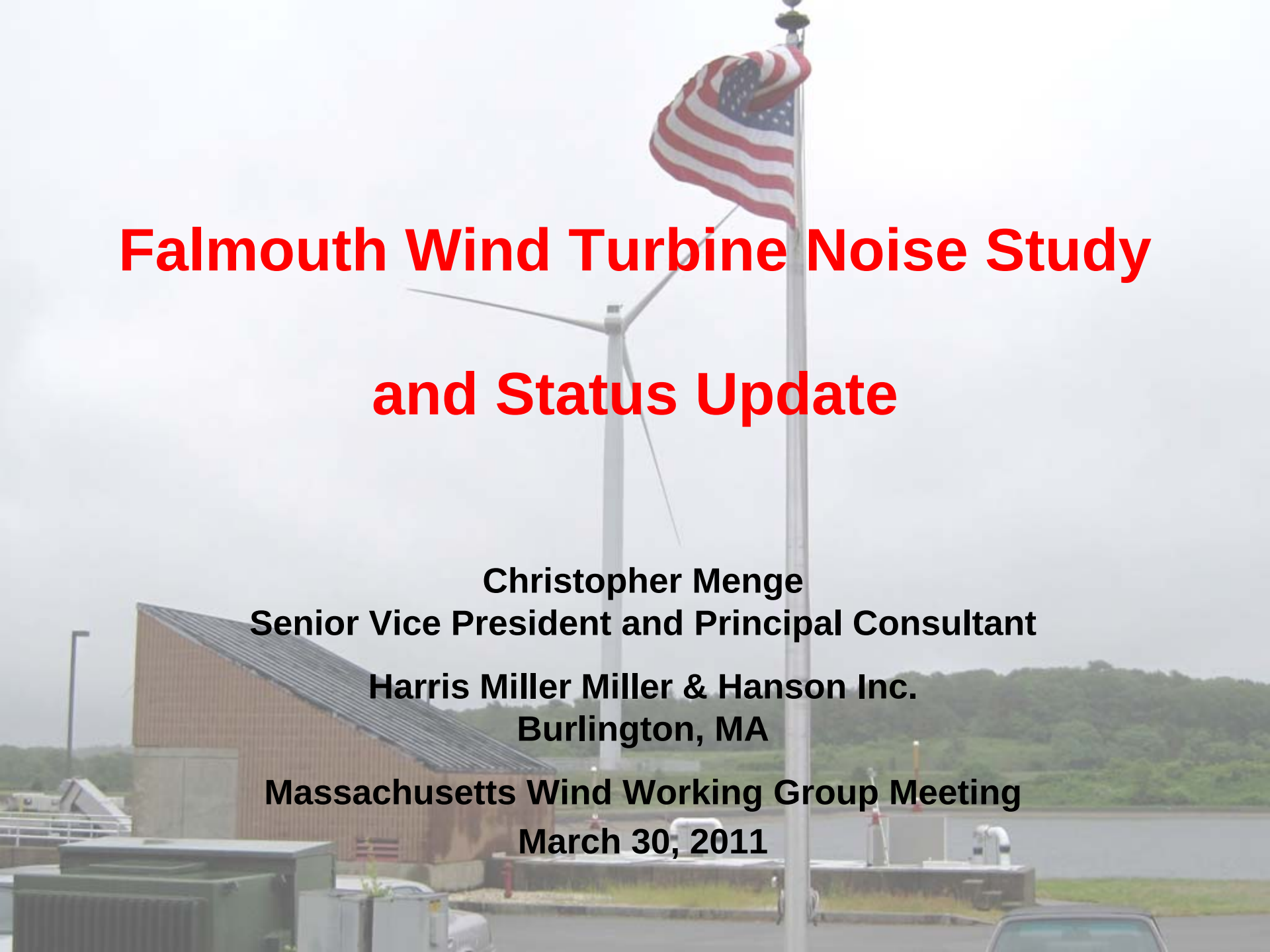


Falmouth Wind Turbine Noise Study

and Status Update

Christopher Menge
Senior Vice President and Principal Consultant

Harris Miller Miller & Hanson Inc.
Burlington, MA

Massachusetts Wind Working Group Meeting

March 30, 2011

Study Area


Falmouth Wind 2 Turbine
Under Construction
Notus/Webb Turbine Erected May 2010
Existing Falmouth Wind 1 Turbine
©2009 Google
Imagery Date: Jul 29, 2007
41°36'36.09" N 70°36'44.98" W elev 0 ft
Eye alt 15345 ft

