

March 21, 2017

El Paso Board of County Commissioners
200 South Cascade Avenue, Suite 100
Colorado Springs, CO 80903-2202

Re: Review of Epsilon Report 4177 October 7, 2016
Golden West Wind Energy Center El Paso County, Colorado

Per request of neighbors in Calhan, Colorado, I respectfully submit this review of the Sound Level Compliance Evaluation Report for the Golden West Wind Energy Center El Paso County, Colorado prepared by Epsilon Associates, Inc. for NextEra Resources, LLC dated October 7, 2016. I found *errors and omissions*. Professional opinions are provided below.

1. The report does not fulfill the requirements of Resolution No. 15-55 Section 17. Section 17 required "*an additional noise impact study, which shall evaluate the actual noise impacts of the project during operation*". The Epsilon Report ignores complaints of noise disturbance registered with the County and/or facility, and omits noise level and character assessments against relevant noise criteria [1].
2. The Epsilon Report disregards Colorado State Statute ARTICLE 12 – NOISE ABATEMENT, C.R.S. Sections 25-12-101 to -110, "Noise in excess of the limits provided in this article [*note: 45 dBA at night for periodic noise*] constitutes a public nuisance."
3. The Epsilon Report does not assess for noise disturbance despite apparent neighbor complaints of noise disturbance. Noise disturbance is prohibited by the County Ordinance No. 02-1, Section 3(e) and Section 4(a).
4. The Epsilon Report's data confirm the presence of intrusive facility noise levels exceeding the Colorado Statute Article 12, 45 dBA noise limit for periodic noise, establishing periodic noise levels a public nuisance at some 23 non-participating properties with dwellings.
5. The Epsilon Report provides *prima facie evidence* that the Golden West Facility wind turbine noise *is a public nuisance* under State law[2] yet neglects to inform the reader.

1 To assess for noise impacts, noise levels and character should be compared to accepted noise criteria associated to adverse impacts on people. Epsilon omitted noise impact assessment. Exceeding known criteria for public nuisance and sleep disturbance but omitting notification, could result in prolonging noise impacts and disturbance such as sleep deprivation, activity interference, or reduced enjoyment of property. Such

2 Colorado C.R.S. Section 25-12-103.

6. The Report does not corroborate that all turbines were operating at full power/acoustic output. Experience at other facilities has shown some turbines operated at lower output during testing which can reduce total noise levels at a measurement location. **The Report as submitted does not represent worst case conditions.**

7. The Epsilon Report attests no non-participating property "will be exposed to sound levels over 50 dBA". This is contradicted by the Report's data exceeding 50 dBA some portion of the time at several non-participating property line locations. Example, the L10 noise level, exceeded 10 percent of the time, may equate to 36 days per year above regulatory limits.

8. Location 7 appears farther away from the nearest Turbine #55 (710 ft) than the nearest non-participating property line (~480 ft based on scaled Epsilon figure). The distance to the Location 7 assures noise levels from Turbine #55 are under-represented by 3 dB.

9. The Epsilon Report removes unattended averaged data over 50 dBA with a dismissive attribute for contamination from non-turbine noise sources. Not a valid assumption without witnessing, observers, recordings, hence no basis to consign to non-turbine noise sources.

10. Noise levels of 40 dBA and higher, per ANSI S12.9 Part 5, are ***incompatible*** with rural land use [***Epsilon knowledge***, footnote 3]. Noise impact assessment absent in Epsilon Report.

11. Noise levels of 40 dBA at night ***exceed*** WHO 2009 thresholds of noise effects on people [***Epsilon knowledge***, footnote 4], **assuring sleep disturbance**. Noise impact assessment was not found in the Epsilon Report. **Epsilon omitted assessment of Golden West noise impacts on children, chronically ill and elderly.**

12. Even wind industry consultants documented, noise levels over 40-45 dBA are associated with ***complaints such as sleep disturbance*** [5]. However, the Epsilon Report was mute.

3 Note: Epsilon's Founder and Senior Consultant Robert Hellweg was Chair for the ANSI Accredited Standards Committee for S12.9 which determines noise source compatibility for various land uses. ANSI standards are widely recognized as standards of good practice internationally.

4 Note: Epsilon's Founder and Senior Consultant Robert Hellweg invoked the WHO 2009 40 dBA,night guideline as an impact criterion in his report, "Review and analysis of the noise impact of the proposed new heliport pad at CHUV as contained in the PAC 315 Report on Environmental Impact (RIE)" dated June 24, 2012, stating, "*The CHUV heliport noise at nighttime now exceeds ... the WHO Europe target value for L_{night}(8hrs) of 40 dBA for nighttime noise to protect the public, especially the most vulnerable groups, such as children, the chronically ill and the elderly*".

5 Robert McCunney, Kenneth Mundt, W. Colby, et al, "Wind Turbines and Health: A Critical Review of the Scientific Literature", Journal of Occupational and Environmental Medicine, November 2014 - Volume 56 - Issue 11 - p e108–e130. Accessed March 10, 2017.

Summary of review:

Contrary to the permitting requirement, the Epsilon Report neglected to assess noise impacts. County, State, and professional noise impact criteria were omitted.

The Epsilon Report substantiates that the Golden West facility noise exceeds predicted noise levels, and exceeds County and State noise limits, while not confirming maximum output for all turbines during testing (noise levels may go higher than Epsilon measured). The Epsilon Report should not be considered protective of public safety, health and welfare, and departs from accepted professional practice.

Epsilon's noise measurements clearly confirm why neighbors complain.

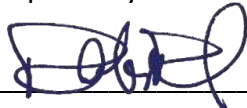
Experience has shown that when there are noise complaints during normal operation, this reveals that the designers, consultants and regulators have failed to meet their public protection responsibilities.

The Epsilon Report ignores law and does not assess complaints or impacts. Who benefits?

My professional experience says this facility should not have been permitted with turbines this large and this close to non-participating residential properties. The Epsilon Report shows the noise levels do not always comply with law and are consistent with noise disturbance. The law, were it to be enforced, requires the facility noise levels to be reduced.

Thank you for your consideration of this review letter. If you have any questions, please contact me.

Respectfully Submitted,

A handwritten signature in blue ink, appearing to read 'R. Rand', is written over a horizontal line.

Robert W. Rand, ASA, INCE

1. Documents Reviewed

The following documents were reviewed for this letter.

- Sound Level Compliance Evaluation Report, Epsilon Report 4177 October 7, 2016
- County of El Paso, CO Board of County Commissioners Resolution No. 15-55
- El Paso County "Ordinance Concerning Noise Levels" No. 02-1 dated 8/15/2002
- Colorado Revised Statutes – Article 12 – Noise Abatement, Sections 25-12-101 to -110
- "Noise Study Update", Golden West Energy Project, Energy Renewal Partners, LLC, prepared for Golden West Power Partners, LLC as a subsidiary of NextEra, Version 2, 12/2/14
- Document dated 1/6/2015, from Craig Dossey, Project Manager III, and Richard Harvey, Engineer III, to El Paso County Planning Commission, Tim Trowbridge, Chair.

2. Review Methodology

This review analysis was based in part on relevant American National Standards Institute (ANSI) standards, sufficient evidence compiled by the World Health Organization on the effects of noise on people, the ISO 9613-2 standard, the Colorado State and County noise regulations, and on years of experience evaluating predictive models and validating by measuring operating noise levels for power generation and wind turbine facilities.

Opinions are given to a reasonable degree of scientific certainty. These opinions are based on professional experience and the information available at the time of drafting this report. I reserve the right to supplement or revise should additional information come to light.

By my professional ethics, I hold paramount the safety, health and welfare of the public. These are the same stringent ethical requirements as for registered professional engineers. I'm aligned in practice to the National Society of Professional Engineers (NSPE) who take seriously their responsibility for the safety and well-being of the public. Institute of Noise Control Engineering (INCE) Members are required to approve only noise control engineering studies, reports, or work which, to the best of their knowledge and belief, is safe for public health, property, and welfare and in conformance with accepted practice.

3. Review Details

Review Detail Sections:

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3.9. The Epsilon Report did not assess for noise impacts using known noise impact guidelines as criteria for sleep disturbance from the WHO.....31

3.1 The Epsilon Report ignored and omitted Colorado State Statute ARTICLE 12 – NOISE ABATEMENT

Originating in 1981 and continuously reaffirmed through 2016, Colorado State Statute Article 12 established A-weighted noise limits associated to noise nuisance [6]. By legislative declaration,

"The general assembly finds and declares that noise is a major source of environmental pollution which represents a threat to the serenity and quality of life in the state of Colorado. Excess noise often has an adverse physiological and psychological effect on human beings, thus contributing to an economic loss to the community. Accordingly, it is the policy of the general assembly to establish statewide standards for noise level limits for various time periods and areas. Noise in excess of the limits provided in this article constitutes a public nuisance."

The State's maximum permissible noise levels are listed below.

25-12-103. Maximum permissible noise levels.

(1) Every activity to which this article is applicable shall be conducted in a manner so that any noise produced is not objectionable due to intermittence, beat frequency, or shrillness. Sound levels of noise radiating from a property line at a distance of twenty-five feet or more therefrom in excess of the db(A) established for the following time periods and zones shall constitute prima facie evidence that such noise is a public nuisance:

Zone	7:00 a.m. to next 7:00 p.m.	7:00 p.m. to next 7:00 a.m.
Residential	55 db(A)	50 db(A)
Commercial	60 db(A)	55 db(A)
Light industrial	70 db(A)	65 db(A)
Industrial	80 db(A)	75 db(A)

(2) In the hours between 7:00 a.m. and the next 7:00 p.m., the noise levels permitted in subsection (1) of this section may be increased by ten db(A) for a period of not to exceed fifteen minutes in any one-hour period.

(3) Periodic, impulsive, or shrill noises shall be considered a public nuisance when such noises are at a sound level of five db(A) less than those listed in subsection (1) of this section.

The maximum permissible noise levels for residential use are essentially the same as found in the El Paso County Noise Ordinance 02-1, including a baseline night noise limit of 50 dBA. However, the State Statute 25-12-103(3) (outlined) defines public nuisance: *"Periodic, impulsive, or shrill noises shall be considered a public nuisance when such noises are at a sound level of five db(A) less than those listed in subsection (1) of this section."*

6 Retrieved from <http://www.lexisnexis.com/hottopics/colorado/> March 7, 2017.

Industrial wind turbines are ubiquitously considered periodic noise sources by wind industry and others due to their design with three blades sweeping in rotation, encountering wind shear, turbulence, blade-tower interaction [numerous references include 7,8,9,10,11,12].

The State Statute Article 12 limits noise from periodic-noise sources such as large industrial wind turbines to 50 dBA minus 5 dB, a maximum permissible noise level of 45 dBA at night.

Legislative Council confirmed the Article 12 Section 25-12-101 to -110 is in effect [13].

A question could arise as to whether the Epsilon Report may have taken an assumption that the El Paso County Ordinance 02-1 preempts State Law. However county preemption is not supported. The General Assembly declaration of statewide noise standards "should be afforded deference" [14].

Further as stated by Colorado Counties, Inc. [15], "Traditionally counties have been

7 Leventhall, G. et al, "periodic rise in level is also referred to as amplitude modulation", Wind Turbine Sound and Health Effects An Expert Panel Review, Prepared for: American Wind Energy Association and Canadian Wind Energy Association, December 2009. http://canwea.ca/pdf/talkwind/Wind_Turbine_Sound_and_Health_Effects.pdf accessed March 16, 2017.

8 Xu et al, "the periodic low frequency noise due to blade rotation", Modeling and Computation of Wind Turbine Low-Frequency Noise Generation and Scattering, <https://arc.aiaa.org/doi/abs/10.2514/6.2005-1189> accessed March 16, 2017.

9 Harrison, J., "the characteristic periodic or impulsive sound of a turbine", Disconnect Between Turbine Noise Guidelines and Health Authority Recommendations, <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.490.5087>, accessed March 16, 2017.

10 Hessler, H., "described as a churning, mildly periodic sound due to blade swish", Assessing Sound Emissions from Proposed Wind Farms & Measuring the Performance of Completed Projects. The National Association of Regulatory Utility Commissioners (NARUC), October 2011.

11 Zajamsek, B. et al, "Amplitude modulation (periodic variation)", Infrasound and Low-Frequency Noise from Wind Turbines, FSSIC2015, Perth, July 2015, DOI: 10.13140/RG.2.1.3826.5049 accessed March 20, 2017.

12 Google Patent, "As prior art blades entered and exited the tower shadow in the plane that is downwind of the tower without such sequential entrance and exit of portions of each blade, the relatively abrupt change in wind speed created an impulsive change in the blade's angle of attack, which resulted in a periodic noise being generated by the blades passage through the tower shadow." <https://www.google.co.in/patents/-WO2007011862A2> accessed March 7, 2017.

