3.17 NOISE

This section evaluates the potential noise effects from construction and operation of the proposed transmission line on background or ambient noise levels, potential vibration effects, and potential exposure of sensitive receptors to excessive noise in the Project Area.

3.17.1 Methodology

This section addresses the potential noise effects resulting from implementation of the Proposed Action (Project), as compared to the No Action Alternative. Anticipated Project-related noise sources were compared to applicable noise standards to determine whether the Proposed Action would cause a temporary or permanent increase in ambient noise levels; result in vibration within or around the Project Area; or expose sensitive receptors to excessive noise levels.

The analysis was informed by comments from the public scoping process that occurred from July to September 2009 and the DEIS comment period from July through September 2010. Comments from agency representatives, local organizations, and private citizens requested that the following issues be addressed with regards to noise:

- Potential operation and maintenance (O&M) noise effects of the wind turbines and the transmission lines to human health.
- Potential O&M noise effects of the wind turbines and the transmission lines to wildlife health:
  - Interference with breeding and other behaviors.
  - Short- and long-term health effects to sage-grouse, bighorn sheep, rare bats, and migratory birds.
- Distance from which noise would be audible.
- Projections for noise levels at night.
- Protection of acoustic resources in quiet, undeveloped areas, sensitive species habitats and other wild landscapes, including remaining less fragmented sagebrush habitats critical for greater sage-grouse and areas that Congress has specially protected.
- Potential noise effects to human recreational enjoyment of the area, particularly for campgrounds along the Steens Mountain Loop Road and near Mann Lake Loop Road, Mann Lake, and the Fish Lake campground.
- Potential noise effects to nearby residents.

3.17.1.1 Acoustics Principles

Sound is mechanical energy transmitted by pressure waves in a compressible or incompressible medium such as air or water, respectively. When sound becomes excessive, annoying, or unwanted, it is referred to as noise. Noise may be continuous (constant noise and decibel level), steady (constant noise with a fluctuating decibel level), impulsive (having a high peak of short duration), stationary (occurring from a fixed source), intermittent (occurring at the same rate), or transient (occurring at different rates). Noise levels are quantified using units of decibels (dB). The decibel is defined as ten times the base 10 logarithm of the ratio between the two quantities of sound pressure squared, or:

$$SPL = 10 \log (p^2 / p_o^2) = 20 \log (p / p_o) \text{ dB}$$

where p is the sound pressure being measured and p_o is the reference sound pressure (in air 0.0002 µbar or 2 x 10^{-5} N/m^2, in water 0.00001 µbar or 1 x 10^{-6} N/m^2). Sound pressure level (SPL, µbar, 0.1 N/m^2) attenuates with respect to the inverse distance law, where sound pressure is inversely proportional to the distance from the noise source (EPA 1974, Plog 1988).

Two measurements used by local, state, and federal agencies that relate the time-varying quality of environmental noise to its known effect upon people are 1) the 24-hour equivalent sound level ($L_{EQ}(24)$) and 2) the day-night sound level (L_{DN}). The $L_{EQ}(24)$ quantifier is the level of steady sound with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. The L_{DN} quantifier is the $L_{EQ}(24)$ with 10 decibels on the A-weighted decibel scale (dBA) added to nighttime sound levels between the hours of 10 p.m. and 7 a.m. to account for people's greater sensitivity to sound during nighttime hours. The 10th percentile-exceeded sound level (L_{10}) (L_{50} and L_{90} can be used also) is the A-weighted sound level that happens 10 percent or more of the time of the measurement (or 50 percent or 90 percent in the case of L_{50} and L_{90}, respectively) (EPA 1974).

