment for new development
  - Appeals
  - Tendering process
  - Compliance monitoring
  - Turbine testing

The EIA Process (?)

- Legislation / Guidance
- Baseline / Existing Situation
- Prediction of Future Situation
- Assessment of Future Situation
- Mitigation as required
- Residual Effects

Wind Turbine Noise Issues

- In most locations, baseline varies with:
  - Wind speed
  - Wind direction
  - Time of day
  - Time of year (?)
  - Exact location
- Turbine noise varies with:
  - Hub height wind speed
  - Wind direction
  - Atmospheric factors

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Scottish Noise Planning Guidance

- PAN56 Planning and Noise

  'Good acoustical design and siting of turbines is essential to ensure there is no significant increase in ambient noise levels as they affect the environment and any nearby noise-sensitive property.'

Scottish Noise Planning Guidance

- PAN45 Renewable Energy Technologies

  'The report, "The Assessment and Rating of Noise from Wind Farms" [aka ETSU-R-97]*, describes a framework for the measurement of wind farm noise and gives indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours… The report presents a series of recommendations that can be regarded as relevant guidance on good practice .'*

Scottish Noise Planning Guidance

- Local Planning Guidance
  - Perth and Kinross
  - Highland Council
  - Aberdeenshire Council
  - Orkney Islands Council
  - Others?

ETSU-R-97

- *'…describes a framework for the measurement of wind farm noise and gives indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable burdens on wind farm development or adding unduly to the costs and administrative burdens on wind farm developers or local authorities.'*
- Always been seen as contentious and has never been consulted on or reviewed.

ETSU-R-97 Noise Limits

- X dB L_{A90} or 5 dB above b/g, whichever is greater
  - X varies with time of day and other factors
    - Day-time: X=35-40
    - Night-time: X=43
    - Land-owner: X=45
  - B/G quantified as a function of wind speed
  - B/G averaged over relevant period
    - night 2300-0700
    - 'sensitive' day-time hours (1800-2300, Sat pm and all day Sun)