13 Telephone communication, March 16, 2017.

14 Colorado General Assembly LegiSource, <https://legisource.net/2011/11/03/when-can-a-local-government-override-state-law-home-rule-cities-in-colorado/> accessed March 20, 2017. "*The General Assembly's declaration that an issue is a matter of statewide or local concern is not conclusive but should be afforded deference in recognition of the legislature's authority to declare public policy of the state in matters of statewide concern. Town of Telluride, 3 P.3d at 37 (citing City and County of Denver v. State, 788 P.2d at 768 n. 6 (noting that the General Assembly's declaration is not binding)). It is not up to the courts to make or weigh policies. Id. at 38. Thus, when sufficient state interests are implicated, an issue that also implicates local interests is still a matter of mixed local and statewide concern. Id.*"

15 Colorado Counties, Inc., <http://ccionline.org/counties/> accessed March 20, 2017.

considered to be a subdivision of state government existing to administer state programs at a local level." Additionally, El Paso County is not a home rule county.

As defined in Statute Article 12, Section 25-12-102(6), *"Residential zone" means an area of single-family or multifamily dwellings where businesses may or may not be conducted in such dwellings*'. "Residential" is typically used to contrast with Commercial and Industrial use where people do not live. In the area of the Golden West facility, the residential use of dwellings on properties appears consistent with the literal wording of this definition.

Indeed, the El Paso County Noise Ordinance 02-1.3(j) agrees, defining residential property as, *"... any property which is occupied by a residence*, whether it be a single family, two-family or multi-family dwelling, or a mobile, manufactured or modular home, which is located within *any* zone district allowing a residence as a permitted principal use as set forth in the El Paso County Development Code, as amended." (emphasis added). The El Paso County Agricultural zoning assigned to most of the area near the Golden West facility allows a residence as a permitted principal use.

Contrary to the State Article 12, the County Ordinance 02-1 omits the 5-decibel penalty for periodic, impulsive or shrill noises. For periodic-noise sources such as large industrial wind turbines, the County Ordinance is more permissive than the State Statute by five decibels. The State Statute is more stringent.

In thirty-seven years of professional work, I have never seen a regulatory authority or governing body permit a permissive standard to take precedence over a more stringent standard.

No statement was found in the Epsilon Report, nor anywhere else, defining that the County Noise Ordinance 02-1 shall or has been determined to supercede, replace or render moot the regulatory authority of State Statute Article 12 Sections 25-12-101 to -110. Neither is any support found for the County Noise Ordinance to be superceded.

The conclusion is that 1) the State Statute Article 12 stands along with the County Ordinance 02-1 as concurrent regulatory requirements for the Golden West facility, and 2) the Epsilon Report was in error to exclude it.

It appears the County, the applicant/owner, and Epsilon all chose to omit assessment of the facility noise under State Statute Article 12. No mention is found in the Epsilon Report, the Golden West permit, nor any of the County documents reviewed.

3.2 Epsilon Report data confirm facility noise levels exceeded Colorado Statute Article 12, 45 dBA noise limit for periodic noise, at most locations

Epsilon Report noise data were compared to the noise levels predicted for the project. Almost all locations appeared selected where predicted "mean" noise levels were 48 dBA.

Epsilon reported Leq "average" levels at or close to 50 dBA at many locations. Average levels at 50 dBA mean that half or a significant portion of the time, the noise source is over 50 dBA. Epsilon discarded data and adjusted data above 50 dBA with results at 50 dBA or less.

Unattended non-witnessed data should not be discarded or adjusted speculatively as due to another noise source. That is not considered good professional practice.

L10 intrusive levels (10 percent of the time) measured above 50 dBA at five locations, and above 45 dBA at all locations except the distant non-property-line Location 15.

Measured average noise levels exceeded predicted average noise levels at the majority of locations. Data were sparse at several locations, limiting confidence in the results.

Location	Nearest IWT	Dist, ft	Predicted, (Mean) dBA	Measured, Leq (Average)	Measured, Lmax	Measured, L10
1	142	880	48	45-55	48-76	46-48
2	122	810	48	48-56	51-81	49-52
3	102	820	49	48-49	52-68	49-50
4	94	1070	48	47-48	51-59	48-50
5	85	1340	46	48-50	54-62	49-52
6	70	890	47	45-49	48-57	47-50
7	55	710	48	46-48	48-63	47-49
8	33	990	48	48	59-63	49
9	36	1140	48	49-50	55-67	51-52
10	37	1100	48	49-50	52-60	50-52
11	7	1470	48	46	48-51	46-47
12	27	960	48	46-50	52-71	46-52
13	144	840	47	44-45	53-55	45-46
14	82	1320	46	45	53-58	46
15	83	3960	37	29-38	34-46	30-39

Table 3.2.1. Epsilon measurement locations, nearest turbine (IWT) and distance to turbine, predicted Leq "average" noise levels and, noise levels measured by Epsilon, Leq (the energy-equivalent or "average" sound level), Lmax (the highest noise level) and L10 (the noise level exceeded only (present) 10 percent of the time). The data listed here are taken from the various tables in the Epsilon report. *The L10 is typically associated to intrusive noise sources and may be considered representative of periodic "whoosh" and "whoomp" noises emitted from wind turbine blades during rotation from faster winds at top to slower winds below.*

3.3 Epsilon Report data confirm predicted noise levels above 45 dBA that would constitute a noise nuisance per State Statute Article 12.

Figure 3.3-1 shows facility predicted 45 dBA and higher noise footprint (red).

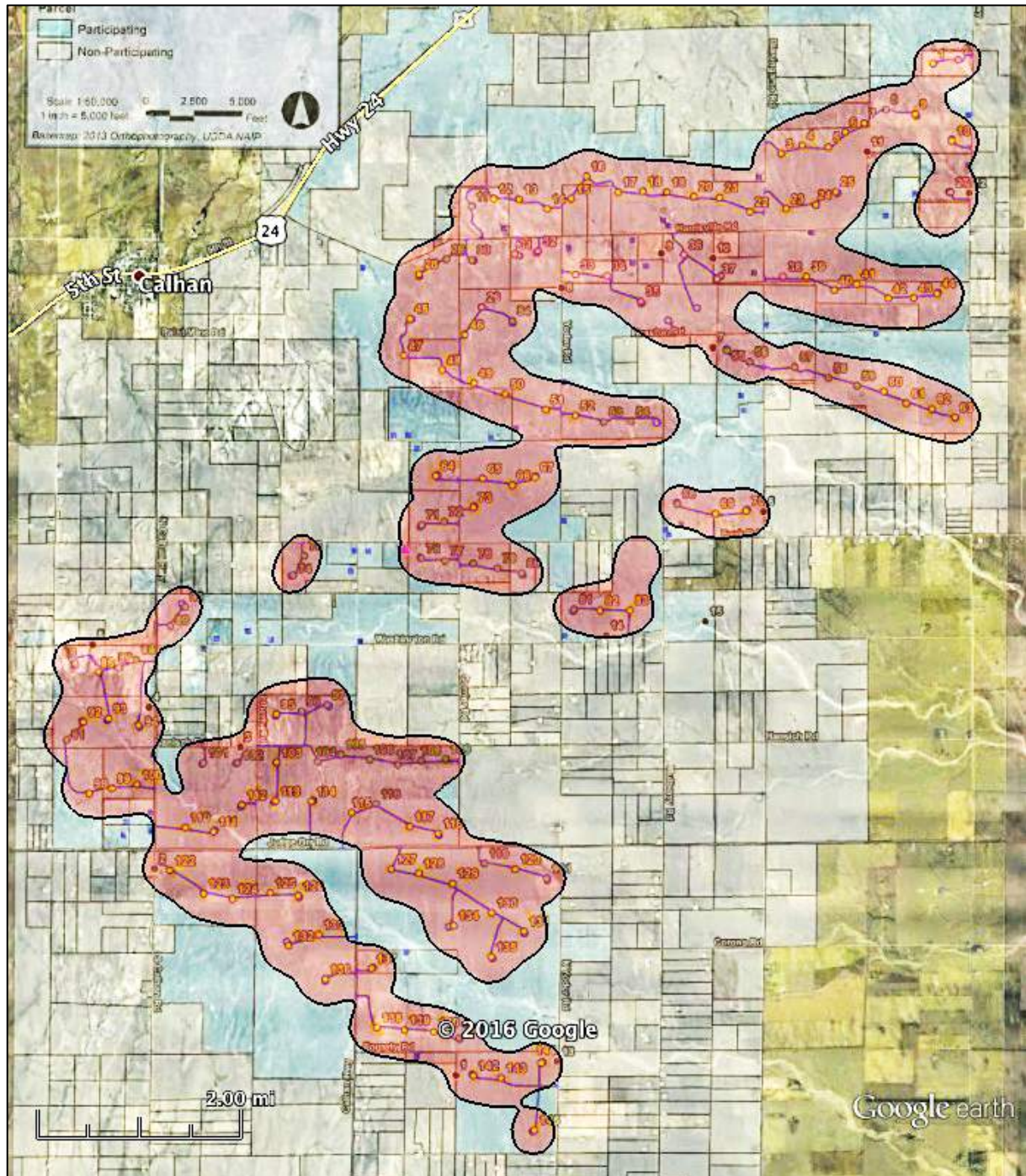


Figure 3.3-1. Golden West facility noise footprint, 45 dBA and higher predicted noise levels.

Epsilon Report Figure 6-1 is also shown for reference.

Some 7041 acres, or 11 square miles, were predicted to be exposed to "mean" noise levels of 45 dBA or higher. Much of that land is leased to the project by participating landowners.

Within the 11-square-mile 45-dBA noise footprint, some 23 non-participating residential properties *with occupied dwellings* (as included on Epsilon Figure 6-1) were found with predicted "mean" levels over 45 dBA at or within the property line. Of those, some 12 dwellings were found with 45-dBA predicted levels at the dwelling itself.

As seen in this letter's Section 3.2, Epsilon Report data substantiate Golden West facility operating noise levels are equal to or higher than predicted.

The Epsilon Report did not assess their measured data to State Statute regulatory limits.

The Epsilon Report data provide *prima facie evidence* that the Golden West Facility wind turbine noise is of sufficient level to constitute *a public nuisance* under State law.

3.4 Epsilon Report Section 4.5 "Evaluation Criteria": evaluates only for A-weighted sound level, omits assessment of *noise disturbance* as regulated under Ordinance No. 02-1 Section 4(a).1.

The Epsilon Report states that "Based on the permit conditions and county noise ordinance, the Golden West Wind Energy Center will be evaluated with respect to the 50 dBA noise limit." The Report provides an incomplete construction of the regulatory obligations of the Golden West facility or any noise source regulated under Ordinance 02-1.

The El Paso County Ordinance regulates with A-weighted sound levels for Sections 4(a)(2) and 4(a)(3). The Epsilon Report appears to consider A-weighting the only regulatory requirement under County law.

However Ordinance 02-1 Section 6 clearly applies only to Section 4(a)(2) and 4(a)(3) and exempts requirement on Section 4(a)(1) for an A-weighting analysis.

SECTION 6. Classification and Measurement of Noise: For the purposes of measuring any noise to determine whether a person has violated Section 4(a)(2) or 4(a)(3) of this Ordinance, the following test measurements and requirements shall be applied:

- a. Any noise originating within a public right of way or other public land shall be measured at a distance of at least 25 feet from the noise source.
- b. Any noise originating on private property shall be measured at or within the boundary of the property from which a noise complaint is made.
- c. The noise shall be measured on a weighing scale on a sound level meter of standard design and quality and in accordance with the standards promulgated with the American National Standards Institute.
- d. For the purposes of this Ordinance, measurements with sound level meters shall be made when a wind velocity at the time and place of such measurement is not more than five (5) miles per hour, or more than twenty-five (25) miles per hour with a windscreen appropriately attached to the microphone.
- e. Vehicle noise shall be measured at a distance of at least twenty-five (25) feet from the near side of the nearest lane being monitored and at a height of at least four (4) feet above the immediate surrounding surface.

El Paso County Ordinance 02-1 contains the regulatory prohibition for noise disturbance 4(a)(1) which was omitted from discussion or use in the Epsilon report:

SECTION 4. Prohibited Activities:

- (a.) It shall be unlawful to engage in any of the following activities, whether by use of a sound producing device, other device, or other means (either natural or artificial):
1. To knowingly permit, make, cause to be made or continue any noise disturbance, as defined in Section 3(e) of this Ordinance.

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2. To exceed the sound levels provided for in Section (5) and as measured as provided for in Section (6), below.
3. To operate a motor vehicle in a public right of way and exceed the sound level provided for in Section (5) and as measured as provided for in Section (6), below.
4. Knowingly and repeatedly sounding any horn or other auditory signaling device on or in any motor vehicle on any public right-of-way or public space, except as a warning of either danger or emergency.

Ordinance Section 3(e) defines "Noise Disturbance":

- (e) "Noise Disturbance" means any sound which is:
- (1) Harmful or injurious to the health, safety or welfare of any individual; or
 - (2) Of such a volume, frequency and/or intensity that it unreasonably interferes with the quiet enjoyment of life of an individual of ordinary sensitivity and habits; or
 - (3) Unreasonably interferes with the value of real property or any business conducted thereon.

Ordinance Section 3(k) defines "sound" as follows:

- (k) "Sound" means an oscillation in pressure, stress, particle displacement, particle velocity or other physical parameter, in a medium with internal forces. The description of sound may include any characteristic of such sound, including duration, intensity and frequency.