Background

- **Feasibility study conducted in 2005**
  - No background noise measurements
  - Projected 42 to 44 dBA @ prop. lines from GE 1.5 or 2.5 MW
  - No significant noise issues expected
- **March 2010 Vestas V82 turbine went online and community complaints started shortly thereafter**
- **Types of audible sound as a source of complaints**
  - Loud “Bong” sound from tower occasionally (later, traced by Vestas to mis-aligned inertial damper and repaired)
  - “Swish-swish” sound – lower-wind conditions
  - “Thumping” sound – high-wind conditions

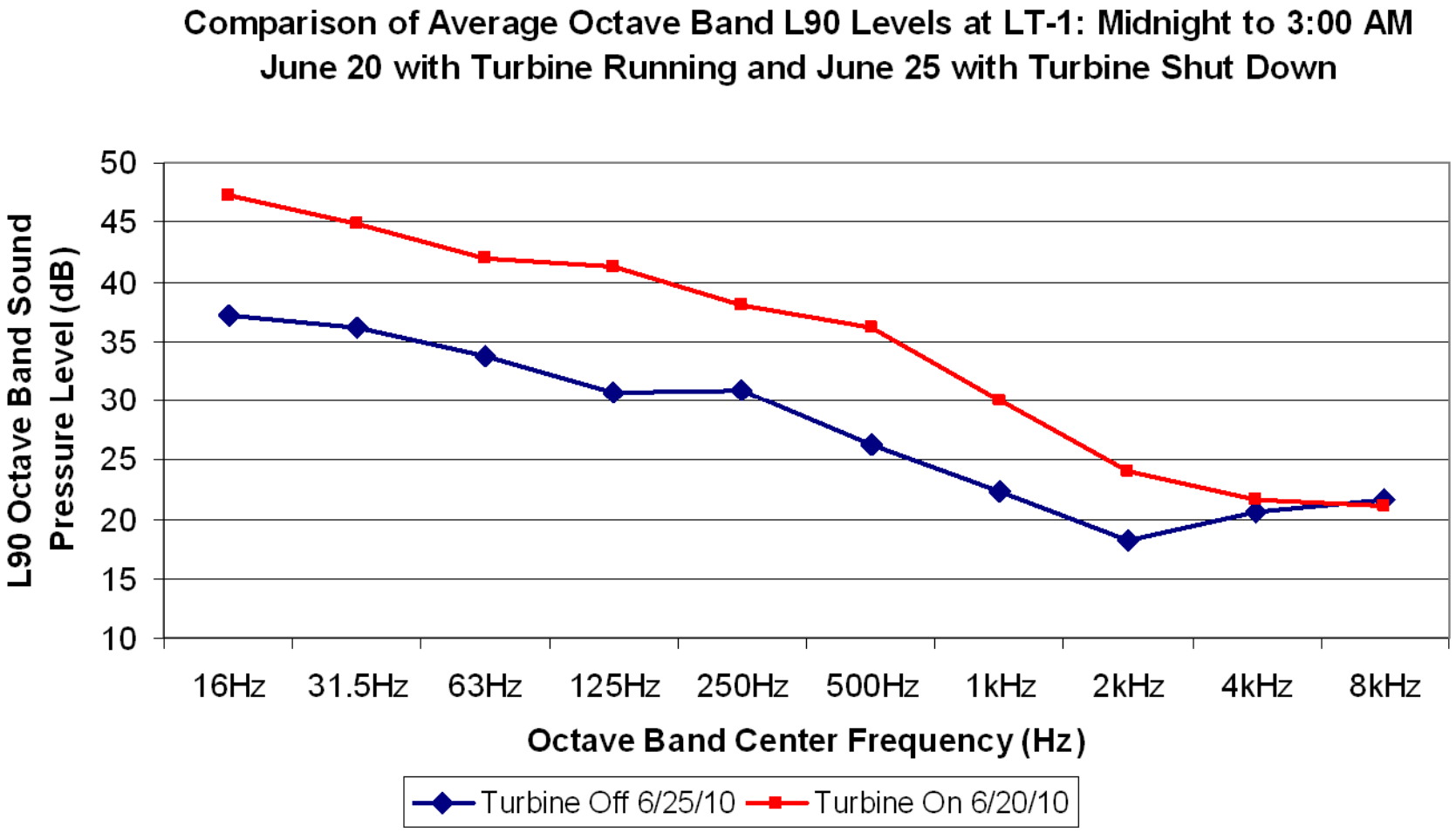
Commissioned Noise Study

- **Measurements of existing conditions**
  - Community locations - before, during and after Wind 1 maintenance shut-downs
  - Reference locations near turbine
- **Modeling of noise from Wind 1 & Wind 2 operations**
- **Determine existing and future compliance with**
  - Falmouth wind turbine ordinance – 40 dBA limit
  - Massachusetts DEP noise guidelines:
    - Not greater than 10 dBA increase in L90 background noise
    - No “pure tone” condition
- **Community attitudinal survey forms distributed – concurrent with noise measurement survey**

