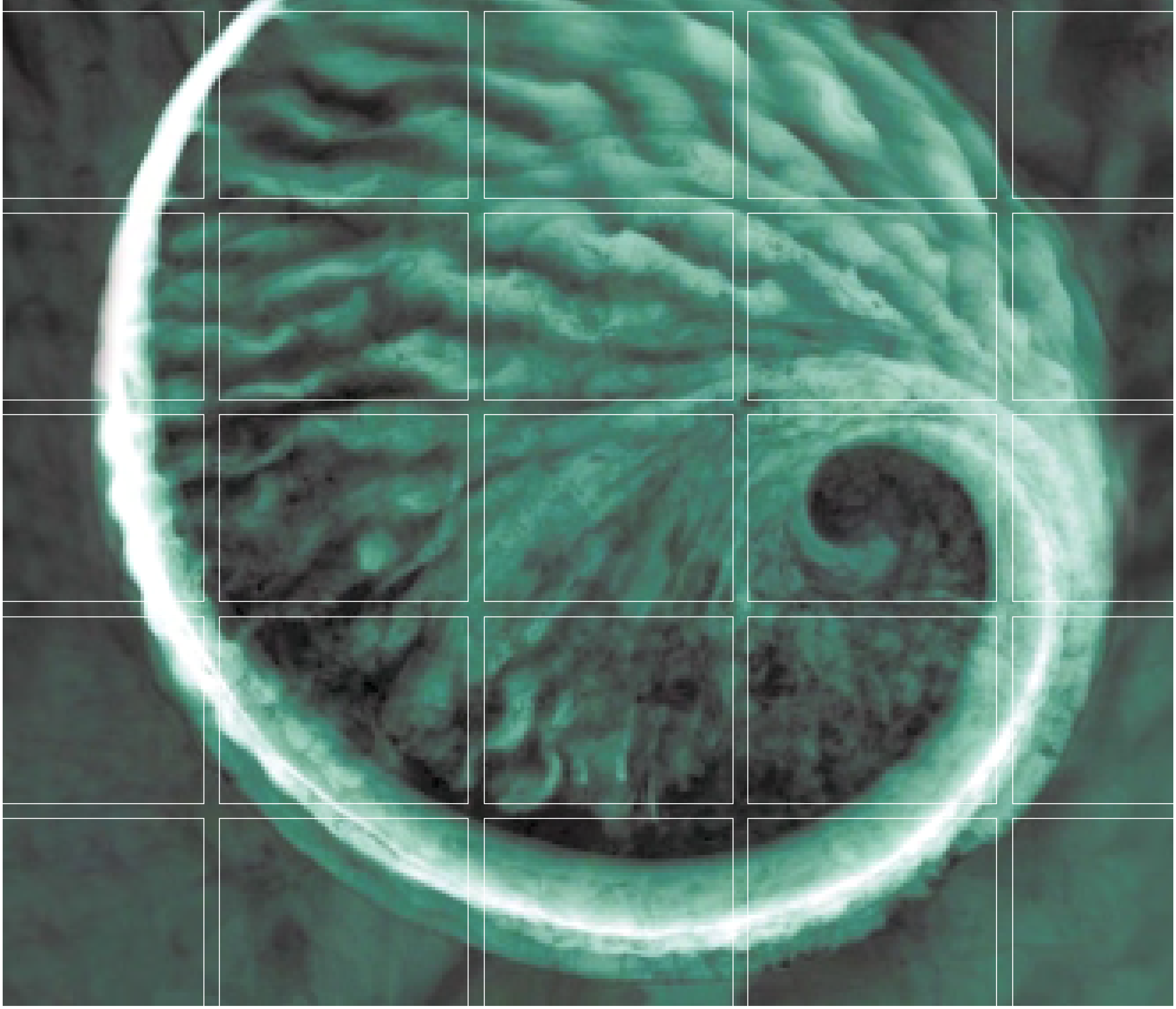


Noise Assessment

Shell WindEnergy
Hermosa West Wind Farm Project, Albany County, Wyoming

March 2, 2010

www.erm.com

Delivering sustainable solutions in a more competitive world

ERM

Shell WindEnergy

Noise Assessment: Hermosa West Wind Farm Project

March 2, 2010

Project No. 0111210
Albany County, Wyoming

Alicia C. Smith, R.E.M.

Partner-in-Charge

Kathryn M. Wanka

Project Manager

Environmental Resources Management Southwest, Inc.
15810 Park Ten Place, Suite 300
Houston, Texas 77084-5140
T: 281-600-1000
F: 281-600-1001

Texas Registered Engineering Firm F-2393

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 HERMOSA WEST WIND FARM NOISE ASSESSMENT

1.1 INTRODUCTION

Shell WindEnergy, Inc. (SWE) proposes to construct, operate and maintain the Hermosa West Wind Farm Project (the Project) in southeast Albany County, Wyoming near Tie Siding (Figure 1-1, Site Vicinity Map). Western Area Power Authority (Western) is evaluating under the National Environmental Policy Act (NEPA) the interconnection of the Project, which consists of transmission system upgrades and construction of a new substation (Proposed Action). The Project would consist of a maximum of 200 wind turbines with a total generating capacity of up to 300 megawatts (MW) of electricity. The wind turbines would be arranged in roughly collinear "strings"; each turbine string would be situated within an approximately 250 foot (ft) or 400ft wide corridor, depending on topography. The Project would interconnect with a Western-operated transmission line traversing the Project area.

The Project would also include a wind energy collection system, on-site operation and maintenance (O&M) building, underground collector lines, an Applicant-built transmission line and substation, associated access roads, and off-site upgrades to facilities owned by Western.

At the request of SWE, Environmental Resources Management (ERM) has prepared this Noise Assessment for the Project. The Noise Assessment is intended to provide information on estimated noise impacts of the three selected turbine models on sensitive noise receptors located near the Project area. Noise prediction (screening) calculations have been undertaken at the closest noise sensitive properties to the three proposed scheme layout and wind turbine options. The following options have been considered:

- 147 Siemens SWT 2.3MW wind turbines (normal operation), hub height 80m and total capacity of 338 MW;
- 224 GE 1.5MW wind turbines (normal operation), hub height 80m and total capacity of 336MW; and
- 113 Vestas V90 3MW wind turbines (mode 0), hub height 80m and total capacity of 339MW.