As shown above, the County Ordinance 02-1 Section 4(a)(1) and its supporting definitions clearly prohibit noise disturbance and authorize assessment of noise disturbance by descriptions of sound that *"may include any characteristic of such sound, including duration, intensity and frequency"*.

For example: in assessing for noise impacts for compliance with Ordinance Section 4(a)(1), characteristics (and associated criteria) such as,

- one-third octave band noise levels (frequency tonal analysis per ANSI S12.9 Annex C),
- interior low-frequency "L_{pa},lf" sound levels (defined by Danish industrial noise standards for assessing noise impacts from industrial noise sources for preventing noise disturbance),
- acoustic oscillations at the blade pass frequencies of the wind turbines (presence of and intensity in Pascals or Pascals expressed as dB re 20uPA in the range of 0.1 to 1 Hz, re ISO 9996 motion sickness periodic oscillations frequency range), and
- L_{max}, dBA noise levels indoors (re WHO 2009 L_{max} sleep disturbance thresholds),

are all examples of "descriptions of sound" included by the definition of "sound" underpinning 4(a)(1) and example noise impact criteria.

The Epsilon Report states that the survey protocol was coordinated with the County and the facility owner. It is assumed that all parties were fully informed of the noise disturbance complaints, and would have coordinated survey methods and reporting as needed through 4(a)(1) to detail such descriptions of sound to determine and document the noise impacts in the Report.

Unfortunately the Epsilon Report lacks analysis and assessment of noise complaints and noise disturbance as defined and prohibited in County Ordinance 02-1 Section 4(a)(1).

3.5. Section 6.2 Sound Level Measurement Locations

The Epsilon Report Figure 6-1 shows the turbine and measurement locations.

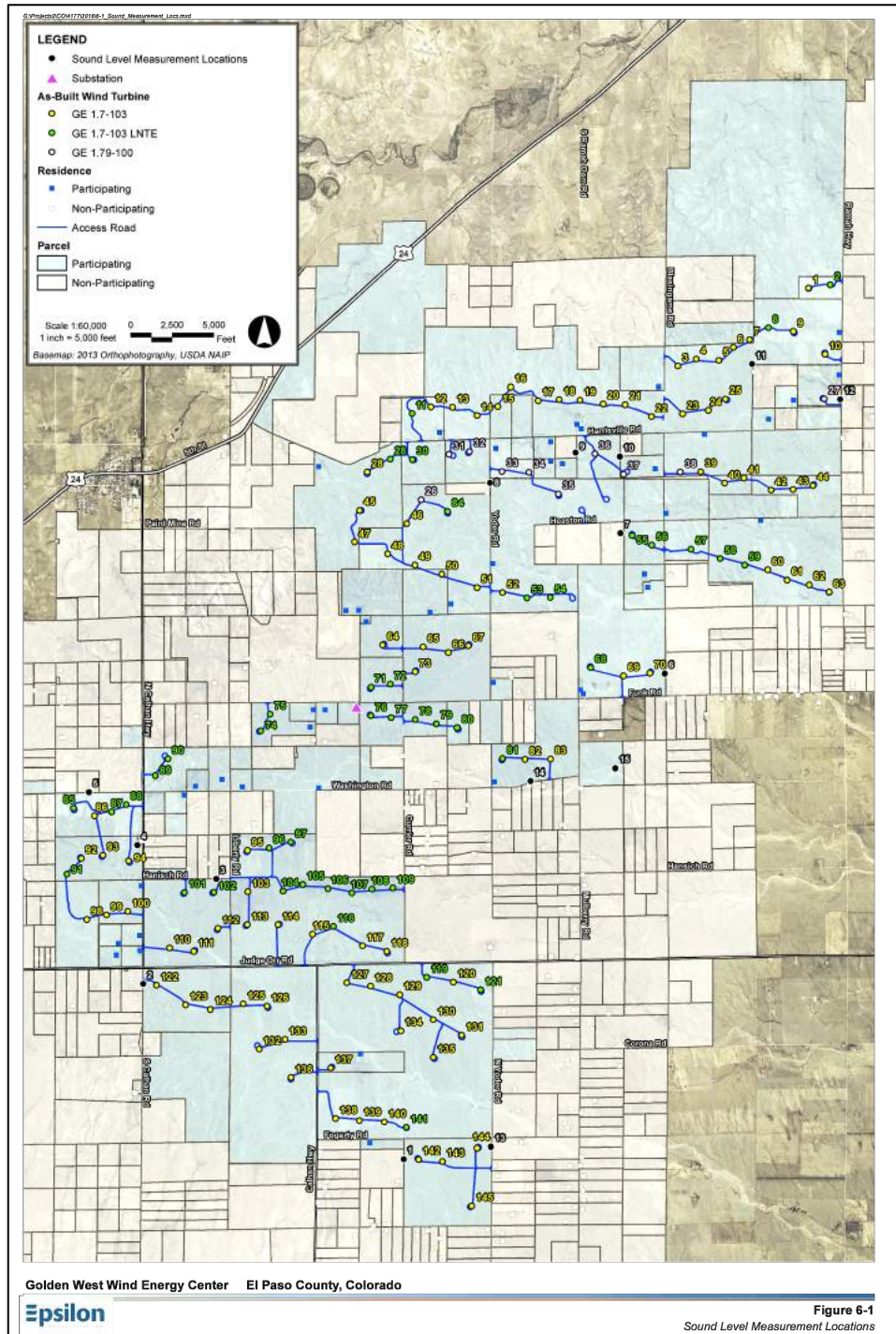


Figure 3.5-1. Epsilon Report Figure 6-1 shown.

The report states the measurements locations (noted ML in this letter) were selected "based on the modeled sound levels". Review of the modeled levels and MLs confirm most MLs were located at a predicted sound level of 48 dBA. See screen shots of predicted noise levels and MLs below. For this section, noise predictions were scaled into Google Earth, overlaid by the Figure 6-1, and notated at the 50, 45, and 40 dBA contours as shown.

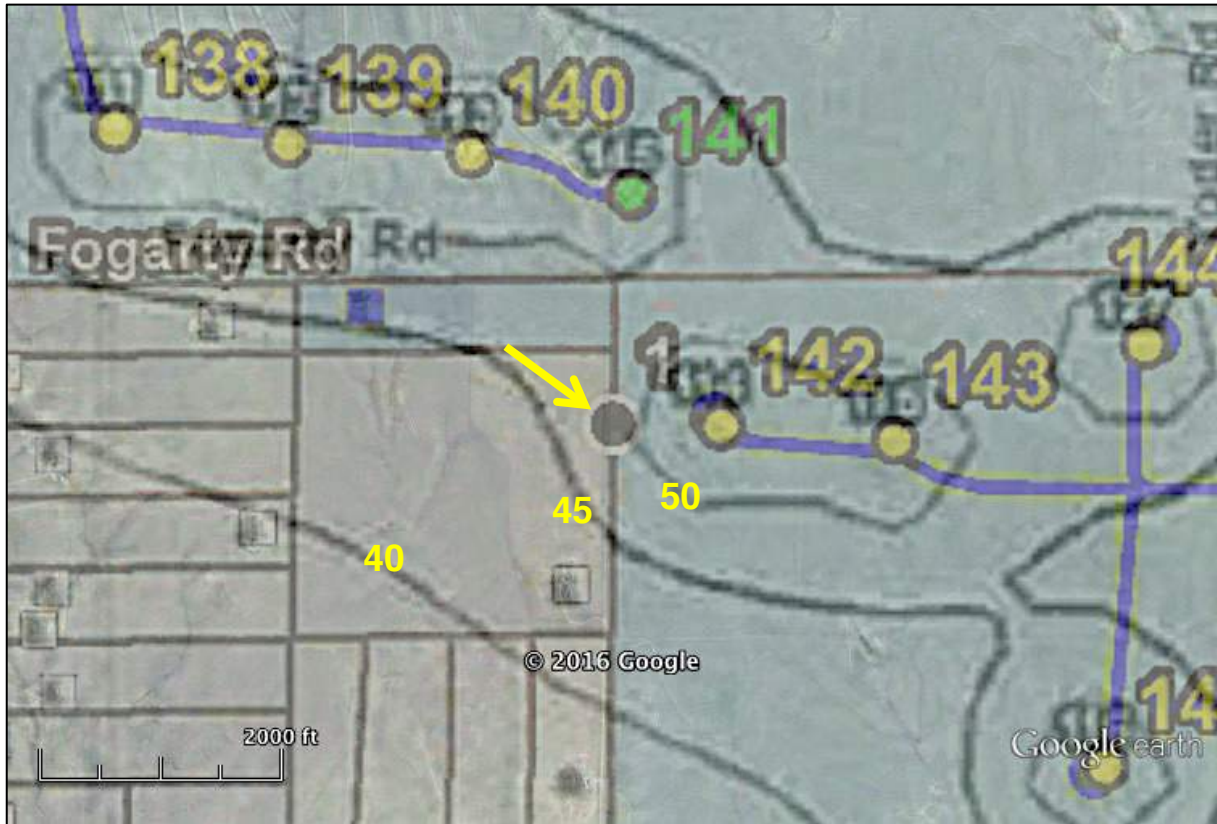


Figure 3.5-1. ML-1 (black dot), located at a predicted sound level of approximately 48 dBA.

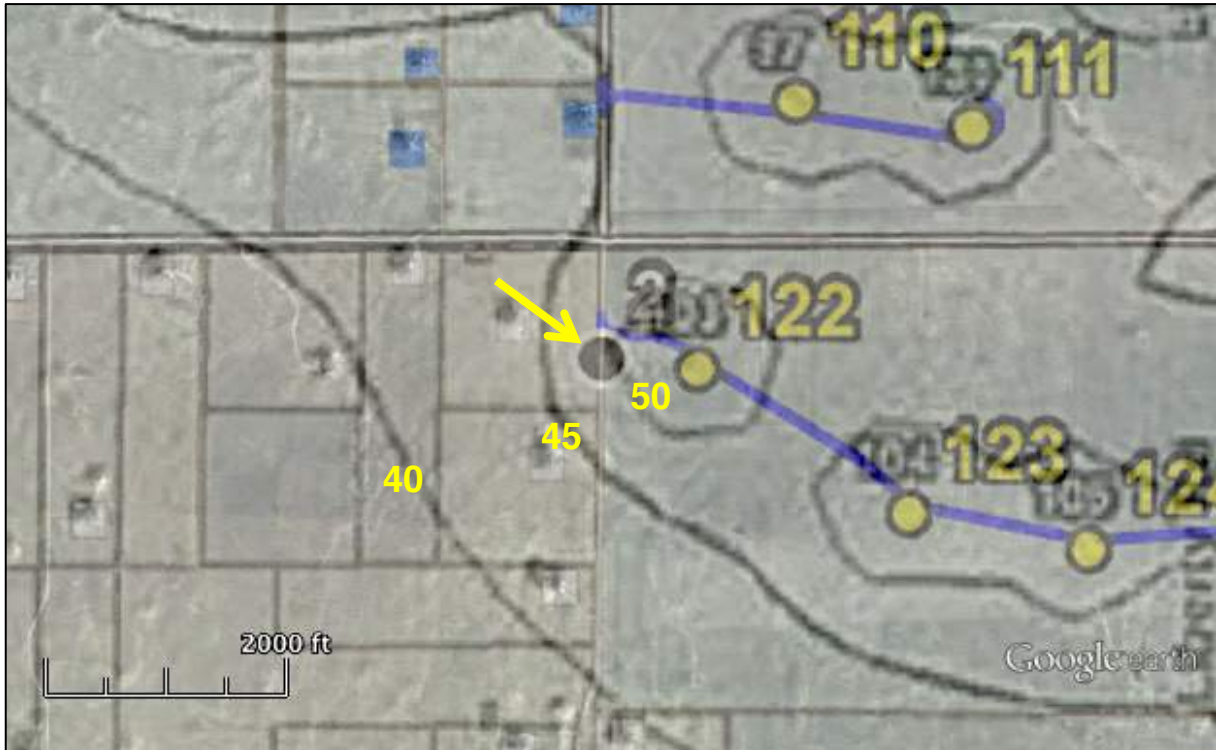


Figure 3.5-2. ML-2 (black dot), located at a predicted sound level of approximately 48 dBA.