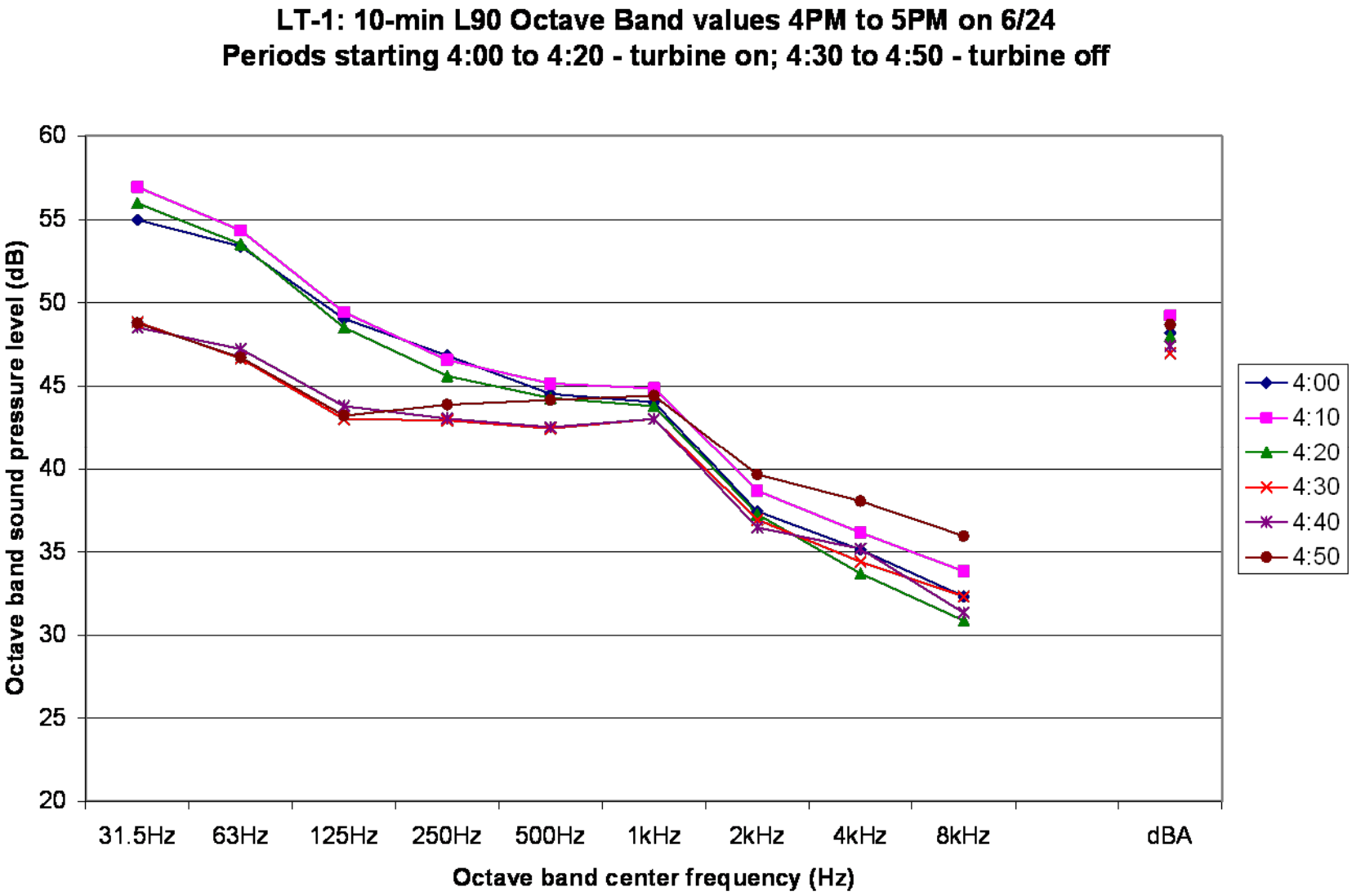
Measurement Sites


Site LT-1, 211 Blacksmith Shop Rd.