In 1974, EPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. That document provides information for state and local agencies to use in developing their ambient noise standards. In it, EPA identified outdoor and indoor noise levels to protect public health and welfare. An $L_{EQ}(24)$ of 70 dBA was identified as the level of environmental noise that would not result in any measurable hearing loss over a lifetime. An L_{DN} of 55 dBA outdoors and an L_{DN} of 45 dBA indoors were identified as noise thresholds that would prevent activity interference or annoyance. These levels are not "peak" levels but are 24-hour averages over several years. Occasional high levels of noise may occur. An L_{DN} of 55 dBA is equivalent to a continuous noise level of 48.6 dBA. Examples of typical noise levels are as follows (EPA 1974):

- Quiet room: 28 – 33 dBA
- Computer: 37 – 45 dBA
- Refrigerator: 40 – 43 dBA
- Forced hot air heating system: 42 – 52 dBA
- Microwave: 55 – 59 dBA
- Clothes dryer: 56 – 58 dBA

The following relationships occur with regard to increases in noise measured on the A-weighted decibel scale (EPA 1974):

- A change of 1 dBA cannot be perceived by humans, except in carefully controlled laboratory environments;
- Outside of a laboratory, a 3 dBA change is considered a just-perceivable difference by humans;
- A change in level of at least 5 dBA is required before any noticeable change in human response would be expected; and
- A 10 dBA change is subjectively heard as approximately a doubling in loudness and can cause an adverse response.

3.17.1.2 Ground Vibration

Ground-borne vibration consists of rapidly fluctuating motions within the ground that have an average motion of zero. The effects of ground-borne vibrations typically cause a nuisance only to people, but at extreme

vibration levels, damage to buildings may occur. Although ground-borne vibration can be felt outdoors, it is typically an annoyance only to people indoors, where the associated effects of the shaking of a building can be notable and because people are moving around less indoors (e.g., seated). Induced ground-borne noise is an effect of ground-borne vibration and only exists indoors, because it is produced from noise radiated from the motion of the walls and floors of a room and may consist of the rattling of windows or dishes on shelves. Although the perceptibility threshold is about 65 VdB (vibration decibels), human response to vibration is not usually significant unless the vibration exceeds 70 VdB, with the threshold of potential architectural damage to fragile structures at about 100 VdB. Human response to different levels of ground-borne noise and vibration are as follows (FTA 2006):

- 65 VdB produces a noise level between 25 (low frequency) and 40 dBA (high frequency). This is the approximate threshold of perception for many humans. Low-frequency sound is usually inaudible, mid-frequency sound is excessive for quiet sleeping areas.
- 75 VdB produces a noise level between 35 (low frequency) and 50 dBA (high frequency). This is the approximate dividing line between barely perceptible and distinctly perceptible. Many people find transit vibration at this level to be annoying. Low-frequency noise is acceptable for sleeping areas, mid-frequency noise is annoying in most quiet occupied areas.
- 85 VdB produces a noise level between 45 (low frequency) and 60 dBA (high frequency). This vibration is acceptable only if there are an infrequent number of events per day. Low-frequency noise is annoying for sleeping areas, mid-frequency noise is annoying even for infrequent events for institutional land uses such as schools and churches.

3.17.1.3 Noise Regulations and Standards

In Oregon, noise is subject to regulation to provide protection of the health, safety, and welfare of Oregon citizens and from the hazards and deterioration of the quality of life imposed by excessive noise emissions. In general, new industrial and commercial facilities are subject to Oregon Environmental Quality Commission (OEQC) regulations that apply to new industrial or commercial noise sources located on a previously unused industrial or commercial site. These regulations are found in Oregon Administrative Rule (OAR) 340-035-0035. Recent amendments include standards for wind energy facilities, as summarized below; however, there are currently no standards for transmission lines connected to wind energy facilities.

For noise levels generated or caused by a wind energy facility, the noise levels may increase the ambient statistical noise levels L_{10} and L_{50} by more than 10 dBA, not to exceed the limits listed in Table 3.17-1 below. If the person who owns the noise sensitive property executes a legally effective easement or real covenant that benefits the property on which the wind energy facility is located, then the easement or covenant must authorize the wind energy facility to increase the ambient statistical noise levels, L_{10} or L_{50}, on the sensitive property by more than 10 dBA at the appropriate measurement point. The increase in ambient statistical noise levels is based upon the lowest assumed background L_{50} ambient noise level of 26 dBA (the ranged is estimated to be 26 to 35 dBA), or the actual ambient background level. The person owning the wind energy facility may conduct measurements to determine the actual ambient L_{10} and L_{50} background level (OAR 2009).