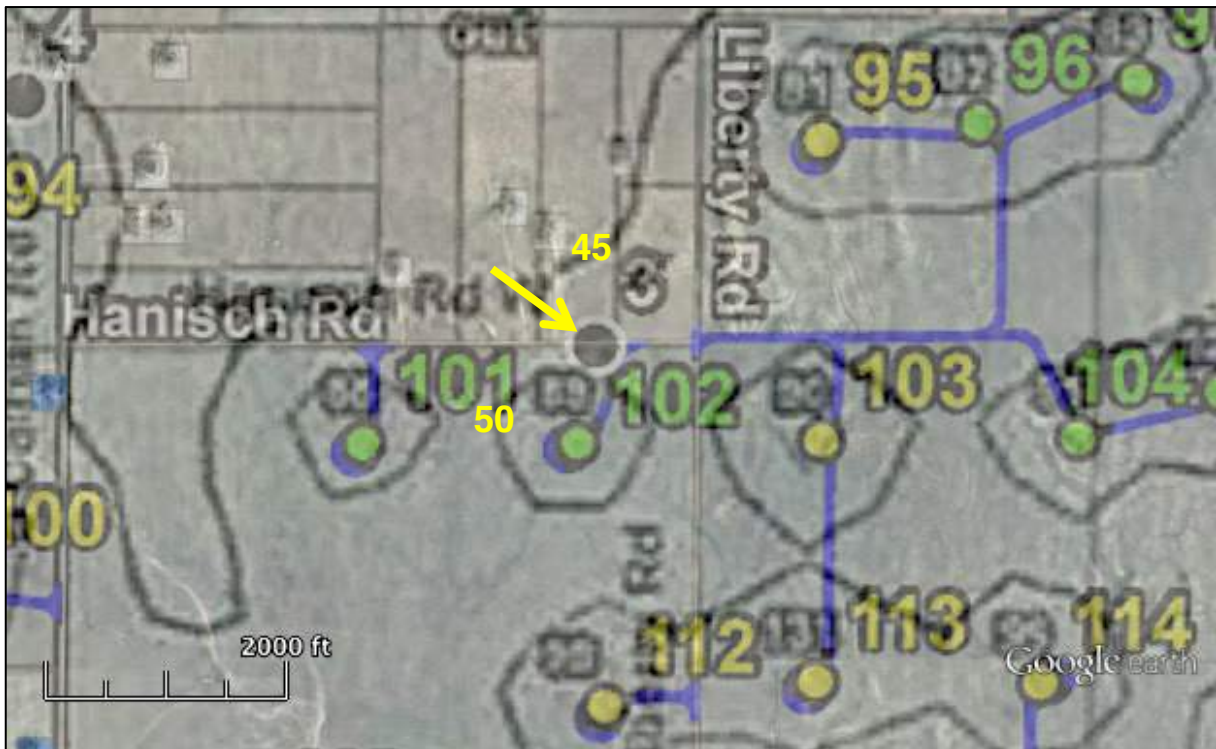


Figure 3.5-3. ML-3 (black dot), located at a predicted sound level of approximately 48 dBA.

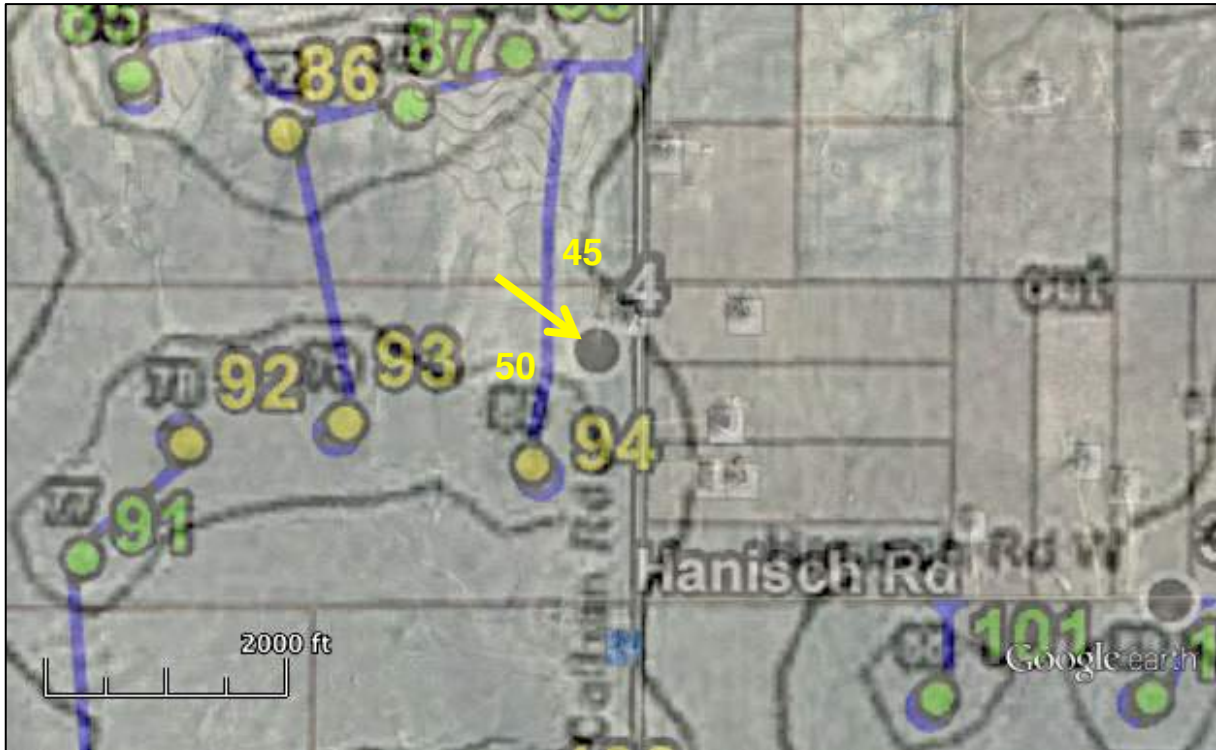


Figure 3.5-4. ML-4 (black dot), located at a predicted sound level of approximately 48 dBA.

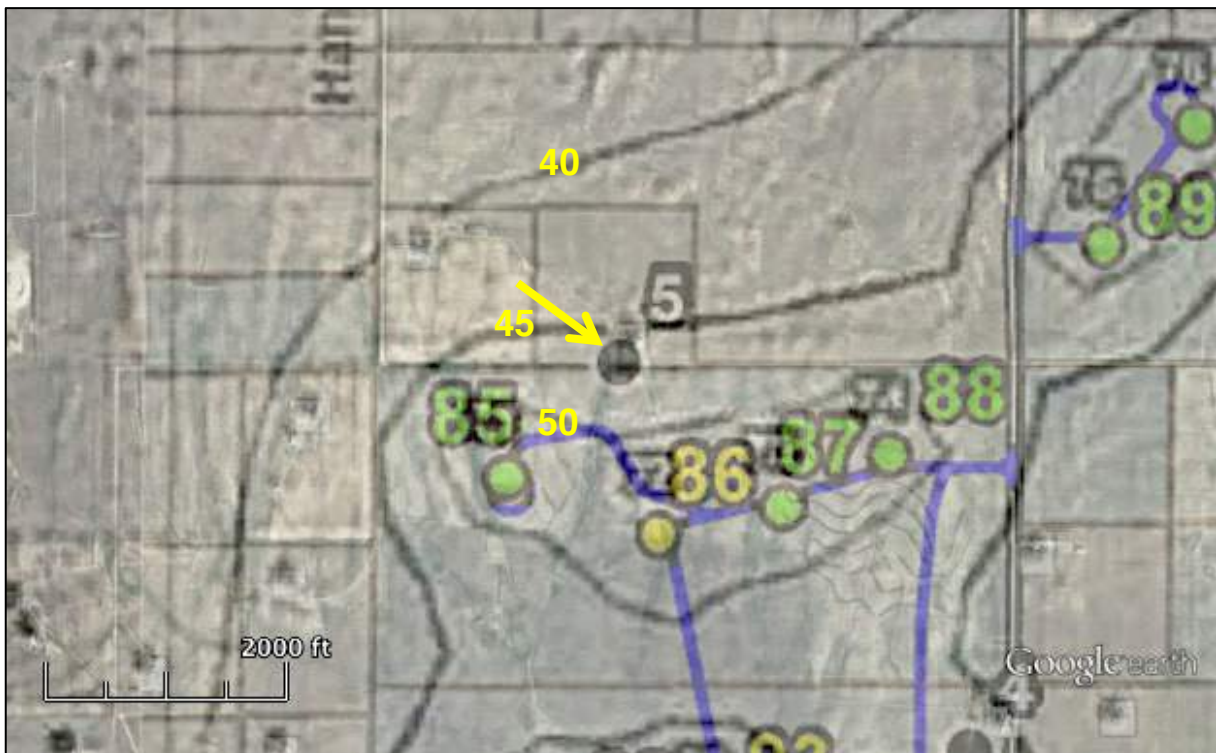


Figure 3.5-5. ML-5 (black dot), located at a predicted sound level of approximately 46 dBA.

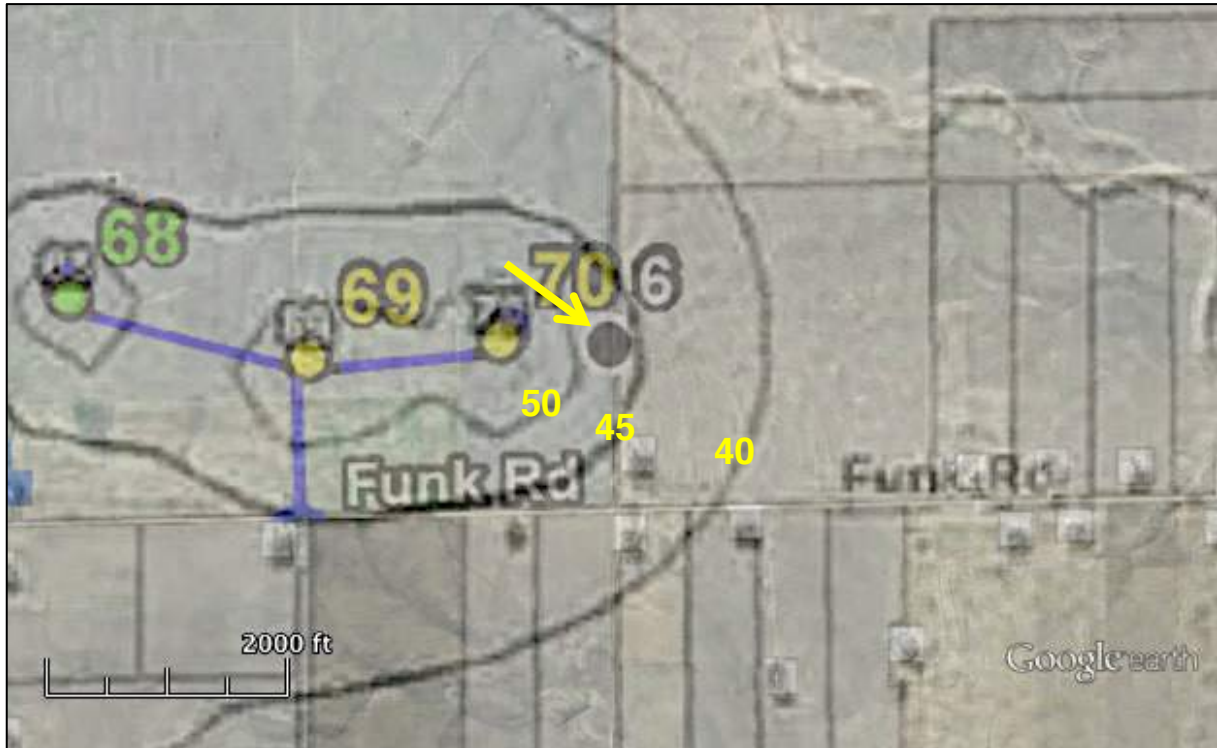


Figure 3.5-6. ML-6 (black dot), located at a predicted sound level of approximately 47 dBA.

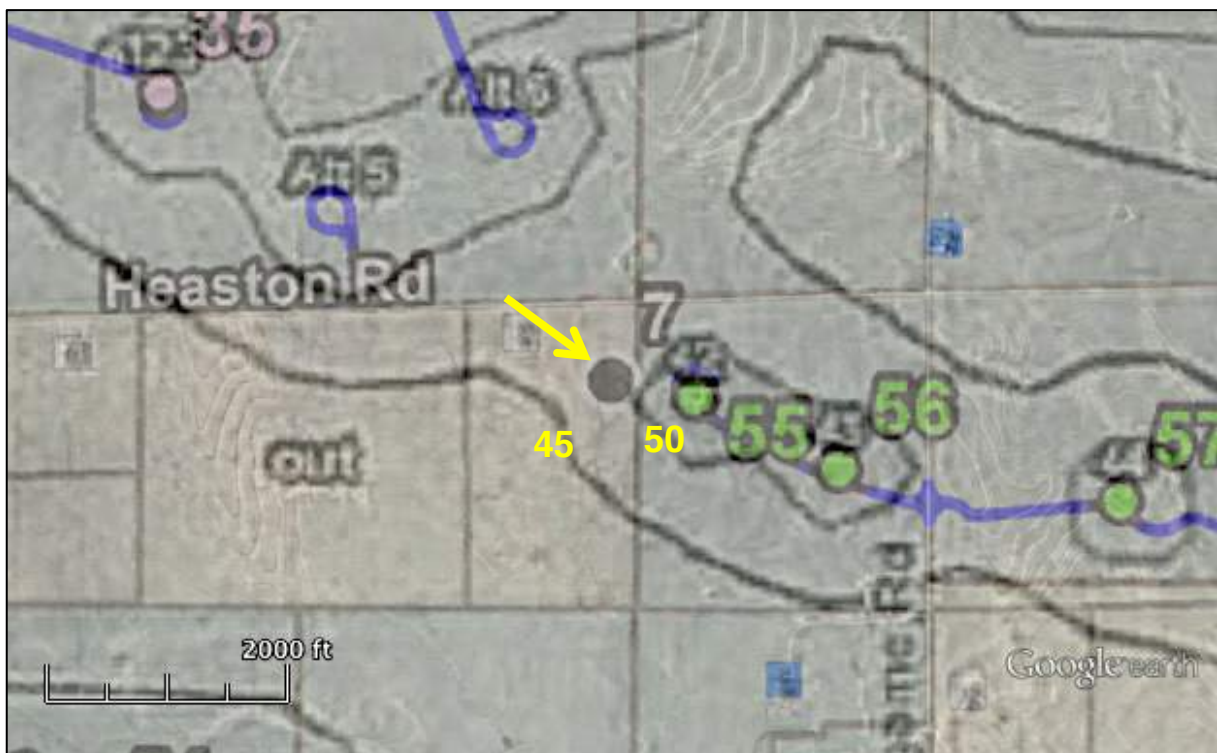


Figure 3.5-7. ML-7 (black dot), located at a predicted sound level of approximately 48 dBA.