Frequency Characteristics and Pure Tone Evaluation

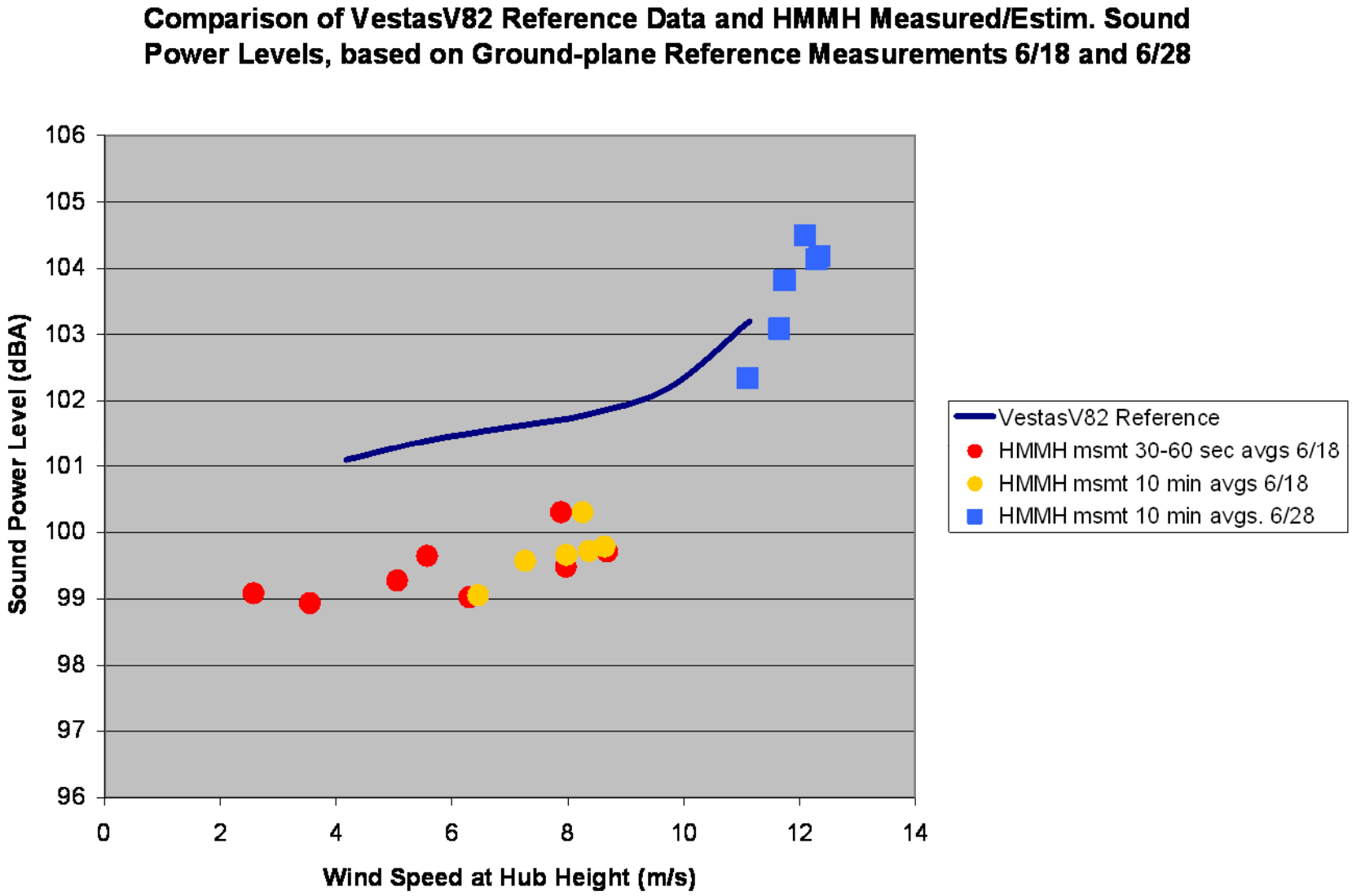


Low-frequency Sound Investigation