The layouts of each turbine option (and closest noise sensitive properties) are illustrated in Figures 1-2, 1-3 and 1-4.

1.2 PROJECT SETTING

The Project area is located within Albany County, Wyoming. The City of Laramie is located approximately 18 miles northwest of the Project area, while the town of Tie Siding, Wyoming is located to the north-northeast of the Project area. One residence is located within the Project area, while the area surrounding the Project area is sparsely populated with a majority of these homes being located directly west of the Project area along a ridge line. The elevation of the Project area is 7,100 to 7,900 ft and it is characterized by nearly level floodplains and low terraces. According to the National Renewable Energy the average wind speed at 30m within the Project Area is approximately 17 miles per hour (mph). The Project area is located approximately three to four miles west of State Highway 287. This is a highly utilized highway which was widened near the Project in 2009 from two to four lanes. There is also a railroad located approximately two miles to the northeast.

1.2.1 Baseline Information

Sources of noise within the Project area include trucks and automobiles, aircraft, railroad, power lines, firearms, animal communications, and wind.

Six noise sensitive properties around the Project participating property boundary have been considered for the screening calculations and are listed in Table 1-1 below.

TABLE 1-1 Closest Noise Sensitive Properties to the Project

Property	Coordinates	Distance to closest turbine (Vestas V90 layout), feet	Distance to closest turbine (Siemens SWT layout), feet	Distance to closest turbine, (GE 1.5 layout), feet
The Buttes	452226, 4558120	36,410	36,320	36,150
Home 4 – Fish Creek	451630, 4543490	3,360	3,210	3,180
Home 3 – Fish Creek	451963, 4543962	2,055	2,045	2,050
Home 2 – Fish Creek	452353, 4541414	8,090	7,610	7,265
Tie Siding	457259, 4547829	6,995	7,190	6,945
Home 1 – Tie Siding	457517, 4546720	5,435	4,790	4,715
Landowner	450567, 4546067	1,500	1,475	1,400
Home 5	450112, 4546288	780	1,350	2,875

Measurements of the prevailing monthly wind speed, direction and wind shear exponent are listed in Table 1-2 below.

TABLE 1-2 Site Wind Measurements

Measurement Period	Mean Wind Speed (m/s) at 57 m height	Mean Wind Shear (57m / 32m)	Prevailing Wind Direction
January 2008	13.21	0.15	West
February 2008	12.81	0.12	West
March 2008	11.28	0.10	West
April 2008	9.98	0.10	West
May 2008	9.06	0.09	North West
June 2008	8.34	0.09	West
July 2008	6.01	0.09	South South East
August 2008	6.60	0.15	South East
September 2008	6.41	0.09	South South East
October 2008	7.43	0.12	West North West
November 2008	14.13	0.17	West
December 2008	13.31	0.16	West

The predominant wind direction, based on 2008 measurements is westerly (7 months out of 12), blowing away from the town of Tie Siding. This could also increase ambient noise levels in the area from the highway.

Wind shear is discussed in Section 3-3 below.

1.2.2 *Acoustics and Glossary of Terms*

The terms 'sound' and 'noise' tend to be used interchangeably, but noise can be defined as unwanted sound. Sound is a normal and desirable part of life. However, when noise is imposed on people it can lead to disturbance, annoyance and other undesirable effects.

Noise is measured and quantified using decibels (dB), and examples of noise levels are shown in Table 1-3.

TABLE 1-3 Examples of Noise Levels on a Decibel Scale

Noise Level, dB(A)	Typical noise source / example
0	"Threshold of hearing" – lowest sound an average person can hear
20	Standard required in a broadcasting or recording studio – just audible
30	Library or soft whisper at 5 feet – this is very quiet
40	Bedroom or living room
50	Conversational speech at 3 feet
60	Busy general office or air conditioning unit at 20 feet
70	Traffic on freeway at 50 feet
80	Pneumatic drill at 50 feet
90	Heavy truck at 50 feet
140	"Threshold of Pain" – maximum tolerable noise level such as very close to a jet engine or similar

The dB(A) scale is a particular way of measuring the different frequencies in sound, designed to match how the human ear perceives sound, called the 'A'-weighting.

The decibel scale is logarithmic, which means that noise levels do not add up or change according to simple linear arithmetic. For example, adding two equal noise sources results in a doubling of sound *energy*, which gives a combined noise level that is 3dB higher than the individual levels.
So, 60 dB + 60 dB = 63 dB (not 120 dB).

However, even though the *energy* levels have doubled, the ear *perceives* only a slight increase in loudness instead of a doubling because human hearing responds to changes in noise logarithmically. This means that a relatively large change in sound *energy* is needed before it is *perceived* to be louder or quieter. For example, it is generally accepted that:

- an increase or decrease of 1dB cannot usually be heard in everyday conditions (although possible in 'laboratory' conditions);
- an increase or decrease of 3dB is generally accepted as the smallest change that is noticeable in ordinary conditions;
- an increase or decrease of 5dB is a clearly perceptible change in noise; and

- an increase or decrease of 10dB is perceived to be a doubling (or halving) of perceived loudness.

To place this into context, to change a noise level by around 3dB there would need to be a doubling or halving of the noise energy; and a change of 10dB would need a ten-fold change in noise energy.

Sound can be distinguished by its content, and Hertz (Hz) is the unit used to describe the tonality or frequency content of sound. The lowest frequency that can be identified as sound by a person with good hearing is 20Hz. Frequencies below this (infrasound) can be detected, but are perceived as a feeling in the body as opposed to an actual sound. At the other end of the scale, the highest frequency that can he heard may be up to 20,000Hz, but this depends on factors such as age, health and previous exposure to noise and an upper range between 16 and 18 kilo hertz (KHz) might be more representative. Sound below 20Hz is referred to as 'infrasound', and sound between 10Hz and 200Hz is often described as 'low frequency noise' (LFN), although there is no a commonly held definition for these terms. Although our hearing can detect sounds throughout this range, it does not ascribe the same importance or weight to sound in each frequency.

For example, if a person was listening to a tone at 1KHz at a fixed level, then a tone at 30Hz would have to be 50dB higher for it to be judged equally as loud, although this varies depending on the reference loudness. To account for our sensitivity to sound over different frequencies, environmental noise sources are often described as 'A'-weighted decibels, denoted as dB(A). This A-weighting is an internationally agreed standard that reflects the frequency sensitivity of the ear.