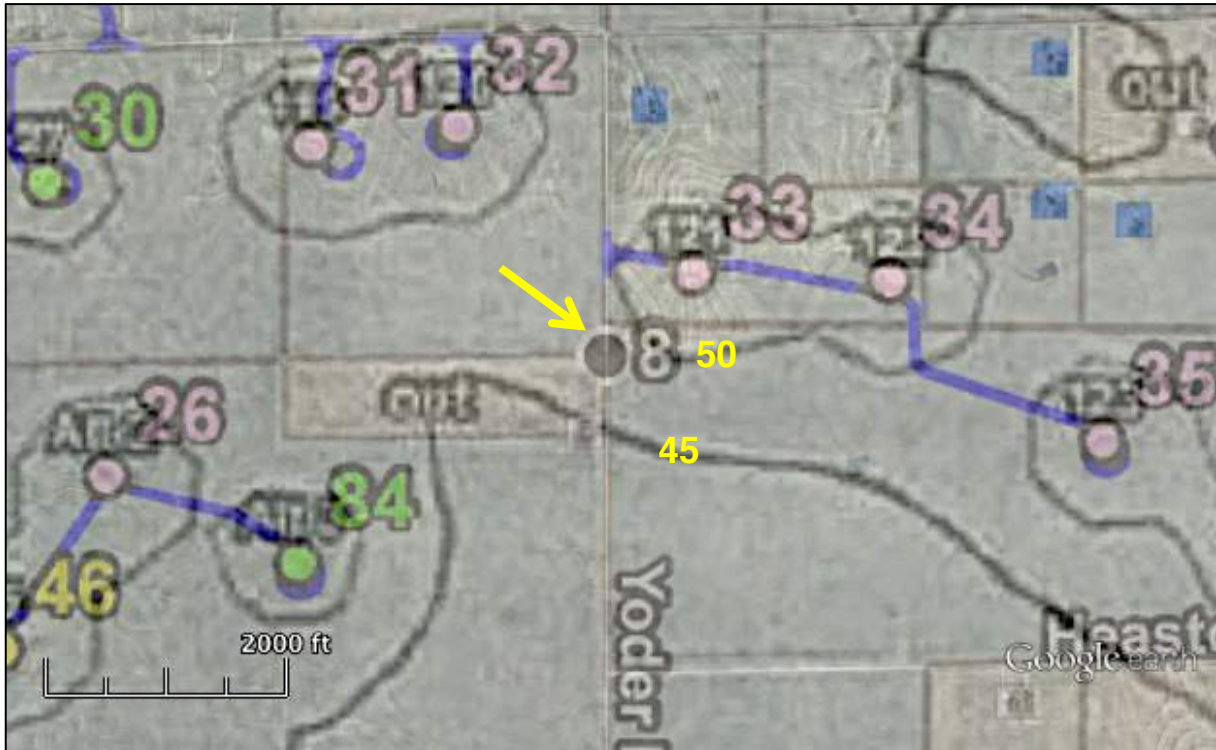


Figure 3.5-8. ML-8 (black dot), located at a predicted sound level of approximately 48 dBA.

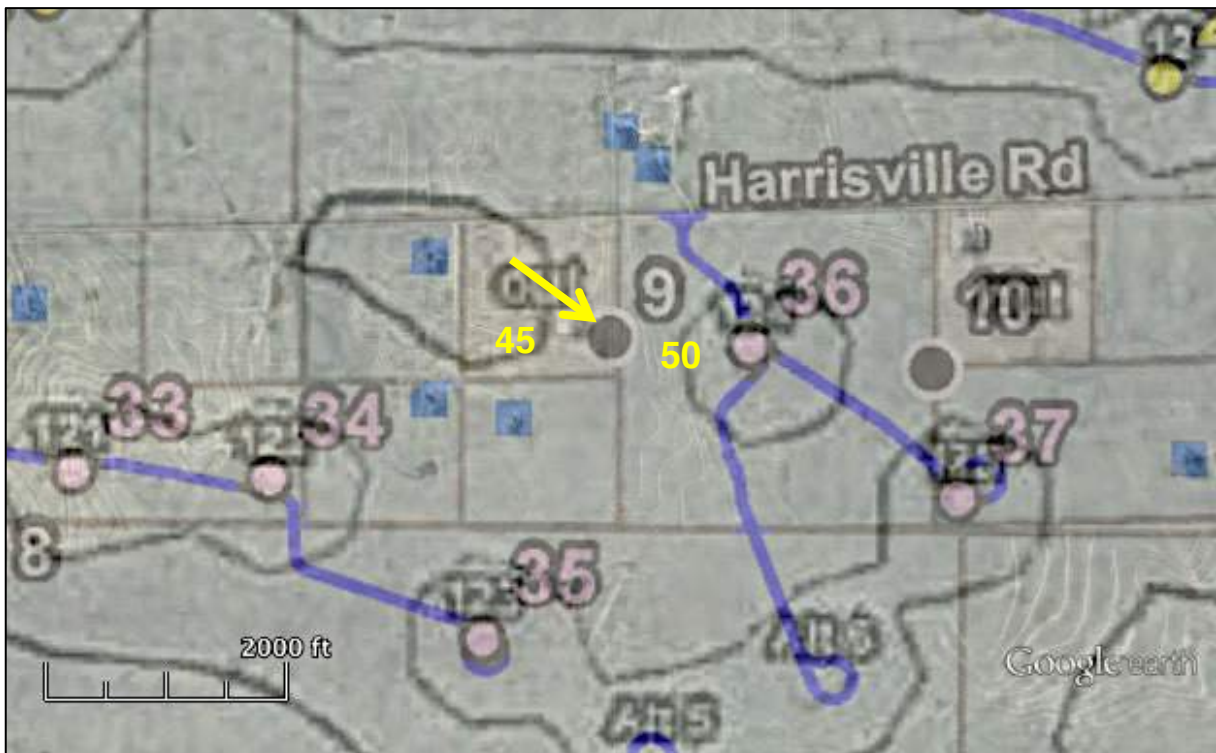


Figure 3.5-9. ML-9 (black dot), located at a predicted sound level of approximately 47 dBA.

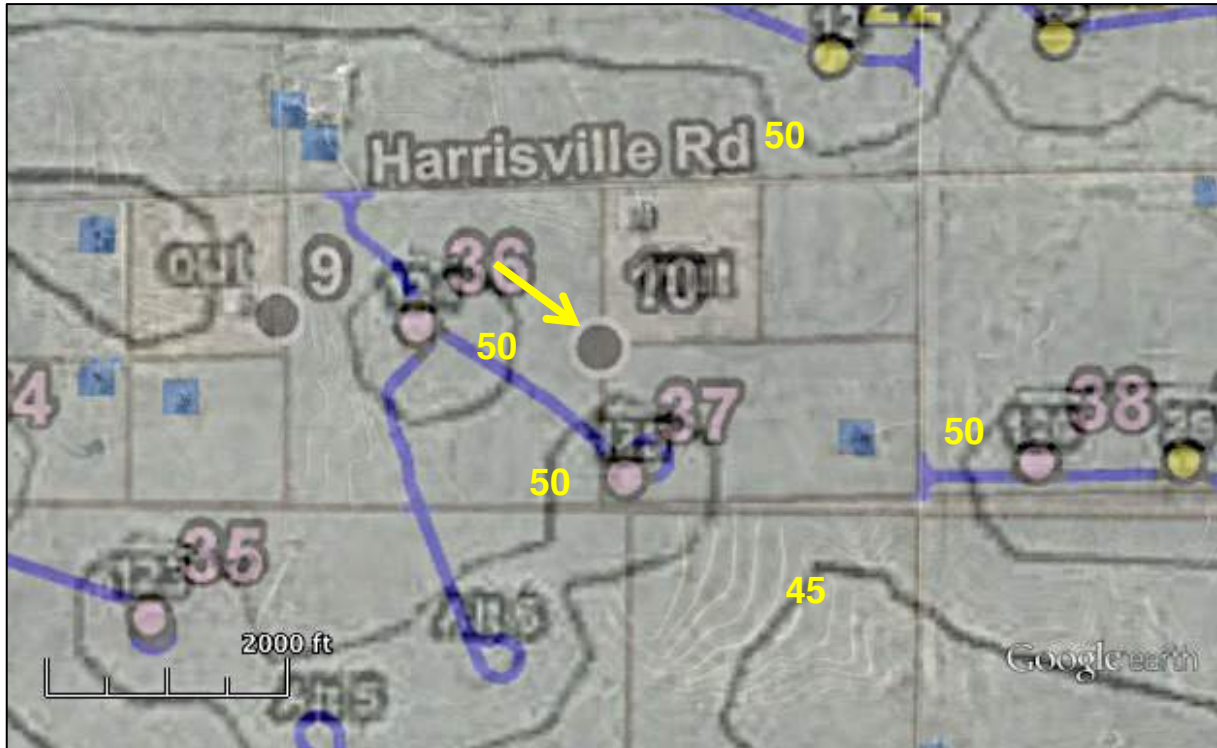


Figure 3.5-10. ML-10 (black dot), located at a predicted sound level of approximately 49 dBA.

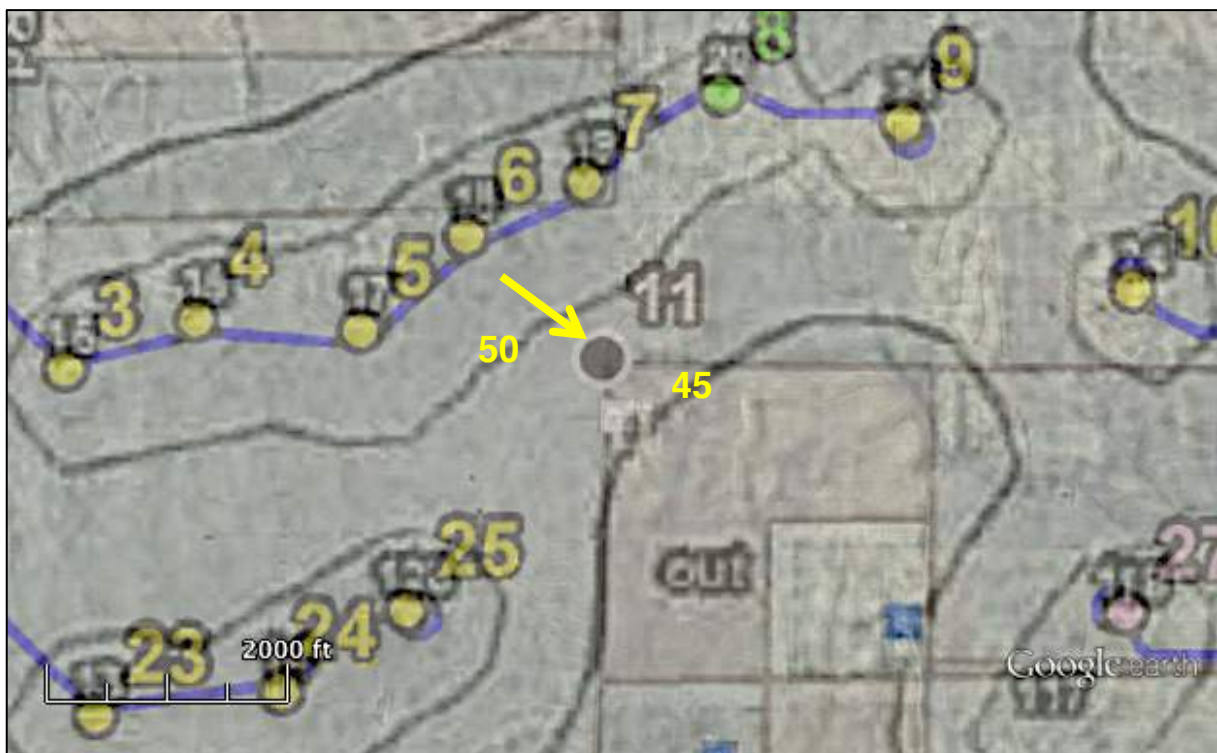


Figure 3.5-11. ML-11 (black dot), located at a predicted sound level of approximately 48 dBA.