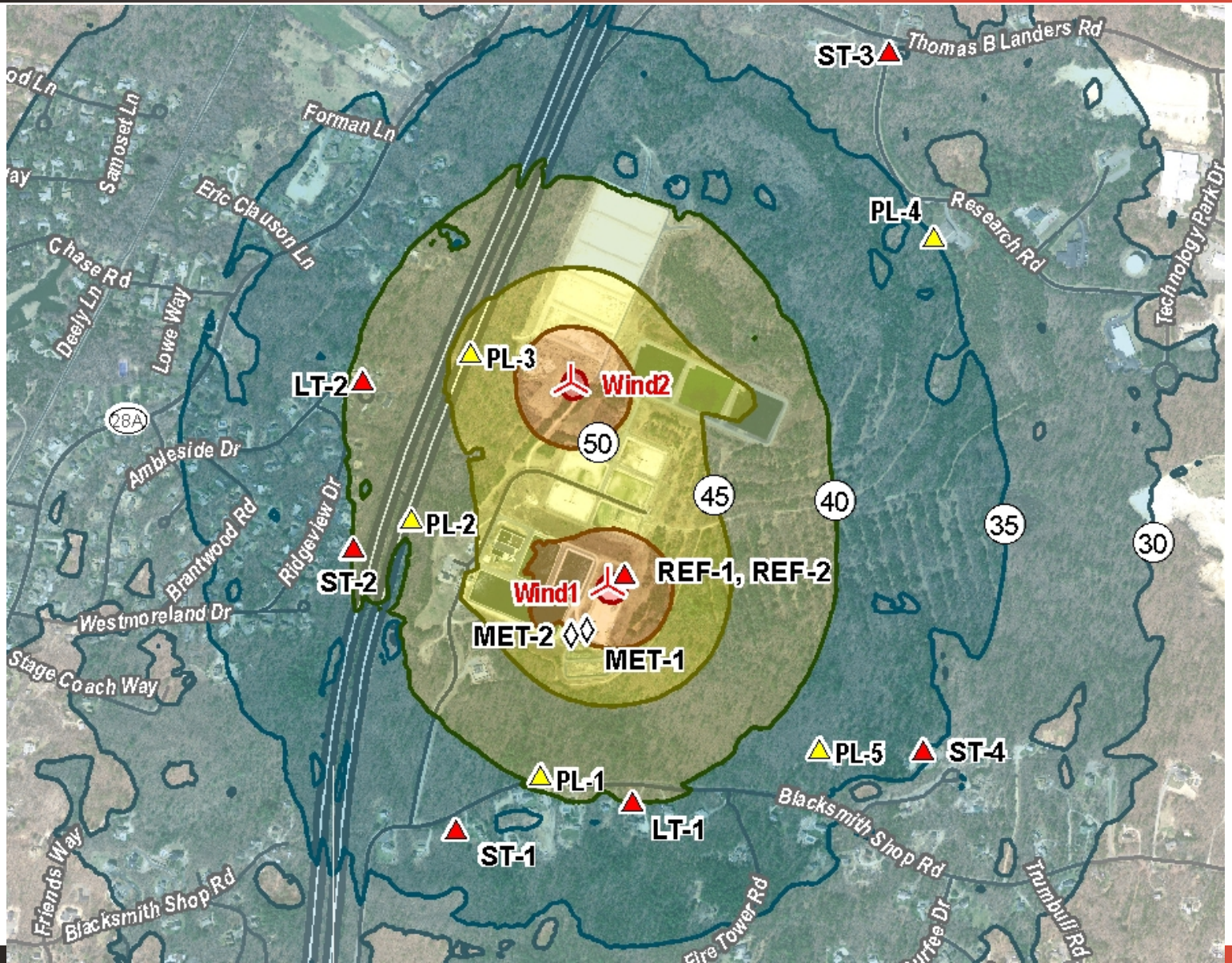


HMMH Reference Sound Level Measurements: Ground-plane Microphone near the Turbine