Other new industrial or commercial noise sources located on previously unused industrial or commercial sites shall not cause an increase in the ambient statistical noise levels, L_{10} or L_{50}, by more than 10 dBA in any one hour or more than the levels specified in Table 3.17-1. Notwithstanding the noise limits in Table 3.17-1, no person owning or controlling an industrial or commercial noise source shall cause or permit the operation of that noise source if an impulsive sound is emitted in air by that source which exceeds the sound pressure levels specified as follows: Blasting shall not exceed 98 dBC, slow response, between the hours of 7 a.m. and 10 p.m. and 93 dBC, slow response, between the hours of 10 p.m. and 7 a.m. All other impulse sounds shall not exceed 100 dB, peak response, between the hours of 7 a.m. and 10 p.m. and 80 dB, peak response,

between the hours of 10 p.m. and 7 a.m. OEQC also regulates the octave band sound pressure levels (OAR 2009).

Table 3.17-1 Oregon New Industrial and Commercial Noise Source Standards

	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.
L_{50} (median noise standard)	55 dBA	50 dBA
L_{10} (intrusive noise standard)	60 dBA	55 dBA
L_1 (annoying noise standard)	75 dBA	60 dBA

Source: OAR 2009

Notes: Levels are allowable statistical noise levels in any one hour. The ambient statistical noise levels L10 and L50 may not be increased by more than 10 dBA.

3.17.2 Affected Environment

3.17.2.1 Existing Noise Environment

The ambient sound level of a region is defined by the total noise generated within the specific environment and is usually comprised of sound emanating from natural and artificial sources. At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of the day and throughout the week. This variation is caused in part by changing weather conditions and the effects of seasonal vegetative cover.

The Proposed Action would be located in rural agricultural and wilderness environments with limited, dispersed noise sources. It is estimated that the existing ambient noise levels in the Project Area are in the range of 26 to 35 dBA (wilderness area) (OAR 2009; EPA 1978). The exact background noise level should be monitored before construction because the ambient statistical noise levels L_{10} and L_{50} cannot be increased by the Project by more than 10 dBA. The background vibration velocity level is less than 50 VdB (FTA 2006).

Sensitive receptors are those populations that are more susceptible to the effects of noise than the population at large and those located in close proximity to localized sources of noise. Sensitive receptors can include long-term health care facilities, rehabilitation centers, convalescent centers, retirement homes, residences, schools, playgrounds, childcare centers, parks and recreations centers, and athletic facilities.

Sensitive noise receptors within the Project Area include 34 residences and three recreational areas, as shown in Table 3.17-2 and Figure 3.17-1. There are other recreational areas in the area, however the listed three are the closest to the Project Area. The nearest sensitive noise receptor to the Project Area is Receptor #15, which is approximately 66 meters (217 feet) from the Alterative C right-of-way (ROW). No communities or other noise-sensitive receptors (from those listed above) are located in the immediate Project Area.

Table 3.17-2 Sensitive Noise Receptors within the Project Area

Sensitive Receptor Number	Type	Nearest Distance to Wind Turbines (meters)	Nearest Distance to Wind Turbines (miles)	Nearest Distance to Alternative B – West Route (meters)	Nearest Distance to Alternative B - South Diamond Lane Option (meters)	Nearest Distance to Alternative B - Hog Wallow Option (meters)	Nearest Distance to Alternative C – North Route (meters)
1	Residential	62,899	39.1	44,938	44,938	44,938	1,023
2	Residential	62,939	39.1	44,647	44,647	44,647	728
3	Residential	62,900	39.1	44,135	44,135	44,135	556
4	Residential	62,646	38.9	44,765	44,765	44,765	986
5	Residential	61,618	38.3	43,571	43,571	43,571	316
6	Residential	60,566	37.6	42,825	42,825	42,825	879
7	Residential	59,864	37.2	41,717	41,717	41,717	121
8	Residential	57,306	35.6	39,786	39,786	39,786	673
9	Residential	56,574	35.1	38,783	38,783	38,783	89
10	Residential	53,657	33.3	36,016	36,016	36,016	247
11	Residential	53,387	33.2	35,961	35,961	35,961	127
12	Residential	51,757	32.1	34,588	34,588	34,588	245
13	Residential	50,946	31.6	33,674	33,674	33,674	74
14	Residential	50,580	31.4	33,569	33,569	33,569	339
15	Residential	48,531	30.1	31,491	31,491	31,491	66
16	Residential	47,913	29.8	31,100	31,100	31,100	226
17	Residential	47,348	29.4	30,995	30,995	30,995	937
18	Residential	44,735	27.8	28,051	28,051	28,051	79
19	Residential	44,331	27.5	27,778	27,778	27,778	115
20	Residential	43,859	27.2	27,684	27,684	27,684	636
21	Residential	28,015	17.4	13,141	13,141	13,141	899
22	Residential	26,108	16.2	11,335	11,335	11,335	258
23	Residential	15,033	9.3	1,132	1,132	1,132	519
24	Residential	29,247	18.2	298	298	298	11,925