…Or Simplified Limit…

- 35 dB L_{A90} up to 10m/s at 10m Height

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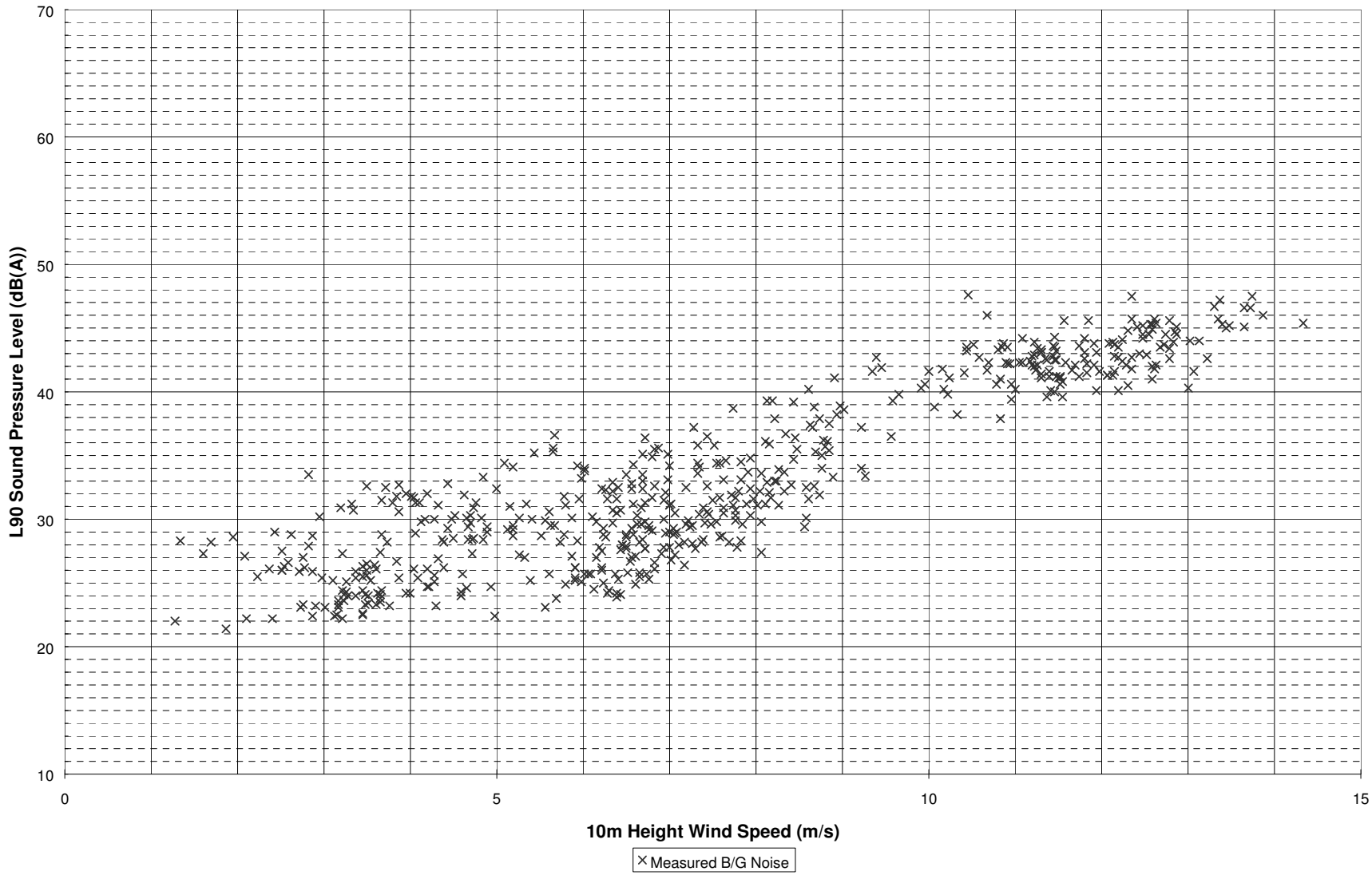
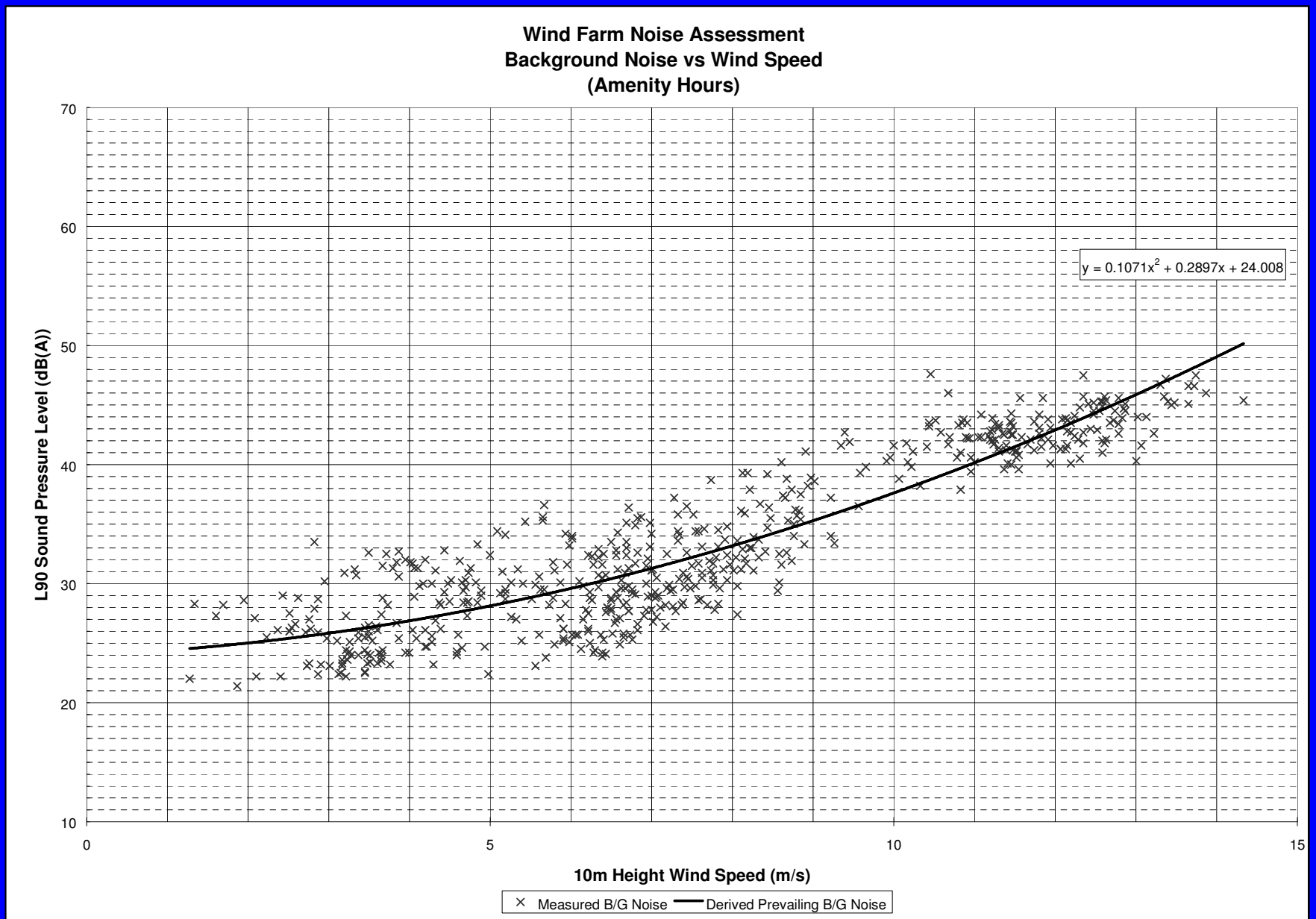
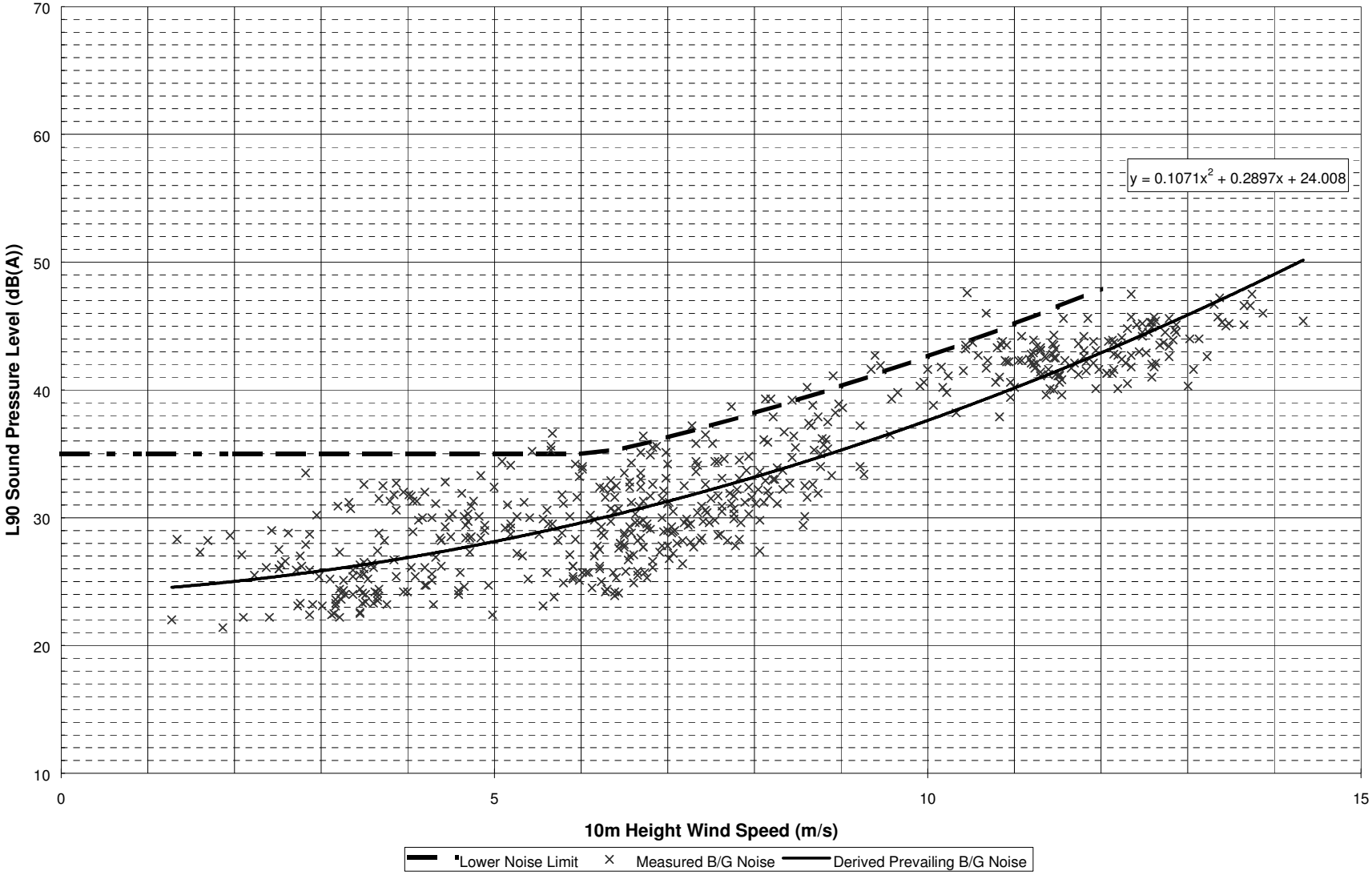
Siting