Since noise also often varies over time, statistical parameters (or metrics) are used to measure, and describe noise. Two common noise metrics used for environmental noise measurement are the L_{Aeq} and L_{A90}.

The $L_{Aeq, T}$ metric is called the 'continuous equivalent sound level'. It represents a varying noise level by calculating the constant sound level that would have the same sound energy content over the measurement period. The letter 'A' denotes that 'A'-weighting has been used and the 'eq' indicates that an equivalent level has been calculated. So '$L_{Aeq,T}$' is the A-weighted continuous sound level, measured over period 'T'. L_{Aeq} is a logarithmic average noise level over a period (instead of an arithmetic average) which gives a high weighting to high noise levels even if they are relatively short lived or infrequent events.

The $L_{A90, T}$ metric is a percentile noise level in dB(A). This represents the value exceeded for 90% of the time period (T) being considered. Note that it is higher than the minimum noise level but may be regarded as the typical noise level during 'quiet periods'.

1.3 NOISE PREDICTION MODEL

Wind Turbine Generated (WTG) noise predictions were carried out under down wind propagation conditions as described in the international standard ISO 9613 [(1)] . The sound power levels used as a basis of the assessment are also measured under down wind conditions.

In undertaking predictions of noise levels from wind farms the following factors can be considered:

- the decrease in noise with distance;
- the absorption of noise in air;
- the attenuation of noise over acoustically 'soft' ground;
- screening of the turbines by topography and other obstacles; and
- meteorological conditions.

In predicting operational noise from the Project area, air absorption and distance attenuation were accounted for using the method described in ISO 9613 assuming 10°C and 70% humidity. No acoustic screening of the turbines is expected. No attenuation from ground absorption has been assumed in the model to present a conservative assumption.

(1) ISO 9613-2 'Acoustics - Attenuation of Sound During Propagation Outdoors. Part 2: General Method of Calculation'. ISO, 1996.

2.0 NOISE PREDICTIONS

2.1 WIND TURBINE NOISE SOURCE TERMS

Three types of wind turbines and layouts have been considered as discussed in Section 1.1 above.

Noise emissions of each turbine have been reported in independent tests undertaken in accordance with IEC 61400-11(2) and used as the basis of the operational noise assessments.

Results have been reported as A-weighted octave band sound power levels for a wind speed of 10 m/s (22 mph), corrected to a height of 10 meters (33 feet) in Table 2-1, and as the A-weighted sound power level at wind speeds of 4 to 10 m/s in Table 2-2.

This is based on the following operating modes:

- Vestas V90 operating in mode 0, with the highest noise emission levels;
- Siemens SWT operating at normal operation as opposed to noise restricted operation; and
- GE 1.5 operating at normal operation as opposed to noise restricted operation.

TABLE 2-1 ***Octave Band Sound Power Levels (dB) for the Vestas V90 3 MW, Siemens SWT 2.3MW and GE 1.5MW Wind Turbines (hub height 80m/262 feet, corrected to 10m/33 feet) in Accordance with IEC 61400-11***

Frequency Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Vestas V90	93.5	96.9	102.0	104.0	104.0	99.7	93.7	80.7	109.3
Siemens SWT	86.3	95.3	102.0	102.6	99.0	95.0	90.2	85.4	107.0
GE 1.5	85.1	94.0	97.2	98.6	97.9	94.5	87.3	78.1	104.0

TABLE 2-2 ***Wind Turbine Noise Levels (dB) for the Vestas V90 3MW, Siemens SWT 2.3MW and GE 1.3 MW Turbines (hub height 80m/262 feet, corrected to 10m/33 feet) at Increasing Wind Speeds***

Wind Speed (m/s) at 10m (mph in brackets)	Sound Power Level (L_{WA}) for Vestas V90, dB	Sound Power Level (L_{WA}) for Siemens SWT, dB	Sound Power Level (L_{WA}) for GE 1.5, dB (1)
4 (9)	97.0	-	98.0
5 (11)	105.0	-	101.1
6 (13)	105.8	105.0	105.0
7 (16)	108.2	107.0	106.0
8 (18)	109.3	107.0	-
9 (20)	109.4	107.0	-
10 (22)	106.7	107.0	-
11 (25)	105.9	-	-
12 (27)	105.7	-	-

(1) This includes a +2 dB uncertainty correction reported in the test report for this turbine

(2) IEC 61400-11 “Wind turbine generator systems - Part 11: Acoustic noise measurement techniques”, IEC, 2002.

The location and elevations of the turbines layouts used in this analysis are illustrated in *Figures 1-2*, *1-3,* and *1-4*. The results of the assessment are presented in Table 2-3, Table 2-4 and, Table 2-5 below.

TABLE 2-3 Predicted WTG Noise from the Vestas V90 3 MW (mode 0) at the Closest Noise Sensitive Properties

Noise Receptor	Predicted WTG Noise		Distance to Closest Turbine (feet)	Closest Turbine	Predicted WTG Noise by wind speed (m/s) (and mph in brackets)								
	L_{A90}, dB	L_{Aeq}, dB			4 (9)	5 (11)	6 (13)	7 (16)	8 (18)	9 (20)	10 (22)	11 (25)	12 (27)
The Buttes	23	25	36,410	T55	32	15	19	21	23	23	20	19	19
Home 4 – Fish Creek	44	46	3,360	T79	32	37	40	43	44	44	41	41	40
Home 3 – Fish Creek	48	50	2,055	T79	35	40	44	47	48	48	45	44	44
Home 2 – Fish Creek	40	42	8,090	T79	28	33	37	39	40	40	38	37	37
Tie Siding	40	42	6,995	T102	27	32	36	39	40	40	37	36	36
Home 1 – Tie Siding	42	44	5,435	T91	30	35	39	41	42	42	39	39	38
Landowner	51	53	1,500	T95	38	43	47	49	51	51	48	47	47
Home 5	52	54	780	T44	40	45	49	51	52	52	50	49	49

TABLE 2-4 Predicted WTG Noise from the Siemens SWT 2.3MW (normal operation) at the Closest Noise Sensitive Properties