Table 3.17-2 Sensitive Noise Receptors within the Project Area

Sensitive Receptor Number	Type	Nearest Distance to Wind Turbines (meters)	Nearest Distance to Wind Turbines (miles)	Nearest Distance to Alternative B – West Route (meters)	Nearest Distance to Alternative B - South Diamond Lane Option (meters)	Nearest Distance to Alternative B - Hog Wallow Option (meters)	Nearest Distance to Alternative C – North Route (meters)
25	Residential	28,478	17.7	240	240	240	11,596
26	Residential	26,554	16.5	171	171	171	9,745
27	Residential	31,708	19.7	503	2,177	512	16,212
28	Residential	24,381	15.1	769	769	769	7,397
29	Residential	24,221	15.0	525	525	525	7,768
30	Residential	14,526	9.0	17,734	17,734	17,734	17,734
31	Residential	4,696	2.9	7,379	7,379	7,379	7,379
32	Residential	5,104	3.2	7,633	7,633	7,633	7,633
33	Residential	5,202	3.2	7,782	7,782	7,782	7,782
34	Residential	17,212	10.7	21,024	21,024	21,024	21,024
35	Recreational – Fish Lake Campground	11,377	7.1	15,058	15,058	15,058	15,058
36	Recreational – Mann Lake Campground	4,337	2.7	4,931	4,931	4,931	4,931
37	Recreational – Jackman Park Campground	10,675	6.6	14,787	14,787	14,787	14,787