Wind Farm Noise Assessment
Background Noise vs Wind Speed




Wind Farm Noise Assessment
Background Noise vs Wind Speed
(Amenity Hours)
L90 Sound Pressure Level (dB(A))
70
60
50
40
30
20
10
0
5
10
15
10m Height Wind Speed (m/s)
y = 0.1071x2 + 0.2897x + 24.008
Measured B/G Noise
Derived Prevailing B/G Noise

Wind Farm Noise Assessment
Noise Limits and Background Noise vs Wind Speed
(Amenity Hours)



Agreement Published in Institute of Acoustics 'Acoustics Bulletin'

- *'We recommend that background noise levels are correlated with **derived** (not measured) 10 metres height wind speeds, arrived at using the following procedure.'*

Agreement Published in Institute of Acoustics 'Acoustics Bulletin

- *'Effectively the result of adopting this procedure is to reference all noise levels (both background levels and immission levels) to the wind speed at turbine hub height, although the results are stated in terms of the derived 10 metres height wind speed for consistency with IEC61400-11 and ETSU-R-97.'*

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Manufacturers Data

- Sound *power* level at integer (standardised) V_{10} wind speeds
- Warranted or measured + un-certainty
- Ideally cut-in to 12 m/s
- Frequency spectrum
- Analysis of tonal noise (for tonal 'penalty')

Agreement Published in Institute of Acoustics ‘Acoustics Bulletin

- Prediction methodology
  - ISO9613-2
- Turbine Sound Power Levels
  - Warranty or Measurement
- Temperature and Humidity
  - 10 degrees C / 70% RH
- Ground Factor Assumptions
  - G=0.5 (Warranty) / G=0 Measurement
- Effects of Barriers
  - Generally no more than 2 dB