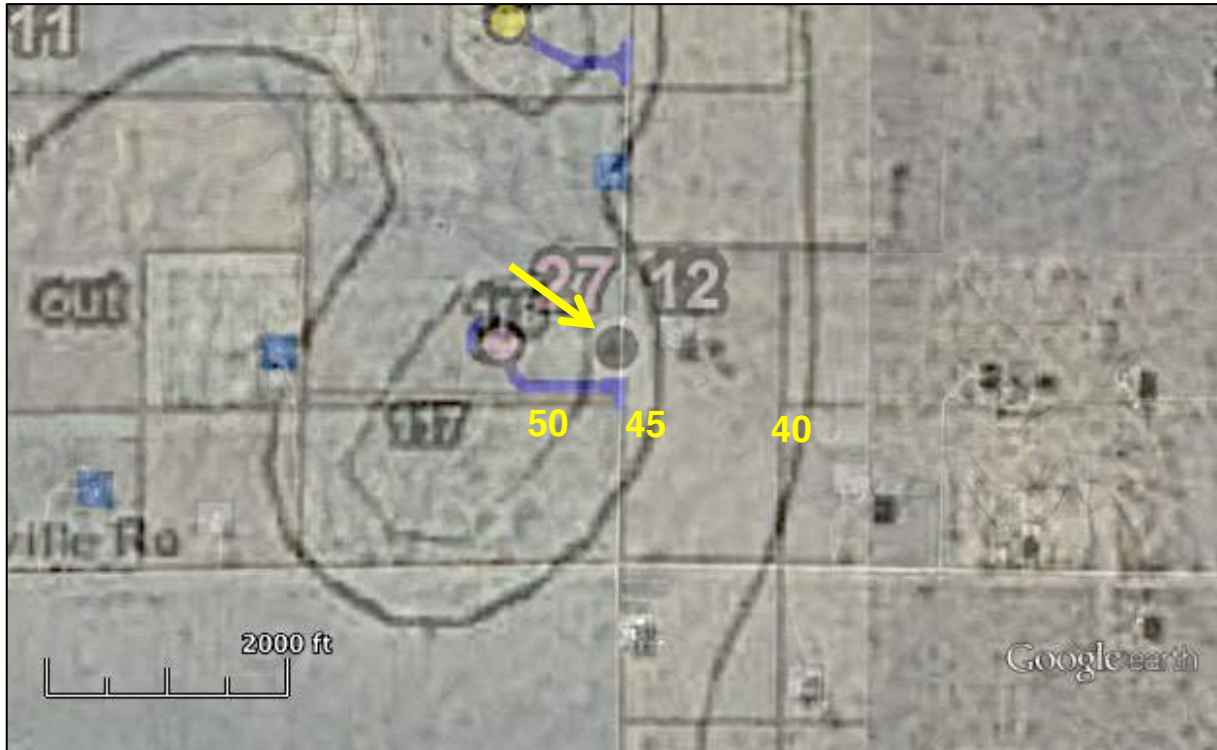


Figure 3.5-12. ML-12 (black dot), located at a predicted sound level of approximately 48 dBA.

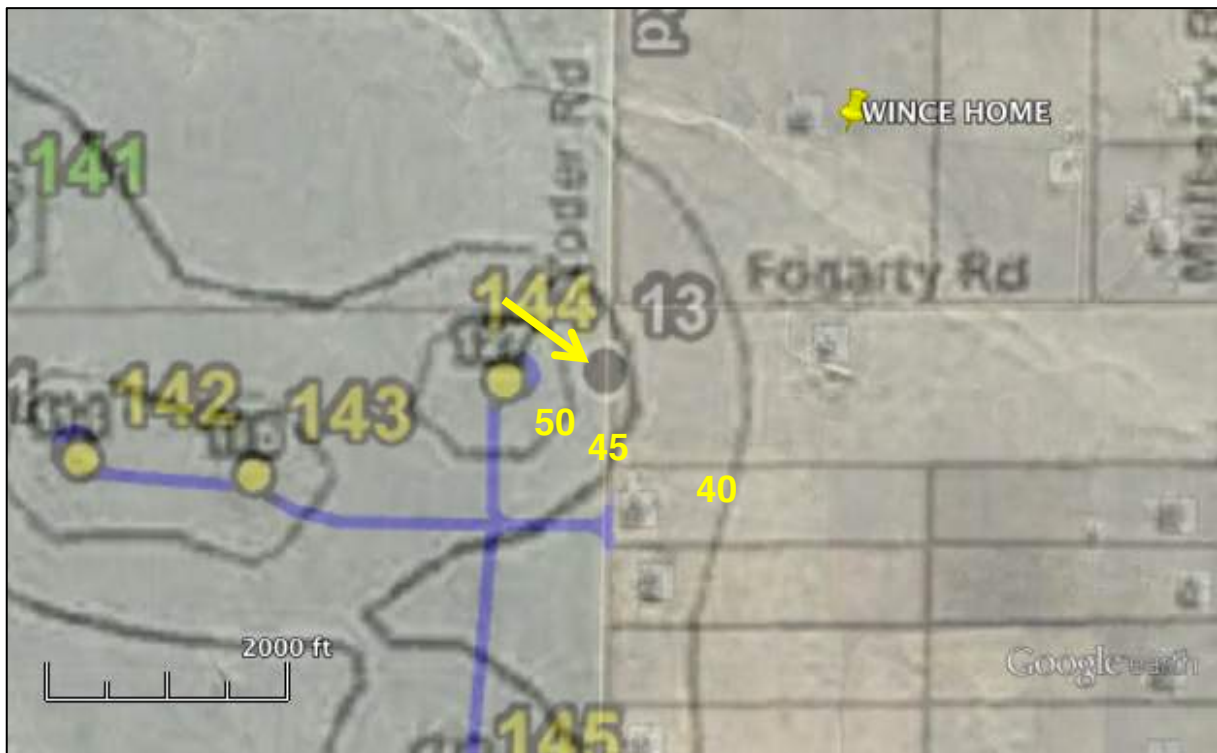


Figure 3.5-13. ML-13 (black dot), located at a predicted sound level of approximately 47 dBA.

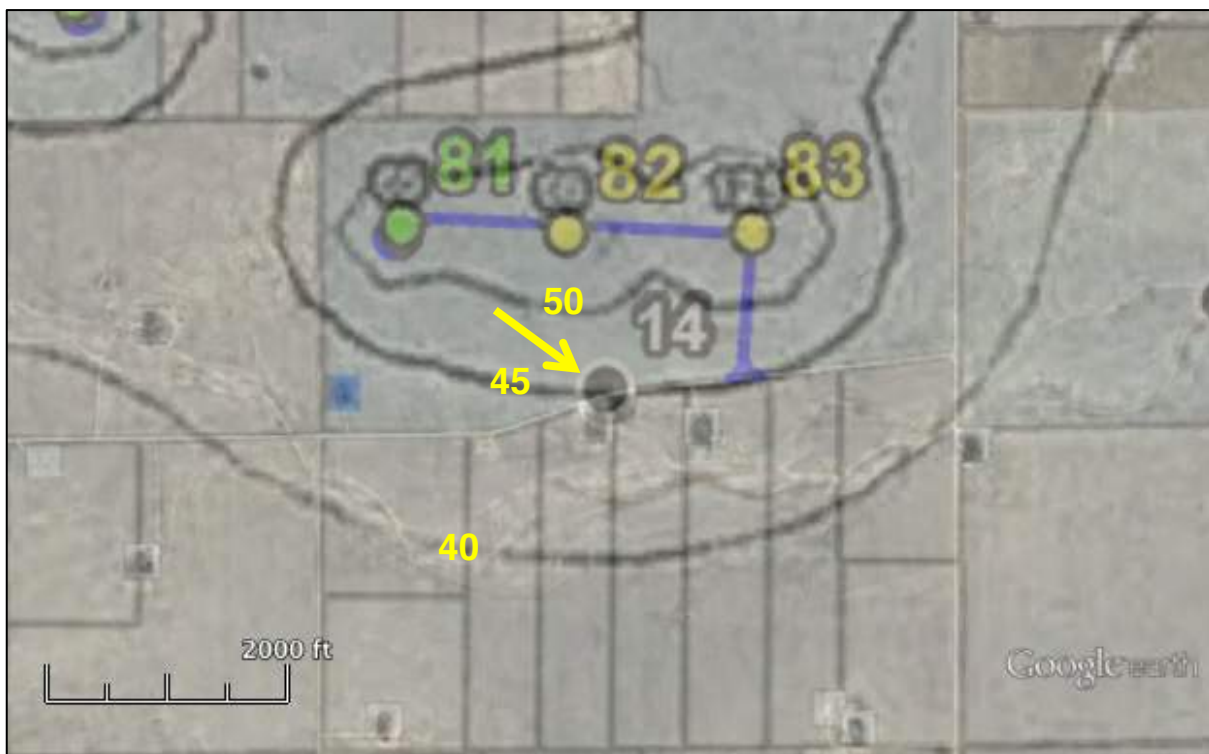


Figure 3.5-14. ML-14 (black dot), located at a predicted sound level of approximately 45 dBA.

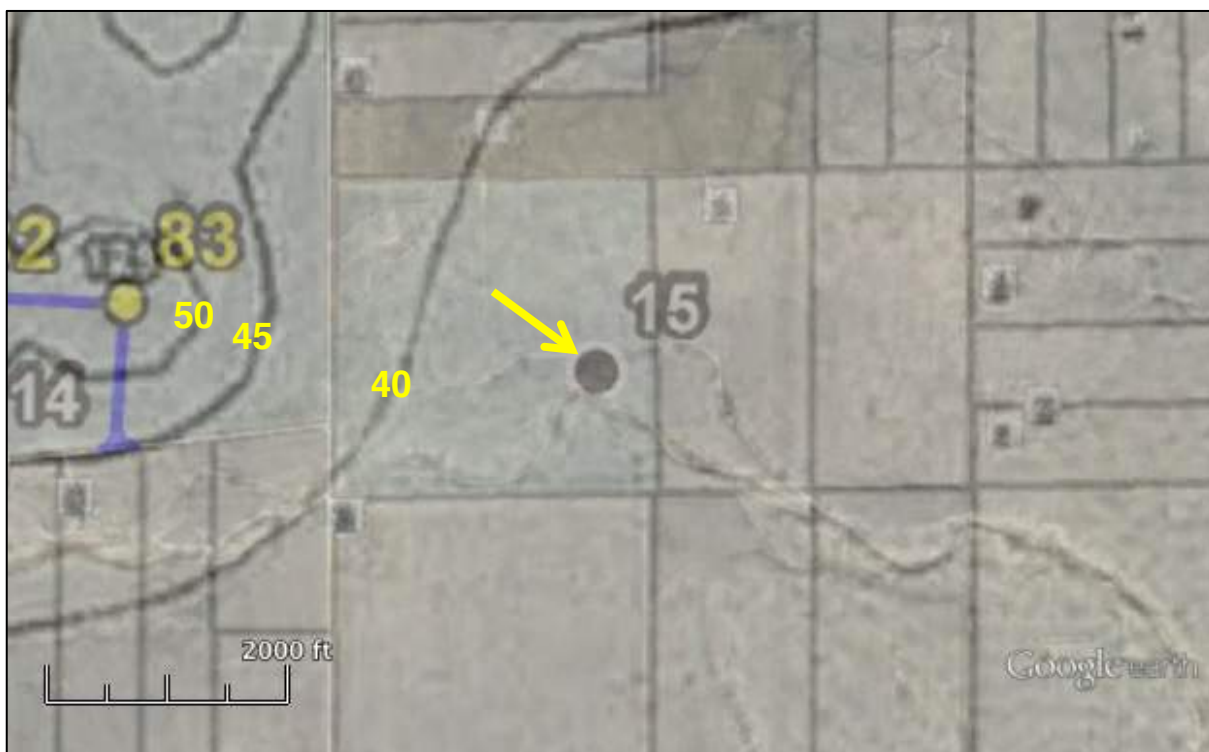


Figure 3.5-15. ML-15 (black dot), located at a predicted sound level of approximately 38 dBA.