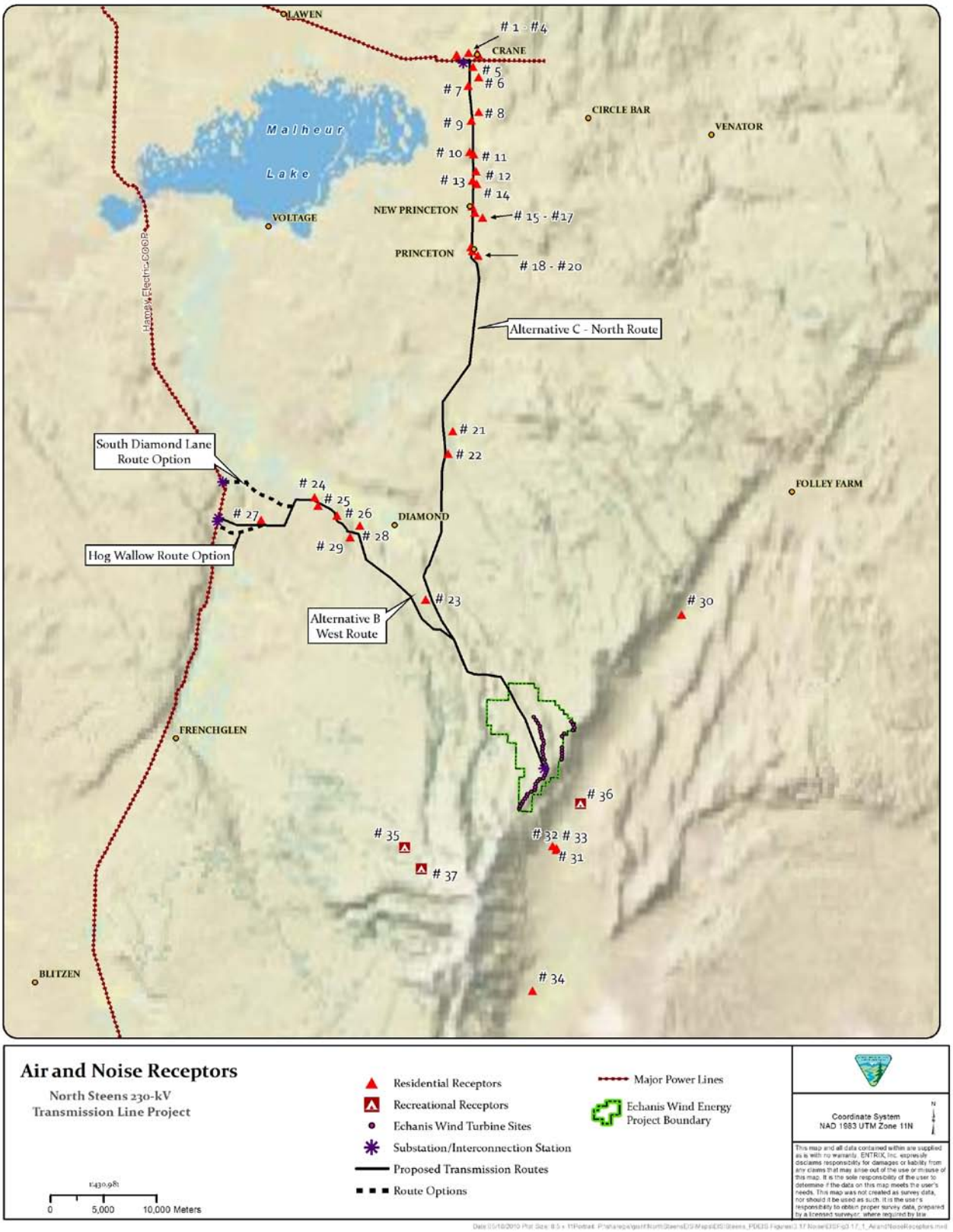

Figure 3.17-1 Noise Receptors.

3.17.3 Environmental Effects and Mitigation

Noise effects generally fall into two categories: temporary (short-term) effects resulting from the use of construction equipment, and permanent (long-term) effects resulting from facility operation. This noise analysis determines the effects of construction and operation of the Proposed Action and alternatives.

The transmission line, whether Proposed or alternative routes, would be constructed on newly installed double-circuit steel-pole towers. Initially, a single 115-kV circuit (three conductors) would be installed on one side of the towers (Phase I) to transmit the power generated by the Echanis Project. This first circuit would be constructed so that it could transmit 230-kV but it would only initially be operated at 115-kV for the Echanis Project, and it would be installed concurrently with the actual erection of the new poles and construction of access roads. Future plans call for a second line operating at 230-kV to be placed on the other side of the towers (Phase II). This second circuit would be installed later, at an unknown date, when additional electrical system capacity was required to transmit the power generated by the West Ridge, East Ridge, or Riddle Mountain Projects. Finally, the initial Phase I 115-kV line could be "re-energized" (no construction required) to 230-kV operation (Phase III) to transmit power if more than one or two of the West Ridge, East Ridge, or Riddle Mountain Projects were constructed and the additional capacity would be needed after Phase II was implemented.

The second phase of construction would use the same laydown areas, tensioning sites, and overland routes used during the first phase. As such, the Phase I construction would be the "heavy lifting" portion of the Proposed Action comprising installation of the new poles along with foundations and access roads. Phase II would only require stringing of three more conductors on the previously erected poles (no additional pole installation), and thus relatively "light" work. It should be noted that implementation of Phases II and III of the Project Applicant's transmission line system would also require upgrades of the Harney Electric Cooperative's existing transmission lines and ancillary facilities in the area, from 115-kV to 230-kV capacity and operation.