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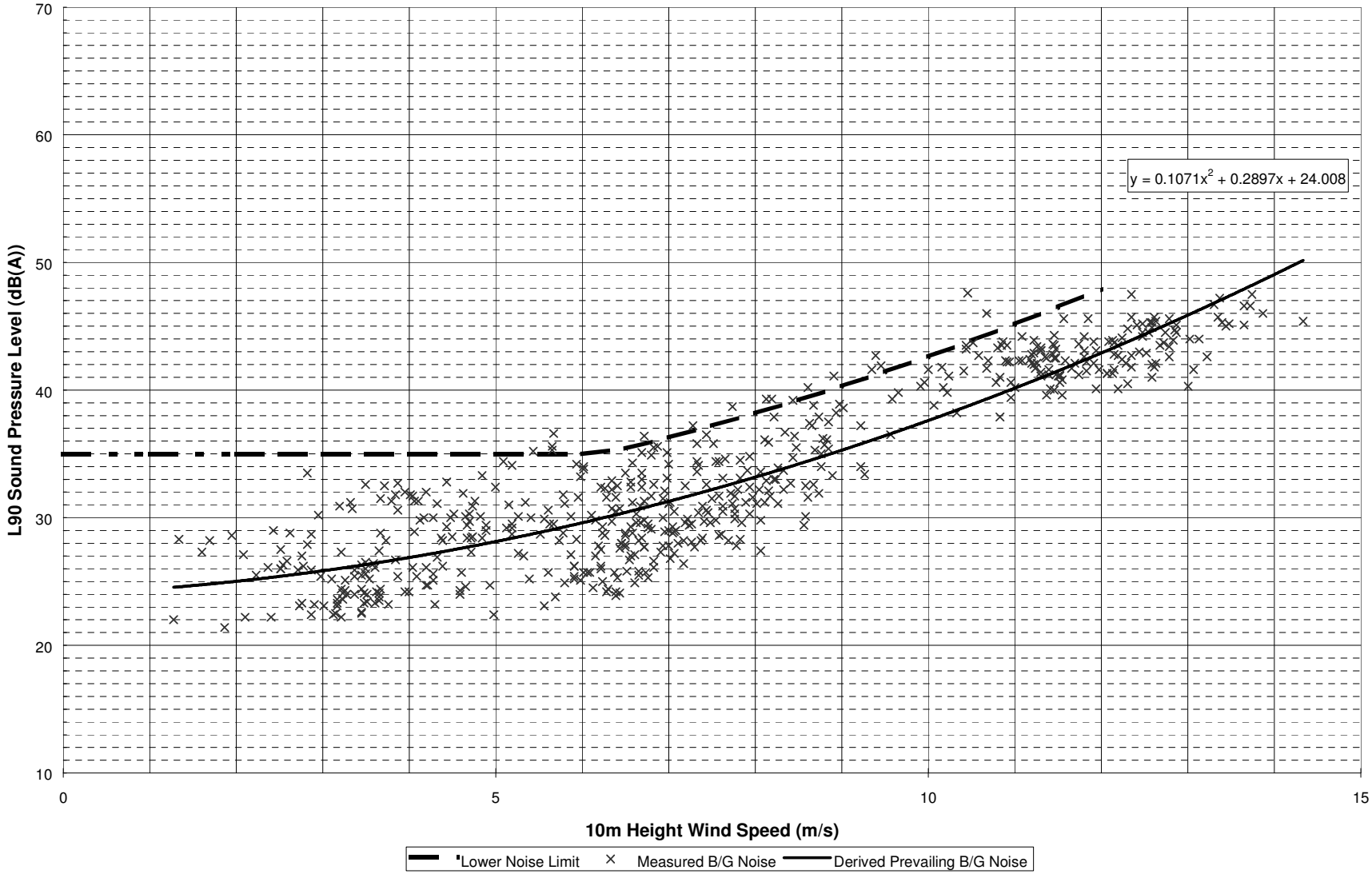
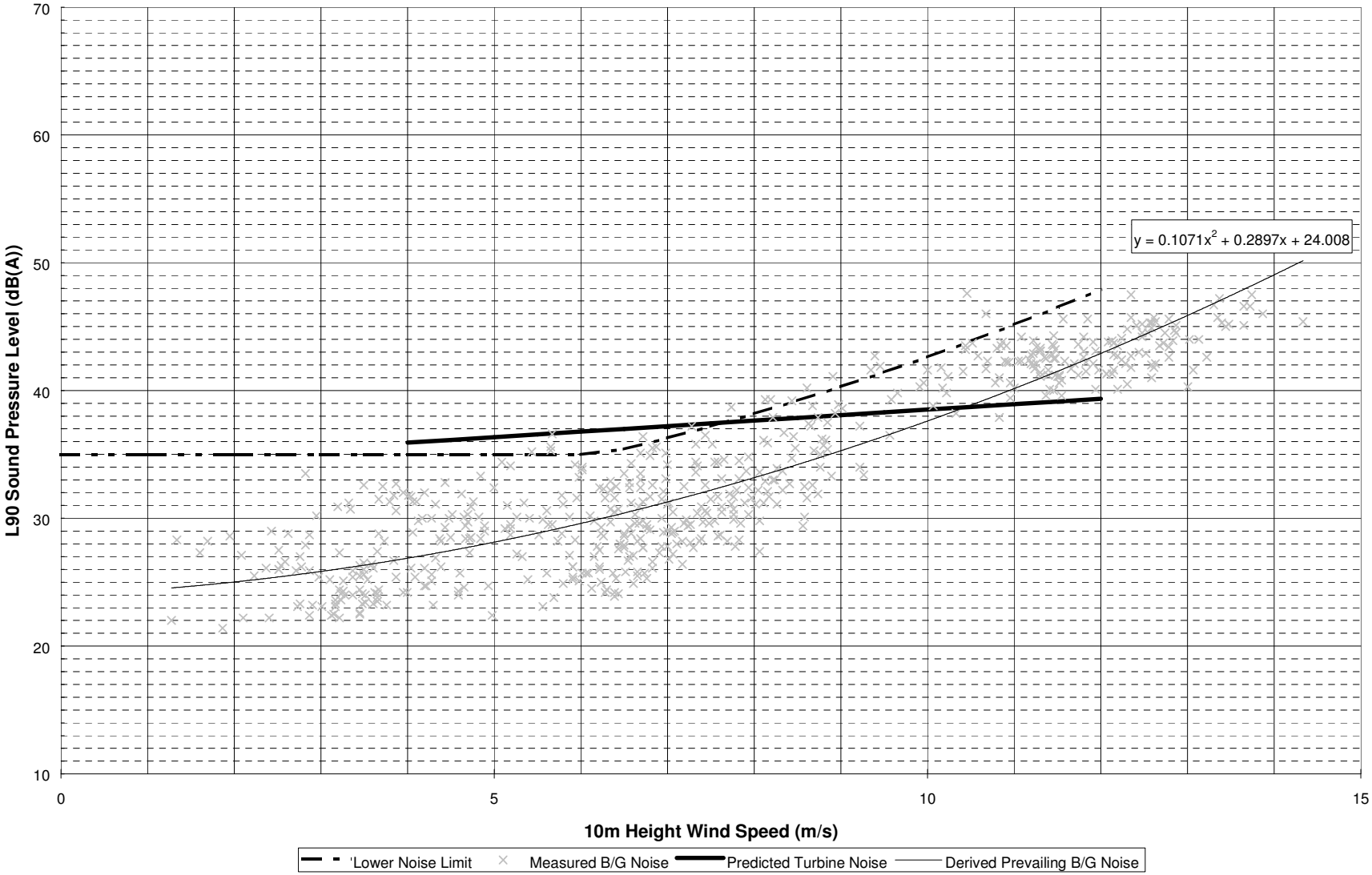
Impact Assessment