3.6. The Epsilon Report shows Location 7 was not at the property line.

Location 7 appears farther away from the nearest Turbine #55 (710 ft) than the nearest non-participating property line (~480 ft based on scaled Epsilon figure). **The distance to the Location 7 assures noise levels from Turbine #55 are under-represented by 3 dB.**

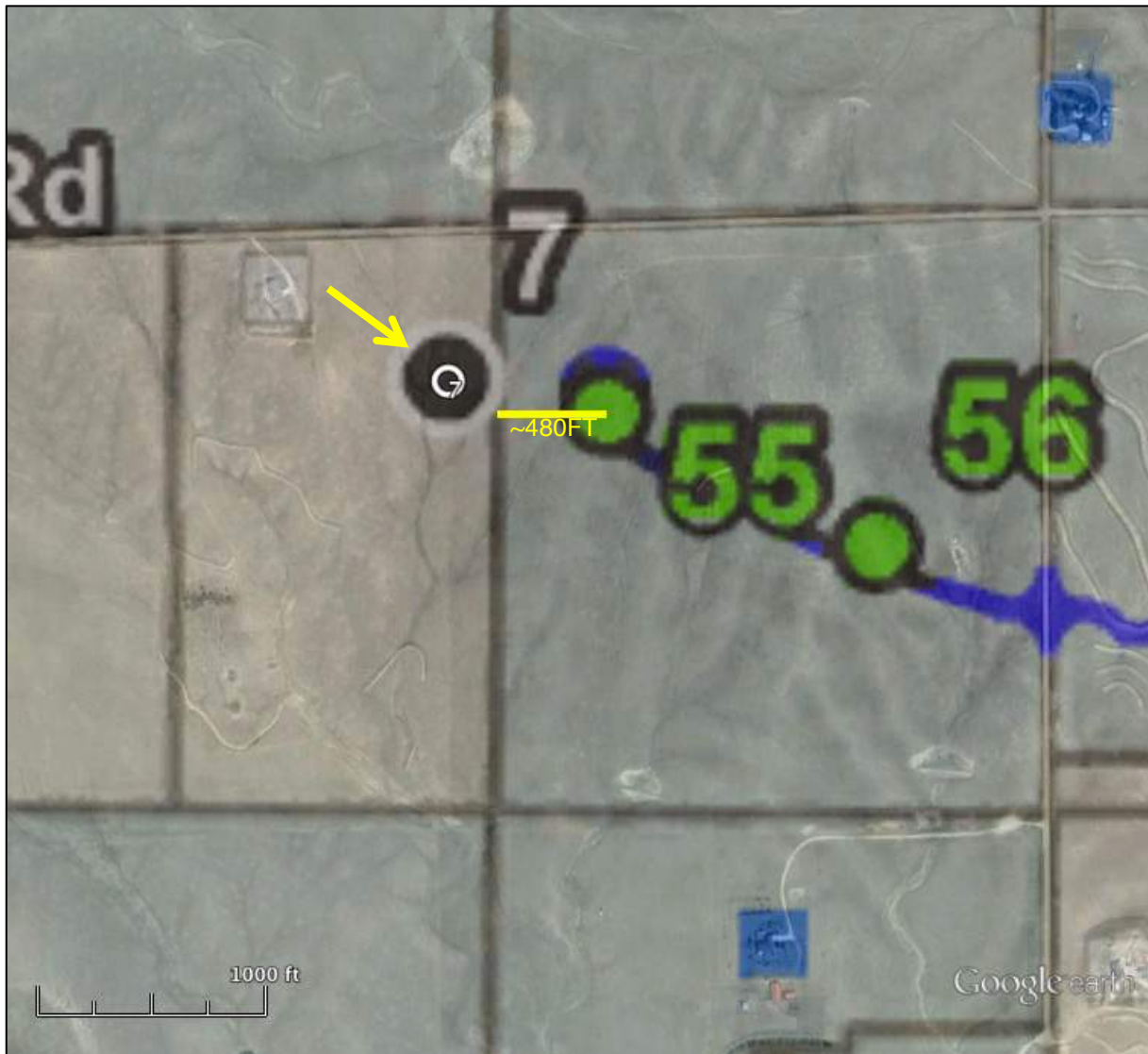


Figure 3.6-1. ML-7, located at 710ft with a predicted sound level of approximately 48 dBA. The sound level at the non-participating property line (~480 ft) would be 3 dB higher.

3.7. The Epsilon Report confirms facility predicted sound levels exceeding 40 dBA over 45 square miles and are higher than predicted

Figure 3.7-1 shows facility predicted 40 dBA and higher noise footprint (red).

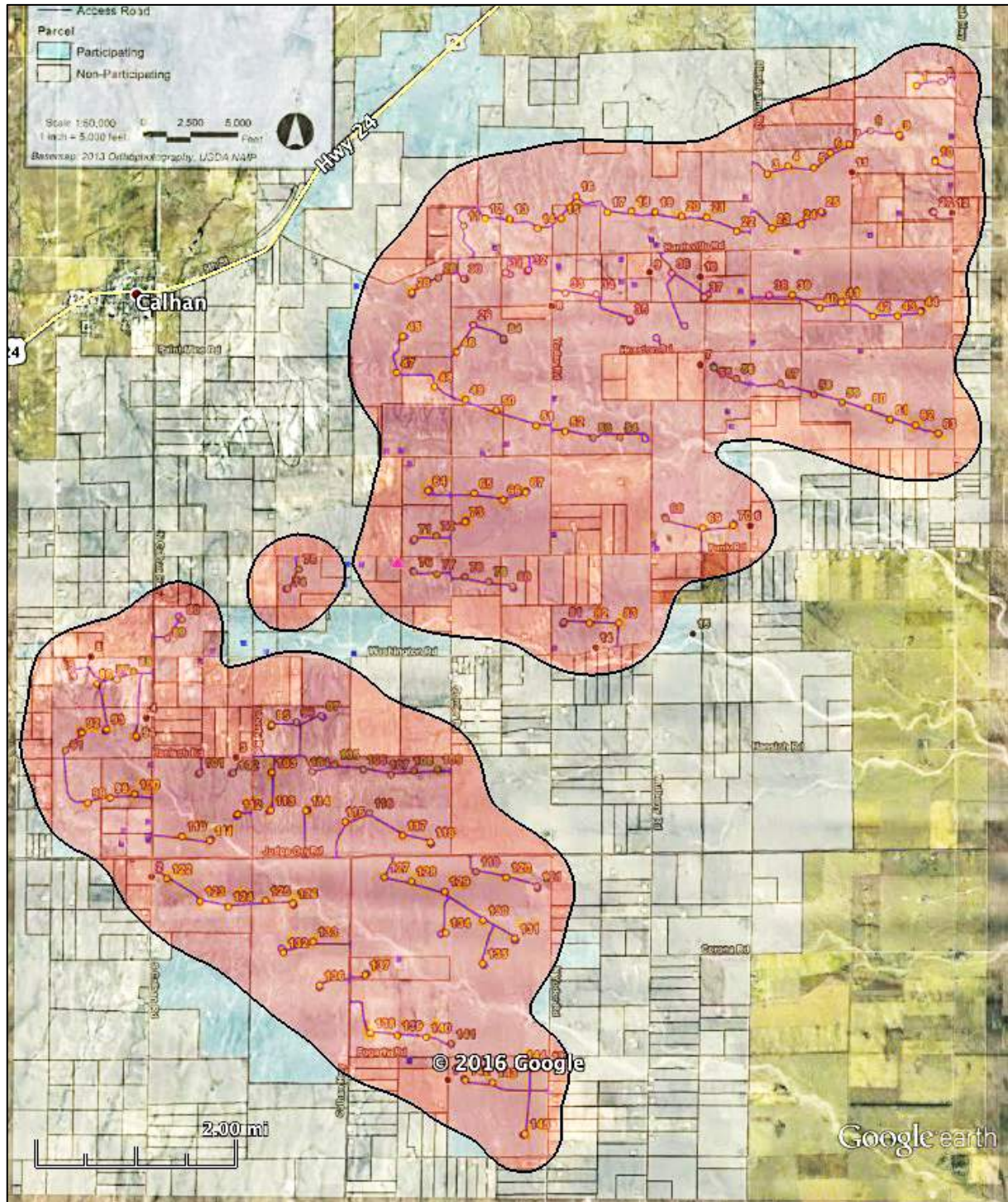


Figure 3.7-1. Golden West facility noise footprint, 40 dBA and higher predicted noise levels.

Epsilon Report Figure 6-1 is also shown for reference. Some 28,808 acres, or 45 square miles, were predicted to be exposed to "mean" (average) noise levels of 40 dBA or higher.

Within the 45-square-mile 40 dBA footprint, some 69 non-participating residential dwellings and 39 participating residential dwellings were found on Epsilon Figure 6-1.

Epsilon Report data substantiate Golden West facility operating noise levels are equal to or higher than the predicted noise levels.

NOISE IMPACT ON COUNTY

A look at the El Paso County as a whole shows the extent of the area with noise effects on people based on the predicted noise emissions from the Golden West facility. See Figure 3.7-2 below. A substantial portion of the county land area is assured sleep disturbance (WHO 2009 adverse effects level). Due diligence would ensure this information was assessed.

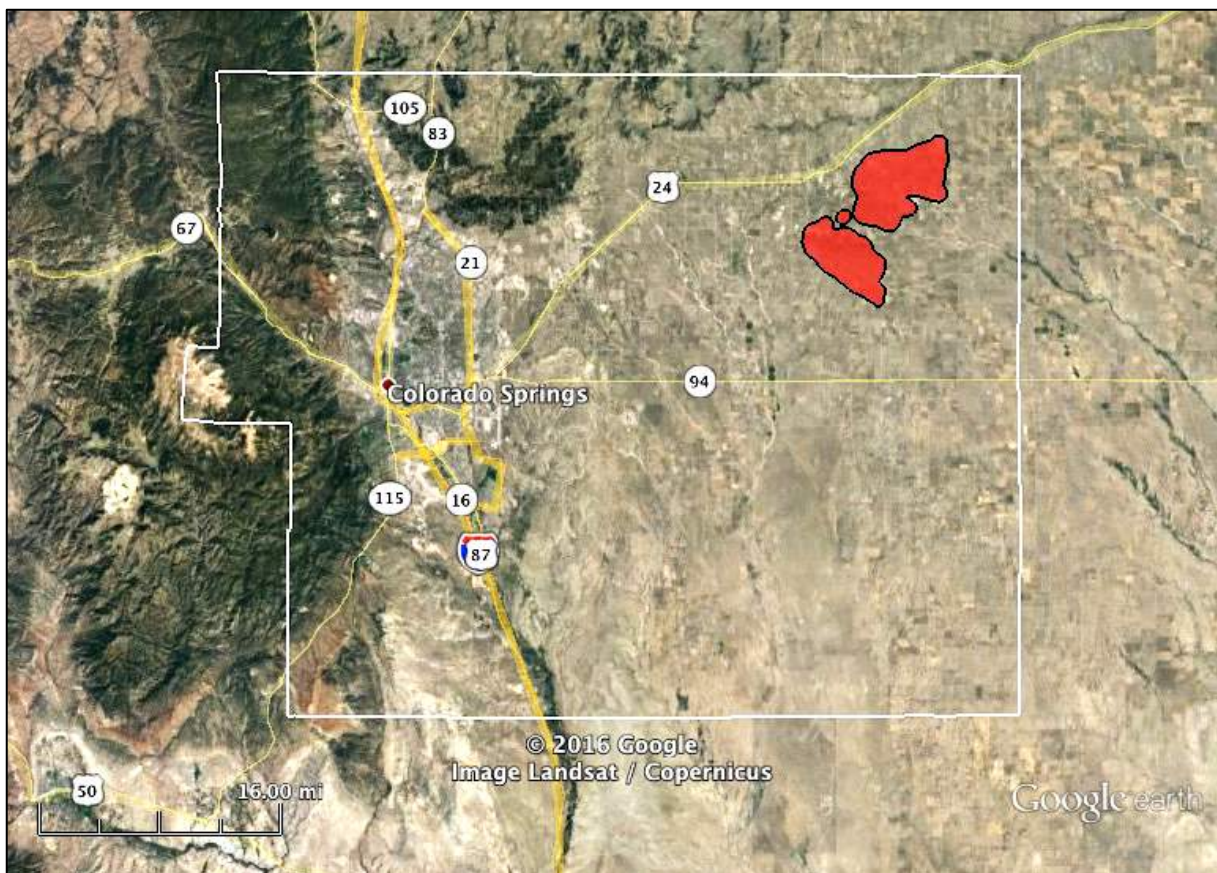


Figure 3.7-2. Noise impact of project for sleep disturbance (levels over 40 dBA, WHO 2009).

3.8. The Epsilon Report did not assess for noise impacts using ANSI standards. ANSI S12.9 Part 5 shows the facility would be INCOMPATIBLE.

If the Epsilon Report had provided such an assessment, the reader would have learned that **the facility noise emissions are *Incompatible with residential land use especially at night.*** Review of the Golden West documents found no assessment for ANSI S12.9 Part 5.

ANSI S12.9 LAND USE COMPATIBILITY RATING

The calculation provided here centers on ANSI S12.9 Part 5 which determines land use compatibility. The calculation of land use compatibility is supported by ANSI S12.9 Part 4. These ANSI standards are adapted from and similar to the US EPA protective guidelines issued under the 1972 Noise Control Act (which is still in effect).

Land use compatibility is defined in ANSI S12.9 Part 5:

3.1 compatible land use. *Land use consistent with the outdoor noise environment such that the annual average of the total day-night adjusted sound exposure or the annual average of the adjusted day-night average sound level at a site is not greater than the compatibility limit designated for that land use.*

3.2 land use. *Existing or intended use of a specifically delineated land area or parcel.*

3.3 land use category. *A logical grouping of a set of related land uses.*

Part 5 Annex A states that "*compatibility of a land use with the outdoor noise environment is assessed by comparing the predicted or measured annual average of the total day-night adjusted sound exposure or the annual average of the adjusted day-night average sound level at a site with the guidance criteria given in Figure A.1.*"

Part 5 Annex A Figure A.1 lists a range of land uses, including at the top, "*Residential-Urban/suburban, Single Family, Extensive Outdoor Use*". This category was selected for evaluation of compatibility for residential land use near the wind turbine facility.