The potential noise effects during the short-term construction phase and the long-term operational phase of the Project are described below. It should be noted that a variety of project design features and best management practices to reduce the effects of noise from both the Echanis Project and the transmission line alternatives, would be implemented as part of Proposed Action and are highlighted below. ~~These measures are not repeated in the mitigation sections below, but are summarized in Appendix A (A.3.10).~~

3.17.3.1 Alternative A – No Action

Under the No Action Alternative, the proposed transmission line and wind turbines would not be installed; therefore, no noise effects would occur from these actions.

3.17.3.2 Echanis Project Effects Common to All Action Alternatives

All action alternatives include construction and operation of the Echanis Wind Energy Project. Consequently, the following noise effects are common to all action alternatives.

PERMANENT EFFECTS

WIND TURBINE OPERATIONS NOISE

Wind turbines generate two types of noise: aerodynamic and mechanical. Aerodynamic noise is generated by the blades passing through the air. Depending upon the turbine model (size) and the wind speed, the aerodynamic noise could sound like buzzing, whooshing, pulsing, and even sizzling.

Older turbines with their blades downwind of the tower are known to cause a thumping sound as each blade passes by the tower. Most noise radiates perpendicular to the blades' rotation. However, because modern turbines rotate to face the wind, they could radiate noise in different directions each day. The noise from two or more turbines could combine to create an oscillating or thumping "wa-wa" effect.

Wind turbines generate broadband noise containing frequency components from 20 to 3,600 Hz. The frequency composition varies with wind speed, blade pitch, and blade speed. Some turbines produce noise with a greater percentage of low frequency components at low wind speeds than at high wind speeds. Utility scale turbines must generate electricity compatible with grid transmission (i.e., frequency synchronized at 60 Hz). To meet this requirement, turbines are programmed to keep the blades rotating at a constant speed via a governor mechanism. To compensate for wind speed changes, they adjust the pitch of the blades into the wind. These adjustments change the sound power levels and frequency components of the noise. Generally, large wind turbines typically have blade tip speeds of about 300 feet per second (90 m/s) or 200 miles per hour (320 k/hr).

Mechanical noise is generated by a turbine's transmission (gearbox), which connects the turbine shaft to the generator shaft via an isolation coupling. Utility scale turbines are usually acoustically insulated to prevent most mechanical noise from proliferating outside of the nacelle or tower. Small turbines are more likely to produce noticeable mechanical noise because of insufficient acoustic insulation. Mechanical gearbox noise can contain discernable tones, which makes it particularly noticeable and irritating. ~~Table 3.17-3 lists the sound power for some common utility scale turbines estimated at various receptor distances from the proposed wind farm locations.~~

~~Table 3.17-3 Estimated Noise Levels of Utility Scale Wind Turbines~~

	~~Estimated Maximum Noise Level, dBA @ Distance, meters~~							
~~Turbine~~	~~15~~	~~4,700~~	~~5,100~~	~~5,200~~	~~14,500~~	~~17,200~~	~~24,000~~	~~26,000~~
~~Vestas V80 (1.8 MW)~~	~~109~~	~~36~~	~~33~~	~~32~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Enercon E70 (2 MW)~~	~~102~~	~~29~~	~~26~~	~~25~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Enercon E112 (4.5 MW)~~	~~107~~	~~34~~	~~31~~	~~30~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Average for Equipment~~	~~106~~	~~33~~	~~30~~	~~30~~	~~0~~	~~0~~	~~0~~	~~0~~

~~Sources: Alberts 2006; Rogers 2006.~~

~~Wind turbine noise resulting from operation of the Proposed Action and alternatives could increase ambient noise levels. The nearest residential receptor to the wind turbine Project Area is Receptor #31, approximately 4,700 meters (2.9 miles) away. At this location, the increased noise level caused solely by wind turbine operation is estimated to be 29 to 36 dBA. The nearest recreational receptor to the wind turbine Project Area is Receptor #36, approximately 4,337 meters (2.6 miles) away. At this location, the increased noise level caused solely by wind turbine operation is estimated to be 31 to 38 dBA. Consequently, wind turbine noise would be compliant with local standards. Therefore, operational effects associated with the wind farm would be considered acceptable and no mitigation measures would be required. Potential effects would be further reduced by implementation of the Project design features specified in Appendix A (A.3.10).~~