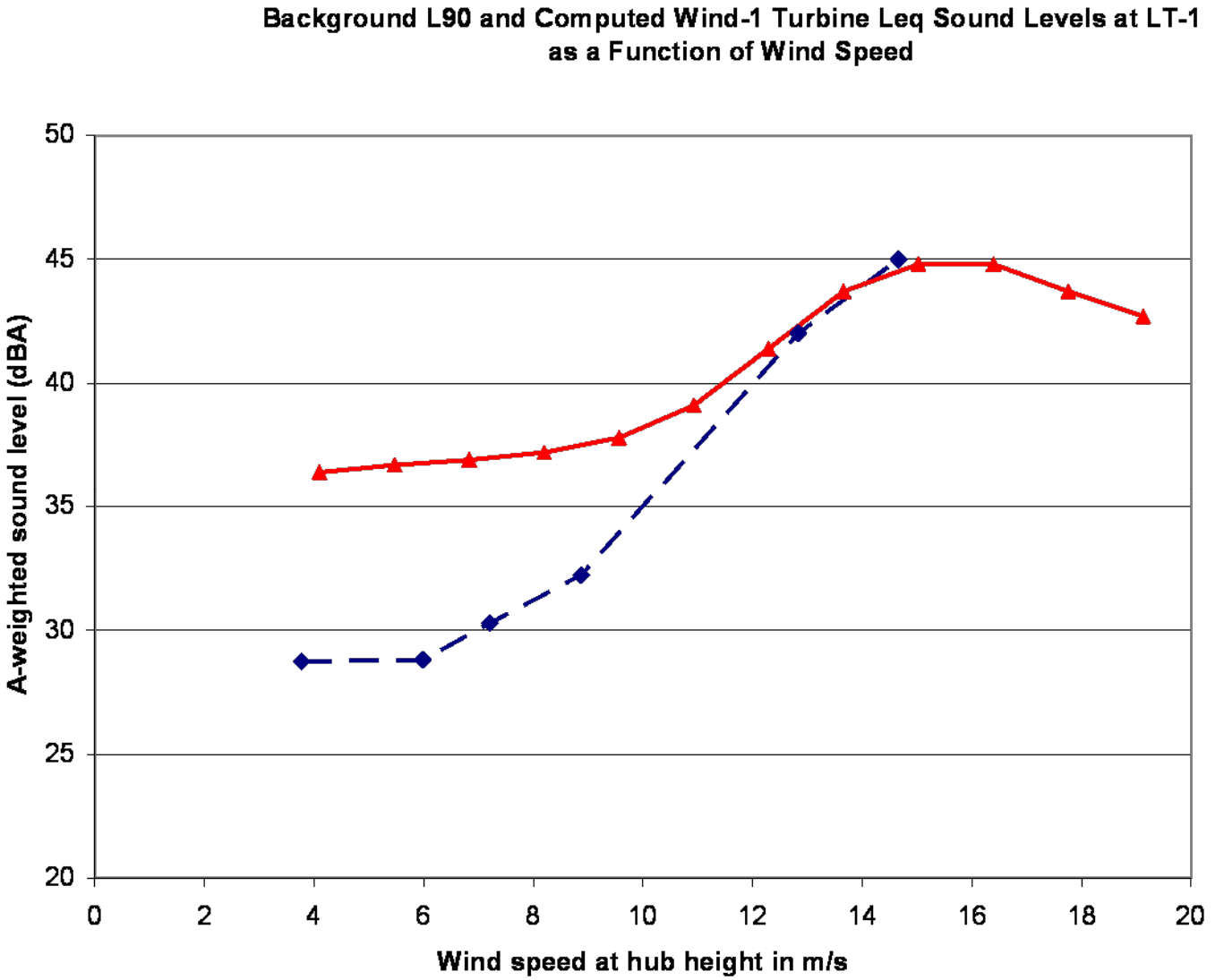
HMMH Reference Sound Level Measurements and Vestas Reference Data