Noise Receptor	Predicted WTG Noise		Distance to Closest Turbine (m)	Closest Turbine	Predicted WTG Noise by wind speed (m/s) (and mph in brackets)				
	L_{A90}, dB	L_{Aeq}, dB			6 (13)	7 (16)	8 (18)	9 (20)	10 (22)
The Buttes	21	23	36,320	T147	19	21	21	21	21
Home 4 – Fish Creek	44	46	3,210	T30	42	44	44	44	44
Home 3 – Fish Creek	47	49	2,045	T33	45	47	47	47	47
Home 2 – Fish Creek	40	42	7,610	T30	38	40	40	40	40
Tie Siding	39	41	7,190	T60	37	39	39	39	39
Home 1 – Tie Siding	42	44	4,790	T49	40	42	42	42	42
Landowner	49	51	1,475	T57	47	49	49	49	49
Home 5	47	49	1,350	T146	45	47	47	47	47

TABLE 2-5 Predicted WTG Noise from the GE 1.5MW (normal operation) at the Closest Noise Sensitive Properties

Noise Receptor	Predicted WTG Noise L_{A90}, dB	Predicted WTG Noise L_{Aeq}, dB	Distance to Closest Turbine (m)	Closest Turbine	Predicted WTG Noise by wind speed (m/s) (and mph in brackets) 6 (13)	7 (16)	8 (18)	9 (20)	10 (22)
The Buttes	20	22	36,150	T116	15	15	18	22	23
Home 4 – Fish Creek	42	44	3,180	T44	36	36	40	43	44
Home 3 – Fish Creek	46	48	2,050	T47	40	40	43	47	48
Home 2 – Fish Creek	39	41	7,265	T164	33	33	36	40	41
Tie Siding	38	40	6,945	T92	32	32	35	39	40
Home 1 – Tie Siding	38	40	4,715	T73	32	32	35	39	40
Landowner	48	50	1,400	T85	42	42	45	49	50
Home 5	43	45	2,875	T89	37	37	40	44	45

3.0 NOISE FROM WIND TURBINES, LOW FREQUENCY NOISE, INFRASOUND AND HEALTH EFFECTS

3.1 INTRODUCTION

Although wind turbines are generally considered to be quiet, concerns have been expressed about low frequency noise and infrasound causing health effects and distress to neighbors. There have been many notable studies published on these topics, some with conflicting viewpoints.

In December 2009, an expert panel was assembled by the American Wind Energy Association (AWEA) and Canadian Wind Energy Association (CanWEA) to 'provide an authoritative reference document for legislators, regulators, and anyone who wants to make sense of the conflicting information about wind turbine sound'(3).

To avoid bias and conflict of interest, the expert panel selected consisted of independent experts in acoustics, audiology, medicine, and public health with a remit to address health concerns associated with wind turbine noise. The findings of the AWEA and CanWEA report are discussed here, however for the interested reader the full report can be found at:

http://www.awea.org/newsroom/releases/12-15-09-sound_panel_release.html

3.2 SOURCES OF NOISE

Wind turbine noise originates from mechanical sound (the gearbox and control mechanisms) and aerodynamic sound (produced by the rotation of the turbine blade through the air).

Aerodynamic noise is the dominant source and will be present over all frequencies, including the infrasound range (i.e. below 20Hz), but is generally within the mid frequency range (approximately 500Hz to 1KHz).

Noise within this range will rise and fall as the turbine blade rotates and this change or 'modulation' is described as 'amplitude modulation' which can be perceived by a listener as a fluctuation in sound occurring approximately every second. It has been suggested that under certain conditions such as wind shear (see below), this fluctuation can be heard some distance away, and because it is a noise that frequently changes, it is more noticeable for the listener.

3.3 WEATHER EFFECTS AND WIND SHEAR

Meteorological factors can affect the propagation of sound from wind turbines. For example, warm air at ground level would cause noise from the turbine to curve upwards which would reduce noise levels; whilst warm air during temperature inversions may cause noise from the turbine to curve downwards,

(3) 'Wind Turbine Sound and Health Effects. An Expert Panel Review'. AWEA and CanWEA, December 2009

resulting in increased noise levels. Wind direction can also affect the level of turbine noise at a property (i.e. blowing towards or away from the property).

Wind shear is a measure of how much wind speed increases with height. Under certain circumstances such as very stable atmospheric conditions, which may occur at night, wind speed at the turbine hub height may be substantially increased over that which is expected. This means that masking of wind turbine noise at a property by the wind does not always occur. For example, the wind at turbine height may be sufficient to power the turbine (and generate noise), yet the wind speed at a property may be negligible and no masking of wind turbine noise will take place leading to higher source noise levels.

There is general agreement that wind turbine noise assessments are undertaken at a reference height of 10m based on the fact that the method(4) used by wind turbine manufacturers to measure noise levels from wind turbines (in turn used to calculated wind turbine noise at properties) are also corrected to a reference height of 10 meters (33 feet). A mathematical correction for wind shear is applied to account for this.

Noise models err on the side of caution and present a reasonable worst-case noise assessment, calculating noise downwind and applying a ground roughness factor to account for wind shear effects.

Wind shear measurements reported in Table 1-2 are typical of smooth, level, grass covered terrain.

3.4 INFRASOUND, LOW FREQUENCY NOISE AND ANNOYANCE

The infrasound from wind turbines is at a level of 50 to 70dB, sometimes higher, but well below the audible threshold of hearing which ranges between 79dB at 20Hz and 107dB at 4Hz. Infrasound from natural sources such as the wind also surrounds us and is also below the threshold of audibility.

Some people attribute health effects to wind turbine noise exposure. When amplitude modulation occurs, this can provoke complaint and may be labeled as 'low frequency noise' or 'infrasound' by some, although this 'swishing' noise is in fact in the 500Hz to 1KHz range. It is this fluctuating noise (i.e. amplitude modulation) which only occurs under certain conditions that cause most complaints due to the more disturbing nature of a fluctuating noise compared to a non-fluctuating noise such as free-flowing traffic.

The AWEA and CanWEA report refers to a UK study (5) that concluded that out of 130 wind farms, only 4 had a problem with amplitude modulation, and 3 of these had been resolved. Furthermore, this amplitude modulation when observed beneath a turbine does not always occur at greater separation distances.