Noise modeling for the Project was completed by Siemens using the ISO 9613-2 General Wind Calculation Model in WindPRO, version 2.7.473 June 2010 (CEP 2011). Output from the noise propagation model is binned into 5 dBA contours, resulting in disturbance bands for the 55, 50, 45, and 40 dBA levels (Figure 3.17-2). As shown in that figure, noise levels would be at background levels north and west of the Echanis Project site.

Outside of the east and southeast Project boundaries, the noise levels would reach 40 to 45 dBA in the Lower Stonehouse WSA because turbines would be within a few hundred meters of the WSA boundary. Noise levels would reach 40 dBA in the Lower Stonehouse LWC because the turbines would be approximately 656 feet (200 meters) away from the LWC boundary. Thus, noise levels in the Lower Stonehouse WSA and LWC would exceed ambient levels, and may exceed OEQC standards. As indicated in Section 3.17.1.1, these noise levels would be comparable to the noise generated by computers (37 to 45 dBA) and refrigerators (40 to 43 dBA); and would become less noticeable the stronger the wind blows and masks the turbine noise. While the threshold for mitigation for sensitive receptors is for noise above 36 dBA (i.e., 10 dBA above the lowest level of assumed background noise levels of 26 to 35 dBA), the Lower Stonehouse WSA and LWC do not appear to be frequented by recreationists and they are not easily accessible by road or trail. Sensitive receptors typically consist of recreational sites, residences, businesses, etc. that would be sensitive to long-term exposure to noise. Due to the lack of recreational opportunities and the minimal access, no effects are anticipated to sensitive receptors situated within the western margins of the Lower Stonehouse WSA and LWC. Other than the Lower Stonehouse WSA and LWC no other WSAs or wilderness would be affected by noise.

Outside of the southwest Echanis Project boundary, noise levels would range from 40 to 50 dBA, but this would all occur on private lands.

MITIGATION

During Project operation, noise from the wind turbines would exceed ambient levels and might exceed OEQC standards within the southern portion of the Lower Stonehouse WSA and western LWC. To minimize the effects of noise, the Applicant would comply with the conditions of approval related to noise as set forth in Exhibit B to the Harney County Conditional Use Permit No. 07-14 issued on April 18, 2007, and revised May 21, 2008. These conditions include provisions that would reduce the effects to the WSA and LWC. These conditions include operating the Project so that noise does not exceed allowable statistical noise levels in any one hour, as measured at off-site sensitive receptors, under applicable OEQC noise standards.

A review of other wind energy project environmental impact statements was conducted to identify potential additional mitigation measures that could be implemented, including the *Wind Energy Development Programmatic EIS* (BLM 2005), the *West Butte Wind Power Right of Way EIS* (BLM 2011), the *Whistling Ridge Energy Project EIS* (2011), the *Desert Claim Wind Power Project EIS* (2009), and the *Kittitas Valley Wind Power Project EIS* (2007). To reduce or address the potential impacts of operation of the Echanis Project, the Applicant could implement the following mitigation measures, in addition to the PDFs and BMPs described in Section 2 and Appendix A:

- Obtain and enforce a warranty, from the selected turbine manufacturer, that the maximum continuous sound power level produced by each turbine under all wind conditions would not exceed 107 dBA measured at the hub height.
- Provide sufficient spacing between wind turbine towers to minimize array and wake losses (i.e., energy losses created by turbulence between and among the turbines).
- Implement a noise-monitoring program under which baseline (pre-Project) and with-Project noise conditions would be determined and documented.
- Establish a process for recording, responding to, evaluating, and resolving noise complaints that might arise during Project operation.

It should be noted that the implementation of these measures would be beyond BLM's jurisdiction, because the Echanis Project would be located on private land.