- Comparison of downwind predicted level, including any tonal correction / penalty, over range of wind speeds, with:
  - ETSU-R-97 noise limits
  - Baseline

Wind Farm Noise Assessment
Noise Limits and Background Noise vs Wind Speed
(Amenity Hours)



Wind Farm Noise Assessment
Predicted Turbine Noise and Background Noise vs Wind Speed



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Mitigation

- Negotiate higher noise limit in 35-40 range
- Increase separation distance
- Remove turbines
- Review turbine type
- Shut down nearest turbine(s) for certain wind conditions.
- Run turbines in ‘noise reduced’ modes.

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Audibility

- Turbine noise which meets limits may be audible, at a low level, when downwind of the site.
- Some people may complain about noise which they can hear, even at levels which are deemed to be ‘reasonable’.
- High levels of amplitude modulation (AM) can increase audibility.
  - investigations ongoing into cause and control.

Effects on Human Health

- Infrasound
  - Acknowledged by (almost?) all noise professionals that infrasound from turbines does not cause ‘health’ issues.
- Sleep Disturbance
  - ETSU noise limits set to prevent sleep disturbance.
  - Audibility may cause stress in some individuals which can prevent returning to sleep if awoken.

Significance of Impact

- Does compliance with limits mean no significant impact?
- Does no significant impact mean no effect on amenity?
- Is silence or very low existing noise level or only ‘natural’ noise an amenity?