---

(4) IEC 61400-11 'Wind Turbine Generator Systems Part 11: Acoustic Noise Measurement Techniques'.
(5) 'Research into Aerodynamic Modulation of Wind Turbine Noise' (2007). www.berr.gov.uk/files/file40570.pdf

Comprehensive research [6] on low frequency noise has been repeatedly shown by measurements of wind turbine noise undertaken in the USA, UK, Denmark and Germany over the past decade that the levels of infrasonic noise and vibration radiated from modern, wind turbines are at a very low level; so low that they lie below the threshold of perception, even for those people who are particularly sensitive to such noise, and even on an actual wind turbine site.

Claims of health effects from wind turbines are addressed within the AWEA and CanWEA report, in particular, the claim of 'wind turbine syndrome' promoted by Pierpont [7] based on the following assertions:

- low levels of airborne infrasound from wind turbines (1 – 2Hz) affect the vestibular system (this is the system that governs our balance and sense of orientation); and
- low levels of airborne infrasound from wind turbines at the 4 – 8Hz range enter the lungs and vibrate the diaphragm which in turn transmits vibration through other organs in the body.

Pierpont claims this combined effect causes a range of symptoms termed wind turbine syndrome.

The AWEA and CanWEA report, in response to these assertions states:

There is no credible scientific evidence that low levels of wind turbine sound at 1 to 2Hz will directly affect the vestibular system. In fact, it is likely that the sound will be lost in the natural infrasonic background sound of the body. The second hypothesis is equally unsupported with appropriate scientific investigations. The body is a noisy system at low frequencies. In addition to the beating heart at a frequency of 1 to 2Hz, the body emits sounds from blood circulation, bowels, stomach, muscle contraction, and other internal sources. Body sounds can be detected externally to the body by the stethoscope.

The report goes on to say:

"Wind turbine syndrome" is not a recognized medical diagnosis, is essentially reflective symptoms associated with noise annoyance and is an unnecessary and confusing addition to the vocabulary on noise. This syndrome is not a recognized diagnosis in the medical community. There are no unique symptoms or combinations of symptoms that would lead to a specific pattern of this hypothesized disorder. The collective symptoms in some people exposed to wind turbines are more likely associated with annoyance to low sound levels.

Furthermore, the evidence presented by Pierpont to support the hypothesis of wind turbine syndrome is based a single case series from a group of self-

---

(6) "A Review of Published Research on Low Frequency Noise and its Effects" Report for DEFRA by Dr Geoff Leventhall Assisted by Dr Peter Pelmear and Dr Stephen Benton. May 2003

(7) Pierpont, N 2009, pre publication draft 'Wind Turbine Syndrome: a report on a natural experiment'. http://www.windturbinesyndrome.com

nominated individuals and from a single investigator. This has limited credibility in terms of scientific peer review.

In summary, following a review of available literature, the Expert Panel assembled by the AWEA and CanWEA concluded the following.

1. Sound from wind turbines does not pose a risk of hearing loss or any other adverse health effect in humans.
2. Sub-audible, low frequency sound and infrasound from wind turbines do not present a risk to human health.
3. Some people may be annoyed at the presence of sound from wind turbines, but annoyance is not a pathological entity.
4. A major cause of concern about wind turbine sound is its fluctuating nature. Some may find this sound annoying, a reaction that depends on personal characteristics as opposed to the intensity of the sound level.

3.5 VIBRATION

A comprehensive study of vibration measurements in the vicinity of a modern wind farm undertaken in 1997 (8) found that vibration levels 100 m from the nearest turbine were a factor of 10 less than those recommended for human exposure in sensitive buildings, such as hospitals or laboratories housing precision measurement instruments.

(8) ETSU W/13/00392/REP 'Low frequency noise and vibrations measurement at a modern wind far'. Department of Trade and Industry, 1997.

4.0 *RESULTS*

The Proposed Action includes construction/decommissioning related noises, as well as operation of a substation. Construction equipment associated with Projects such as this one typically generate noise levels ranging from approximately 75 to 90 dB(A) at 50 feet, depending on the equipment being used (U.S. Department of Transportation 2006: United States Department of Transportation. August 2006. FHWA Highway Construction Noise Handbook). Construction of the Proposed Action would cause temporary increases in ambient noise levels in the immediate vicinity of the construction sites. On-site construction noise would occur mainly from heavy-duty construction equipment (e.g., trucks, backhoes, excavators, loaders, and cranes). As a result, construction-generated noise would be considered a less-than-significant short-term impact.

The Wyoming Department of Transportation (WYDOT) completed noise studies along State Highway 287 as part of an Environmental Assessment (EA) for the expansion of State Highway 287 which was completed in 2009. Prior to the expansion of State Highway 287, WYDOT determined that the existing noise conditions at Tie Siding were between 54.8 and 63.3 dB(A) and these were attributed to wind effects and not traffic noise emanating from State Highway 287. Based on noise modeling, the post highway expansion noise conditions at Tie Siding were estimated to be between 56.7 and 70.0 dB(A). The EA determined that the expansion would only have a minor noise impact to one receptor (a single family home) and no mitigation measures were required. Additionally, the EA determined that noise impacts from construction activities would be temporary and minimal.

Substations typically produce between 60 and 70 L_{A90}, dB during operations. The proposed substation location is over 3,000 feet from the participating owner's property line. Noise dissipates at approximately 6 dB(A) per doubling of distance based on a point source (and not taking account of additional mitigation from air and ground absorption which will be quite significant at distances greater than approximately 300 feet), and impacts would be considered less than significant.

In addition to the impacts discussed above, the Project would include wind turbine generated noise. The Albany County standard for noise is as follows.

Noise associated with wind energy operation shall not exceed fifty-five (55) dB(A) as measured at any point along the common property lines between a non-participating property and a participating property.

a. This level may be exceeded during short-term events such as utility outages, severe weather events, and construction or maintenance operations.

b. This standard shall not apply along any portion of the common property line where the participating property abuts state or federal property.

c. Noise levels may exceed the fifty-five (55) dB(A) limit along common property lines if written permission, as recorded with the Albany County Clerk, is granted by the affected adjacent non-participating property owners.