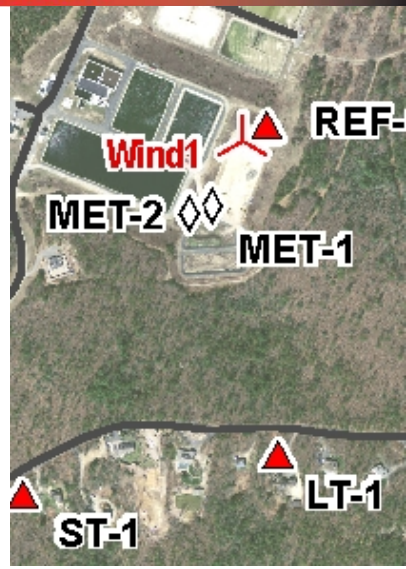


Model Results – Wind 1 and Wind 2 Turbines: Reference wind speed of 8 m/s at 10m (11 m/s at hub)



Turbine Sound Levels Relative to Background at Wind Speeds other than Reference





Key Findings – Presented to Falmouth Community

- **The Town is very concerned about effects of turbines on neighbors, and interested in hearing ideas**
- **Background sound levels increase with wind speed**
- **Sound from Wind-1 does not cause violations of MassDEP noise guidelines, but sound levels approach the 10 dBA increase threshold on Blacksmith Shop Rd.**
- **With both Wind-1 and Wind-2 operating, modeling predicts no violations at any measurement positions, but there may be slightly greater than 10 dBA increases at two homes at the end of Ambleside Drive only:**
  - During early morning hours when background is quietest, and
  - With wind speeds in the range of 5 to 6 m/s at turbine hub