It can be seen that for each land use category a range of acceptable annual average day-night sound levels are listed, for "Compatible", "Marginally Compatible", "Compatible with Sound Insulation", and "Incompatible". For the *Residential-Urban/suburban, Single Family, Extensive Outdoor Use* category, "Compatible" average noise levels (such as those predicted by the Applicant) range up to 55 Ldn, and "Marginally Compatible" ranges between 55 and

60 Ldn. Intrusive noise levels above 60 Ldn are "Incompatible". However an adjustment is then made to account for differences between Residential-Urban/Suburban and Quiet Rural.

ANSI S12.9 Part 5 Annex A Table 1. Red notations indicate which sections are relevant for residential use (circles) and which sections are not relevant (crosses).



Part 5 Annex A Figure A.1 includes a footnote, "For residences in quiet rural areas (e.g., not near busy roads, busy railroads, grain elevators, etc.), the +10 dB adjustment in ANSI S12.9 Part 4 clause F.3.4.2 should be used." Based on knowledge of the area around the Golden West facility, this note was factored into this analysis.

The ANSI S12.9 Part 4 adjustment from urban to the Golden West area quiet rural conditions is a reduction of 15 dBA: 10 dB for "quiet rural settings" (*ANSI S12.9 Part 4 Section F.3.4.2*) and 5 dB for unfamiliar intrusive noise (*ANSI S12.9 Part 4 Section F.3.4.1*). These two factors are additive (*ANSI S12.9 Part 4 Section F.3.4.3*). In practice, these factors may be used to either 1) adjust measured or predicted levels upward to Ldn to assess against ANSI land use compatibility ratings, or 2) adjust ANSI land use compatibility ratings downward to Leq to assess measured or predicted sound levels. For this calculation, the compatibility noise ratings were adjusted downward to Leq *for direct comparison to facility noise levels*.

The tables below summarize the arithmetic utilized to determine land use compatibility noise criteria for the facility noise levels using ANSI S12.9 Parts 4 and 5. "Criteria" means the level that should not be exceeded- the highest allowable long-term average noise level.

Criteria for "Compatibility" per ANSI S12.9:

Factor	Day-Night Sound Level (DNL)	Day Sound Level:	Night Sound Level:	Average Level (Leq*):
Part 5 Figure A.1 Residential Urban/suburban, Single Family Marginal Compatibility:	55	55	45	49
Adjust: 10 dB for quiet rural settings (Part 4 F.3.4.1):	-10	-10	-10	-10
Adjust: 5 dB for unfamiliar intrusive noise (Part 4 F.3.4.3):	-5	-5	-5	-5
Criteria for "Compatibility", dBA:	40	40	30	34

Criteria for "Marginal Compatibility" per ANSI S12.9:

Factor	Day-Night Sound Level (DNL)	Day Sound Level:	Night Sound Level:	Average Level (Leq*):
Part 5 Figure A.1 Residential Urban/suburban, Single Family Marginal Compatibility:	60	60	50	54
Adjust: 10 dB for quiet rural settings (Part 4 F.3.4.1):	-10	-10	-10	-10
Adjust: 5 dB for unfamiliar intrusive noise (Part 4 F.3.4.3):	-5	-5	-5	-5
Criteria for "Marginal Compatibility", dBA:	45	45	35	39

* The energy-equivalent average level (Leq) equivalent to a day-night level (DNL) is 6 dB less than the day-night level due to level weighting of -10 dB from 10 pm to 7 am.

The highest long-term average wind turbine noise level that could be considered "Compatible" under ANSI S12.9 Parts 4 and 5 at occupied dwellings near the wind turbine facility is DNL 40, which equates to Leq 40 dBA,day, Leq 30 dBA,night, equivalent to a long term average of 34 dBA,Leq if the noise source was constant in its noise output.

Wind turbine average noise levels above 40 dBA,night would be Incompatible under ANSI standards.

Epsilon would have had intimate knowledge of and access to the ANSI S12.9 Part 5 noise impact assessment during Report development [3]. There is no explanation in the Report for omitting the ANSI assessment.

The Golden West facility noise exposure data was submitted to the County by the applicant during the permitting process. It must be presumed that the County is well acquainted with ANSI standards and would have utilized ANSI S12.9 in their due diligence work to assess whether the facility would or would not be compatible with the quiet rural residential land use according to ANSI standards.

3.9. The Epsilon Report did not assess for noise impacts using known noise impact guidelines as criteria for sleep disturbance from the WHO.

It is more than troubling that Epsilon, *having cited WHO 2009 sufficient evidence as cautionary limits in a previous non-wind-turbine project [4]*, chose to ignore the Golden West wind turbine facility permit requirement to assess for noise impacts and omit assessment noise impacts relative to WHO 2009 for the Report.

From the World Health Organization 2009 Executive Summary [16],

The review of available evidence leads to the following conclusions.

- *Sleep is a biological necessity and disturbed sleep is associated with a number of adverse impacts on health.*
- *There is sufficient evidence for biological effects of noise during sleep: increase in heart rate, arousals, sleep stage changes and awakening.*
- *There is sufficient evidence that night noise exposure causes self-reported sleep disturbance, increase in medicine use, increase in body movements and (environmental) insomnia.*
- *While noise-induced sleep disturbance is viewed as a health problem in itself (environmental insomnia), it also leads to further consequences for health and well-being.*
- *There is limited evidence that disturbed sleep causes fatigue, accidents and reduced performance.*
- *There is limited evidence that noise at night causes hormone level changes and clinical conditions such as cardiovascular illness, depression and other mental illness. It should be stressed that a plausible biological model is available with sufficient evidence for the elements of the causal chain.*

Emphasis:

"noise-induced sleep disturbance is viewed as a health problem in itself".

"a plausible biological model is available with sufficient evidence for the elements of the causal chain"

The WHO further states,

"...adverse health effects are observed at the level above 40 dB L_{night,outside}, such as self-reported sleep disturbance, environmental insomnia, and increased use of somnifacient drugs and sedatives."

The WHO 2009 Night Noise Guidelines Summary is shown below.

Average night noise level over a year L _{night,outside}	Health effects observed in the population	Table 3 Effects of different levels of night noise on the population's health
Up to 30 dB	Although individual sensitivities and circumstances may differ, it appears that up to this level no substantial biological effects are observed. L _{night,outside} of 30 dB is equivalent to the no observed effect level (NOEL) for night noise.	
30 to 40 dB	A number of effects on sleep are observed from this range: body movements, awakening, self-reported sleep disturbance, arousals. The intensity of the effect depends on the nature of the source and the number of events. Vulnerable groups (for example children, the chronically ill and the elderly) are more susceptible. However, even in the worst cases the effects seem modest. L _{night,outside} of 40 dB is equivalent to the lowest observed adverse effect level (LOAEL) for night noise.	
40 to 55 dB	Adverse health effects are observed among the exposed population. Many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected.	
Above 55 dB	The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases.	

Table 3.9-1. Effects of different levels of night noise on the population's health, WHO 2009 Executive Summary Table 3.

They include a yearly average sound level of 30 dBA, night, outdoors as the level below, which there are no observed health effects, the "No Observed Effects Level" or NOEL. Above the 30 dBA NOEL, health effects including sleep disturbance were found, mild at lower levels for healthy individuals and more adverse with higher levels for "vulnerable groups"; children, the elderly, and people with disease or pre-existing health conditions. Above 40 dBA, the "No Observed Adverse Effects Level" (NOAEL), adverse health impacts are clearly evident and more severe for vulnerable groups.

WHO's 2009 Table 1 listing of sufficient evidence for effects and threshold levels (see Table 3.9-2 below) includes the medical sufficient evidence that noise impacts produce biological effects on sleep and health, including EEG awakening,

I understand that neighbors including children have been directed by the Board of Health to obtain sleep sedatives in order to combat sleep deprivation due to noise exposure. This is unfortunately consistent with the indicator below of 40-42 dBA "L_{night,outside}" which was forecast at numerous neighbor residential properties.

Effect		Indicator	Threshold, dB
Biological effects	Change in cardiovascular activity	*	*
	EEG awakening	L _{Amax,inside}	35
	Motility, onset of motility	L _{Amax,inside}	32
	Changes in duration of various stages of sleep, in sleep structure and fragmentation of sleep	L _{Amax,inside}	35
Sleep quality	Waking up in the night and/or too early in the morning	L _{Amax,inside}	42
	Prolongation of the sleep inception period, difficulty getting to sleep	*	*
	Sleep fragmentation, reduced sleeping time	*	*
	Increased average motility when sleeping	L _{night,outside}	42
Well-being	Self-reported sleep disturbance	L _{night,outside}	42
	Use of somnifacient drugs and sedatives	L _{night,outside}	40
Medical conditions	Environmental insomnia**	L _{night,outside}	42

Table 1
Summary of effects and threshold levels for effects where sufficient evidence is available

** Although the effect has been shown to occur or a plausible biological pathway could be constructed, indicators or threshold levels could not be determined.*

***Note that “environmental insomnia” is the result of diagnosis by a medical professional whilst “self-reported sleep disturbance” is essentially the same, but reported in the context of a social survey. Number of questions and exact wording may differ.*

Table 3.9-2. Thresholds for observed noise effects, WHO 2009 Executive Summary Table 1.

The WHO documented that motility, onset of motility, and changes in duration of various stages of sleep, in sleep structure and fragmentation of sleep, occur with a maximum indoors noise level in the range of 32 to 35 dBA. These researched medical health impacts are from **momentary maximum noise levels**, not noise levels averaged over a year.

Recent testing in a quiet rural area in Vermont confirmed that the A-weighted outdoor-to-indoor wind turbine noise level reduction (OILR) can be very poor, on the order of 1-3 dBA [17] with windows open. For example, periodic wind turbine noise (such as "whumps" or "thumps" as often reported by neighbors) of 43 dBA outdoors could result in an indoors sudden intrusive noise of 40-42 dBA, well above the Lmax sleep disturbance thresholds established by WHO medical research. Maximum outdoors intrusive industrial noises above 35-40 dBA while windows are open can result in **sleep disturbance** due to intrusive indoors noise levels above thresholds established by WHO sufficient evidence.

For nights when El Paso County occupied dwellings windows must be open to cool the house and improve sleeping, there could be a condition where intrusive wind turbine noise levels indoors can be almost the same as outdoors wind turbine noise levels. The Epsilon Report documents that the Golden West facility is capable of producing *average* outdoors noise levels above 40 dBA at numerous occupied dwellings.

As shown in Figure 3.7-1, the Golden West facility noise footprint for 40 dBA and higher covers an extensive area with many homes. The total land area affected is 45 square miles. **Total occupied dwelling residences noted on Epsilon Figure 6-1 with predicted noise levels above 40 dBA were counted as 108: 39 participating, 69 non-participating.**

Epsilon omitted assessment of Golden West noise impacts on children, chronically ill and elderly. The WHO identified children, chronically ill, and elderly as vulnerable risk groups. The Epsilon Report as submitted raises a serious matter of professional practice.

The Epsilon Report omissions raise another serious matter for the Golden West permit: While regulators tend to dismiss consideration of participating homes who signed lease agreements, some homes may have children, chronically ill and elderly residing. Through the lease and permit process and in exchange for fee payment, did the County and applicant agree to waive protection from noise-induced sleep disturbance impacts on health and welfare for children, chronically ill, and elderly.

--This concludes supplemental details for this review of the Epsilon Report.

17 "Acentech measurements in July 2014 under similar test conditions did generally agree with this value; and depending on the measurement location within the room, yielded an OILR value of about 1 to 3 dBA with the windows fully open.", Acentech Report to Vermont Public Service Department, Vermont Public Service Board Docket 7156, Acentech Project 624219, 25 September 2015.

4. Reviewer Qualifications

Robert W. Rand, ASA, INCE, is the principal investigator at Rand Acoustics. I am a Member of the Institute of Noise Control Engineers (INCE) since 1993 and a Member of the Acoustical Society of America (ASA). I am a principal acoustic investigator with over thirty-five years of experience including environmental and technical consulting services to power generation, commerce, industry, regulatory agencies, and communities. My several decades of experience surpasses equivalent requirements for Board Certification in INCE, and includes large-scale industrial noise control and cost management, environmental impact assessment, interior acoustics, and electro-acoustics, with ten years working in multiple forms of electric power generation, gas transmission, and process facilities in the Noise Control Group at Stone & Webster Engineering Corporation in Boston, Massachusetts. I have conducted environmental acoustic analyses, project engineering and cost analyses, permitting reviews, acoustic testing, noise control design, and operations monitoring activities for power generation and commercial projects. I have provided an independent acoustic consultancy to industry, commercial, and community clients since 1996. For the last eight years since Spring 2009 I have been investigating wind turbine noise with site noise measurements and analysis. I have furnished reports and expert testimony at a number of hearings, including federal, state and local governments. A copy of my biography, work history, cases where I have been accepted as an expert witness in the field of acoustics, and a list of papers published is available separately.