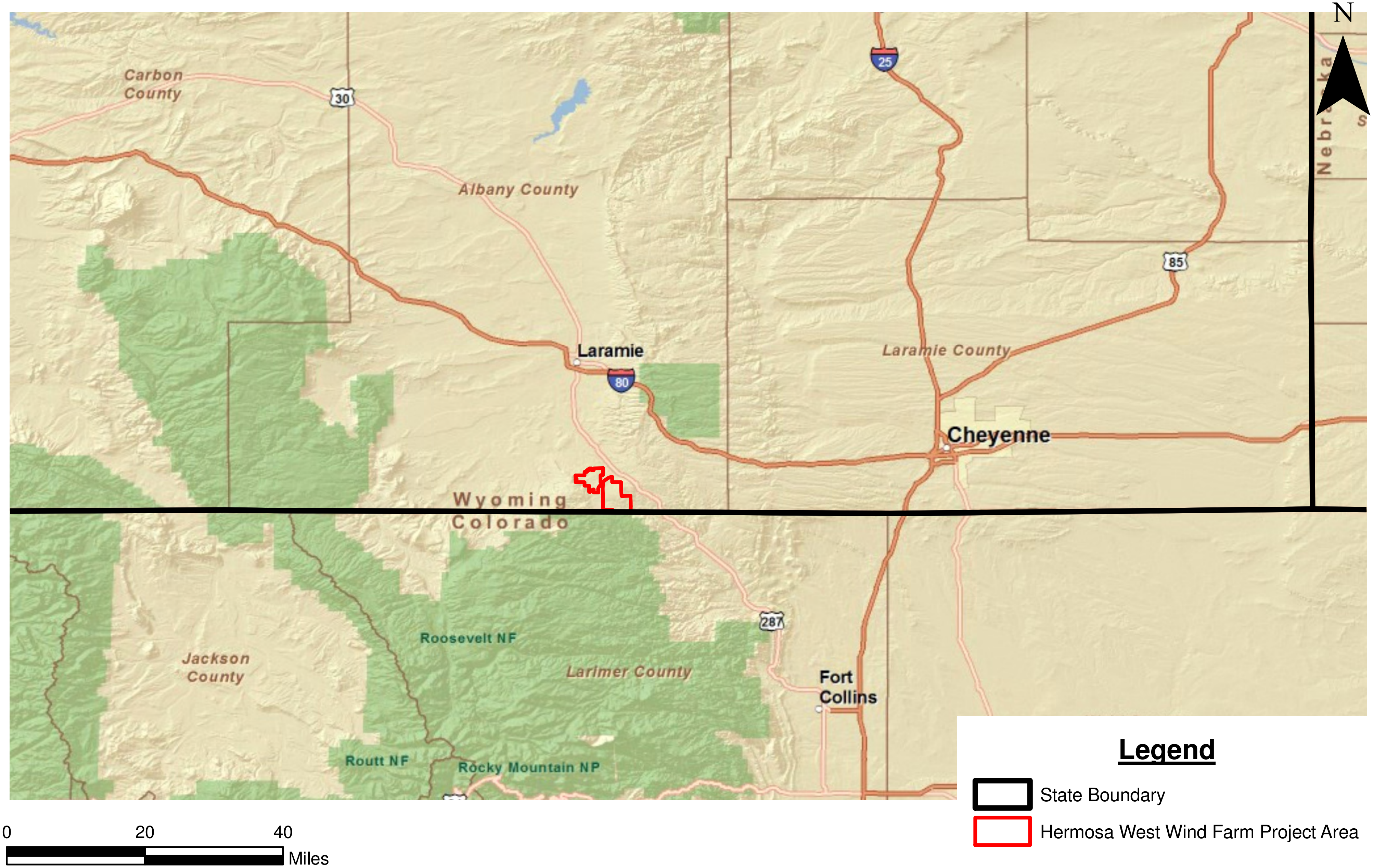
Based on the assessment performed, noise levels would not be expected to exceed fifty-five (55) dB(A) as measured at any point along the common property lines between a non-participating property and a participating property. During high wind events in excess of 10 m/s wind generated noise is likely to be masked from wind noise.

Other factors such as the existing ambient noise levels (especially from the nearby highway) and wind direction will also affect the perception of wind turbine noise at local properties.

Figures

March 2, 2010
Project No. 0111210

Environmental Resources Management Southwest, Inc.
15810 Park Ten Place, Suite 300
Houston, Texas 77084-5140
(281) 600-1000