Key Findings – Presented to Falmouth Community

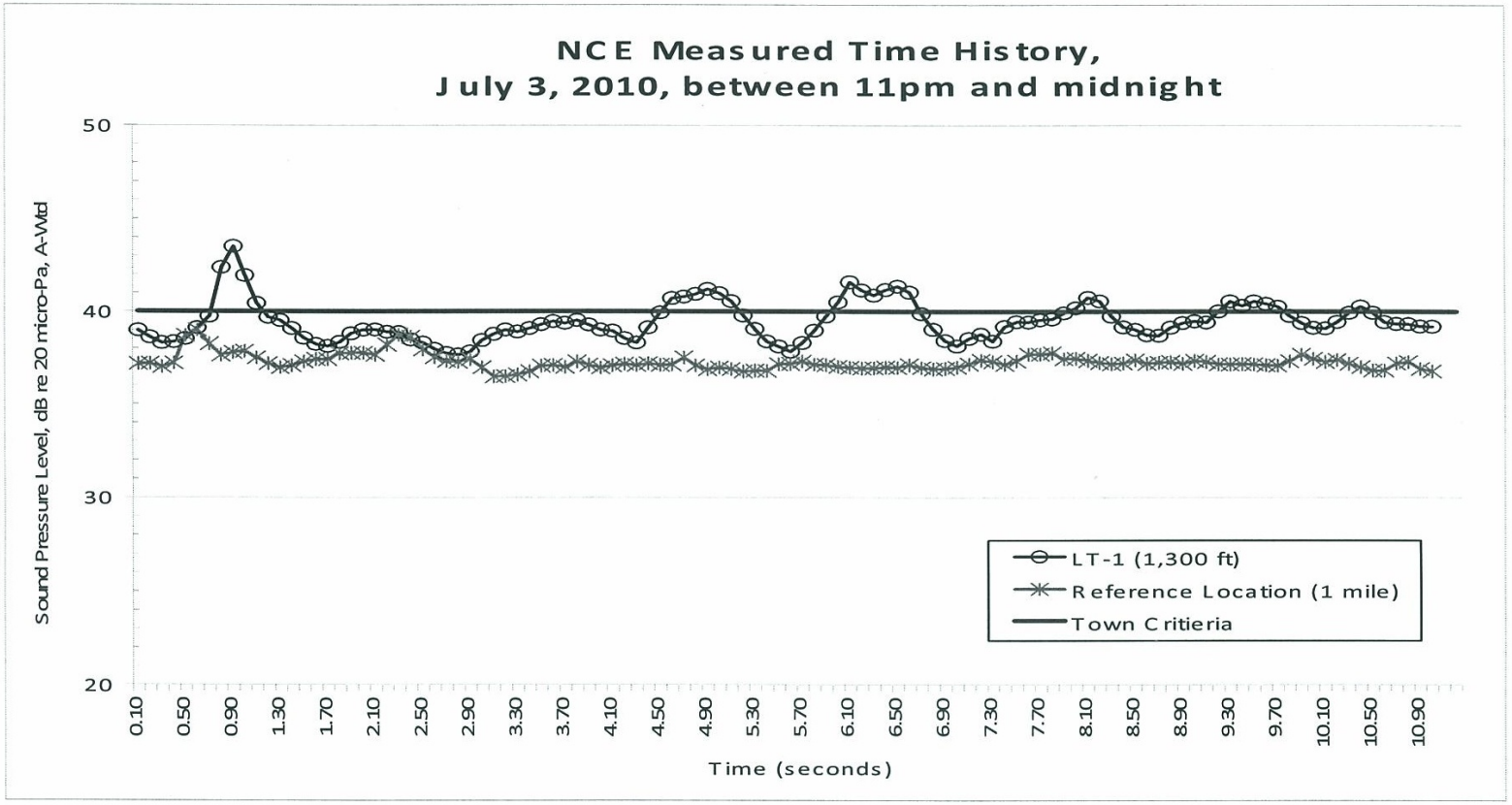
- **Nighttime background sound levels with low wind measured in June 2010 are nearly the same as those measured in January 2008, suggesting minimal seasonal variation**
- **Reference measurements suggest the Wind-1 turbine is operating at or below the manufacturer's noise specs.**

Noise Control Engineering Inc.: "Amplitude Modulation is the Main Issue"

Noise Control Engineering, Inc.

November 15, 2010

FIGURE 1: NCE measured data showing Aerodynamic Amplitude Modulation (AAM).



Study Update – 2011

- **Letter from DEP SE Region (Jan.-Feb.)**
  - One-hour periods
  - Lowest 1-hr L90 per wind speed
- **Meeting with DEP to discuss study rationale (March)**
- **Follow-up meeting minutes from DEP**
- **HMMH reprocessing Falmouth data per DEP request**

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