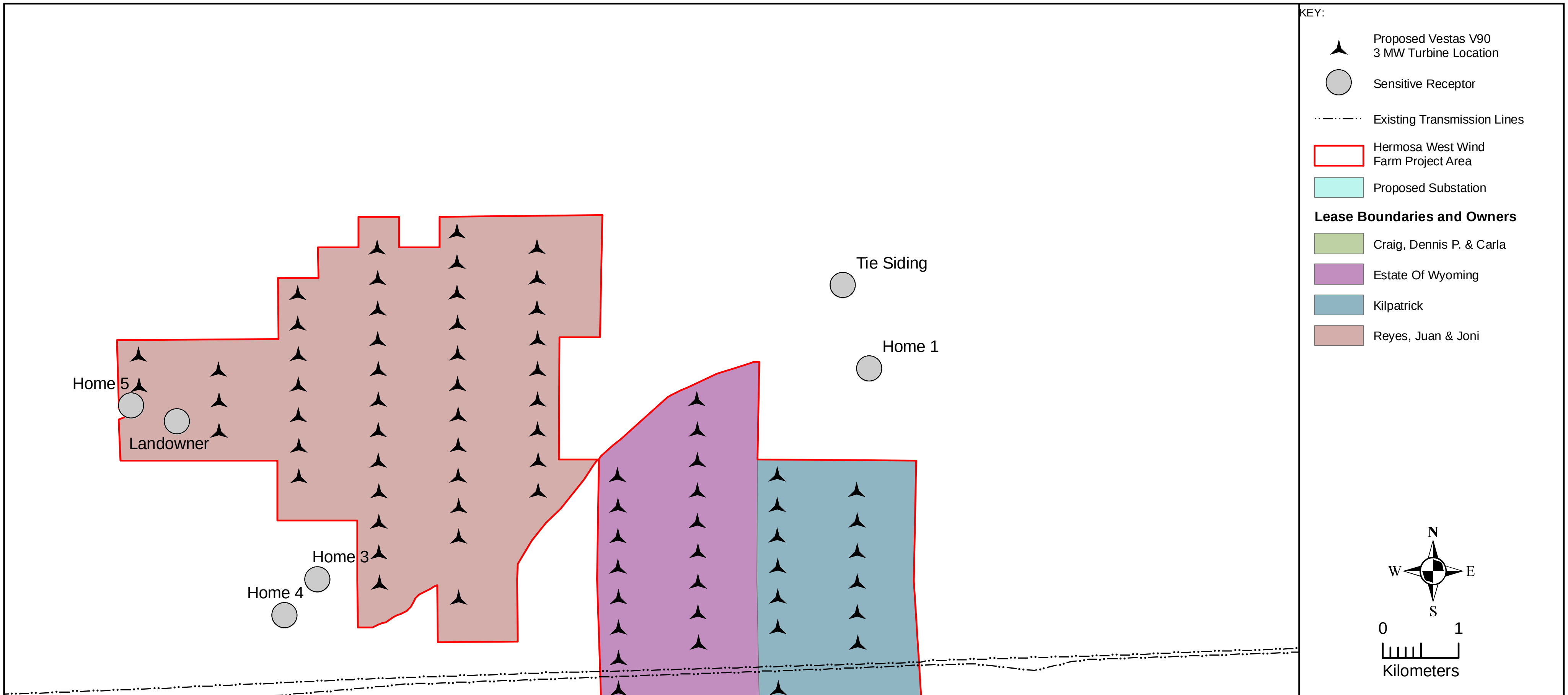


Environmental Resources Management

DESIGN:	E Johnson	DRAWN:	S King	CHKD.:	A Smith
DATE:	10/02/2009	SCALE:	AS SHOWN	REVISION:	0
FILE:	I:\GIS\Shell\projects\vicinity.mxd				

FIGURE 1-1
VICINITY MAP
Shell Wind Energy
Hermosa West Wind Farm Project

ERM



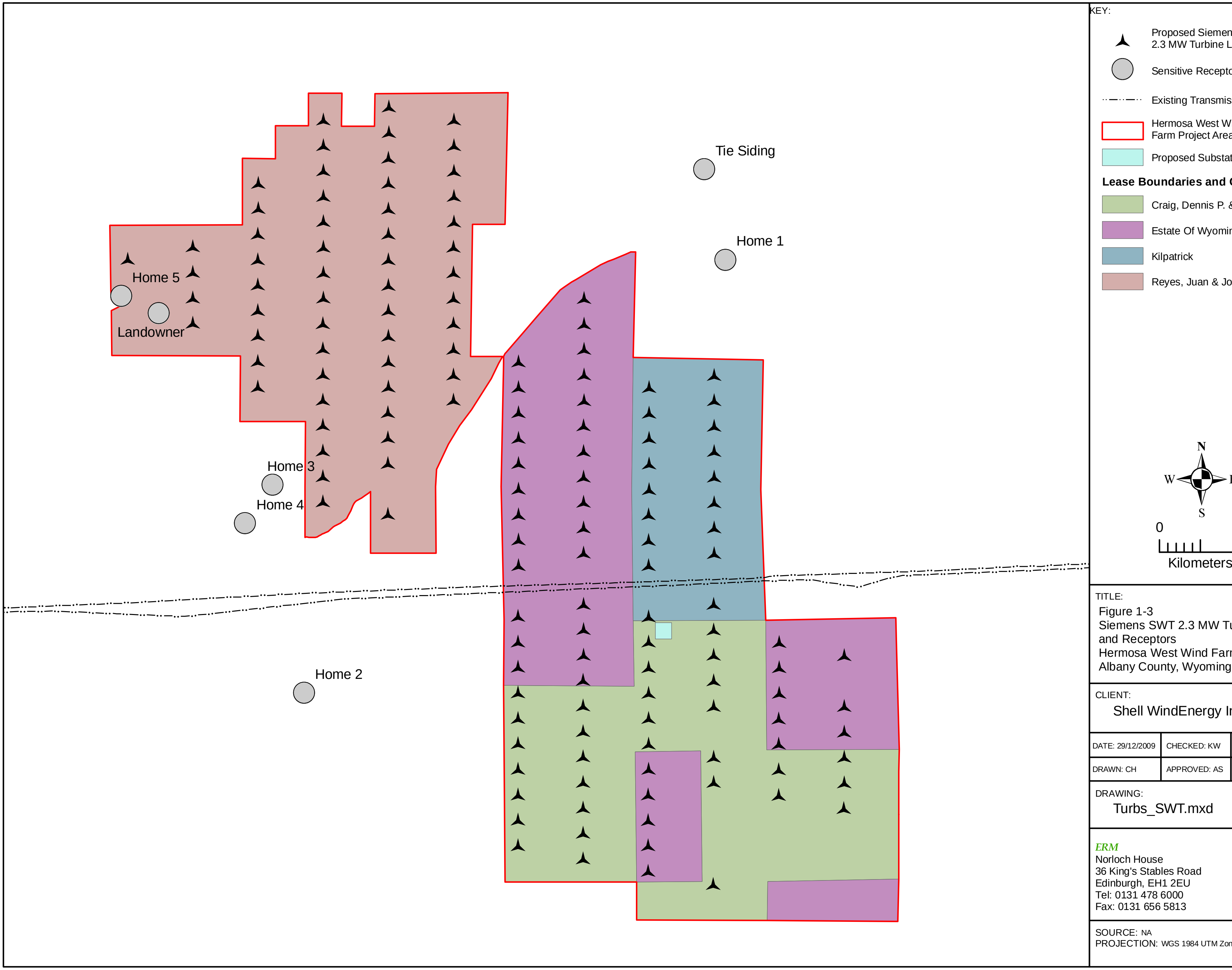
TITLE:
Figure 1-2
Vestas V90 3 MW Turbines
and Receptors
Hermosa West Wind Farm Project
Albany County, Wyoming

CLIENT: Shell WindEnergy Inc.		SIZE: A3
DATE: 01/03/2010	CHECKED: KW	PROJECT: 0105023
DRAWN: CH	APPROVED: AS	SCALE: As Scale Bar
DRAWING: Turbs_V90.mxd		REV: 0

ERM
Norloch House
36 King's Stables Road
Edinburgh, EH1 2EU
Tel: 0131 478 6000
Fax: 0131 656 5813

SOURCE: NA
PROJECTION: GCS WGS 1984

File: 0105023Hermosa_Wyoming_PM_CO\MAPS\Turbs_V90.mxd



KEY:

- Proposed Siemens SWT 2.3 MW Turbine Location
- Sensitive Receptor
- Existing Transmission Lines
- Hermosa West Wind Farm Project Area
- Proposed Substation

Lease Boundaries and Owners

- Craig, Dennis P. & Carla
- Estate Of Wyoming
- Kilpatrick
- Reyes, Juan & Joni

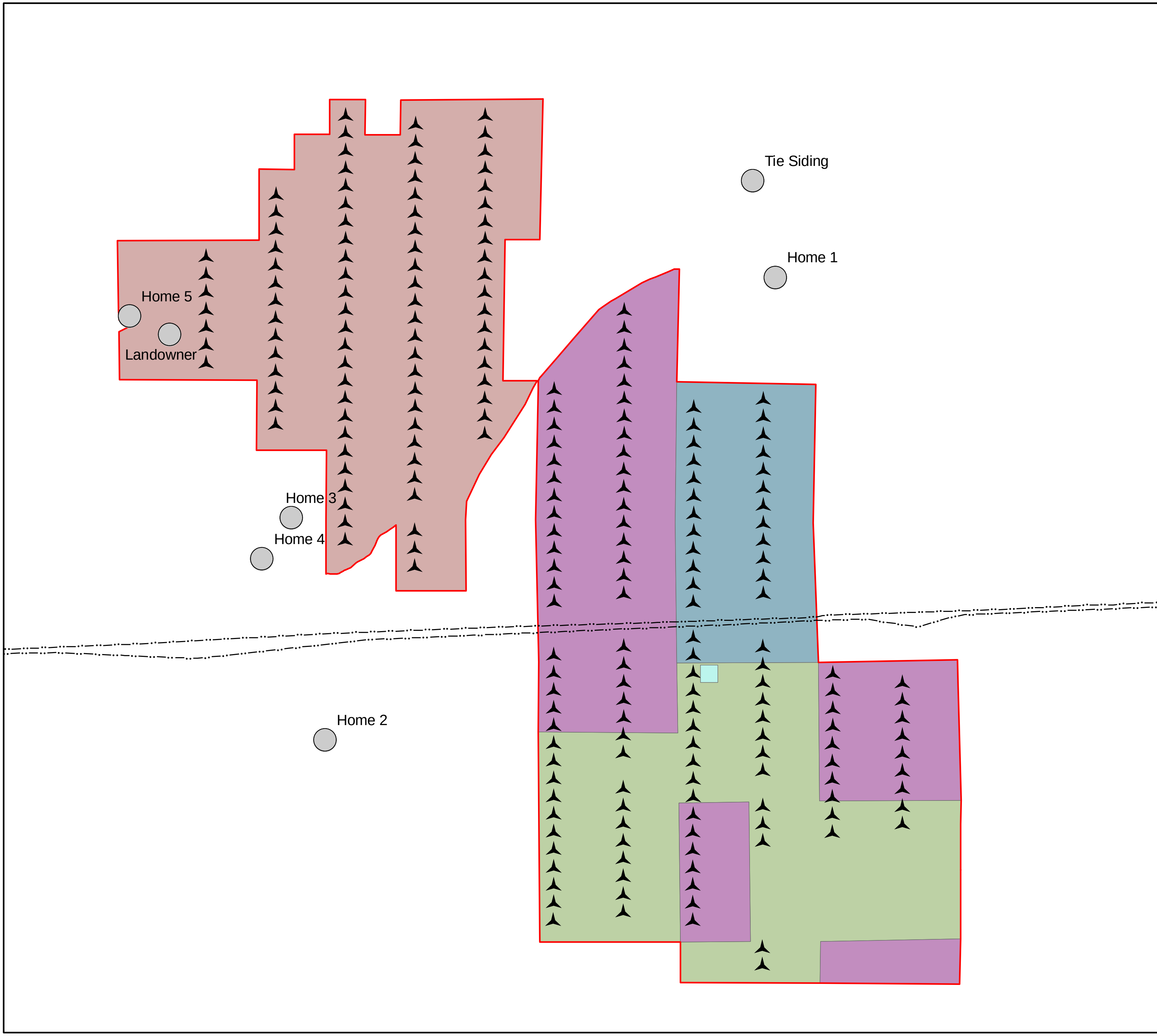
TITLE:
Figure 1-3
Siemens SWT 2.3 MW Turbines and Receptors
Hermosa West Wind Farm Project
Albany County, Wyoming

CLIENT: Shell WindEnergy Inc.		SIZE: A3
DATE: 29/12/2009	CHECKED: KW	PROJECT: 0105023
DRAWN: CH	APPROVED: AS	SCALE: As Scale Bar
DRAWING: Turbs_SWT.mxd		REV: 0

ERM
Norloch House
36 King's Stables Road
Edinburgh, EH1 2EU
Tel: 0131 478 6000
Fax: 0131 656 5813

SOURCE: NA
PROJECTION: WGS 1984 UTM Zone 13N

File: 0105023Hermosa_Wyoming_PM_CO\MAPS\Turbs_SWT.mxd



KEY:

- Proposed GE 1.5 MW Turbine Location
- Sensitive Receptor
- Existing Transmission Lines
- Hermosa West Wind Farm Project Area
- Proposed Substation

Lease Boundaries and Owners

- Craig, Dennis P. & Carla
- Estate Of Wyoming
- Kilpatrick
- Reyes, Juan & Joni

TITLE:
Figure 1-4
GE 1.5 MW Turbines and Receptors
Hermosa West Wind Farm Project
Albany County, Wyoming

CLIENT: Shell WindEnergy Inc.		SIZE: A3
DATE: 29/12/2009	CHECKED: KW	PROJECT: 0105023
DRAWN: CH	APPROVED: AS	SCALE: As Scale Bar
DRAWING: Turbs_300MW.mxd		REV: 0

ERM
Norloch House
36 King's Stables Road
Edinburgh, EH1 2EU
Tel: 0131 478 6000
Fax: 0131 656 5813

SOURCE: NA
PROJECTION: WGS 1984 UTM Zone 13N

File: 0105023Hermosa_Wyoming_PM_CO\MAPS\Turbs_300MW.mxd