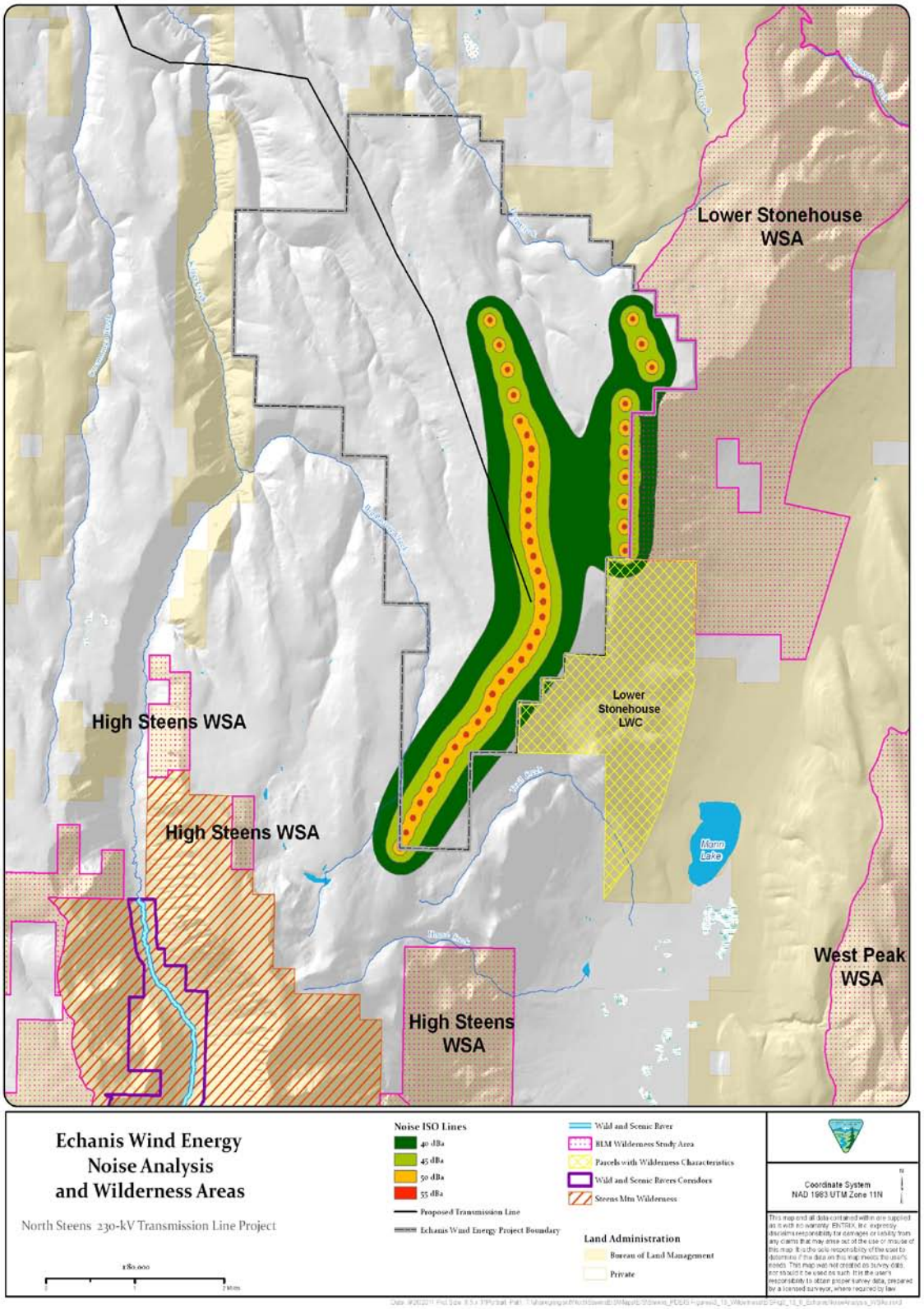

Figure 3.17-2 Echanis Wind Energy Project Noise Modeling/Analysis.

TEMPORARY EFFECTS

WIND TURBINE CONSTRUCTION AND MAINTENANCE NOISE AND VIBRATION

Construction noise associated with the Echanis Project could temporarily disturb sensitive receptors and violate local rules, standards, and/or ordinances. Construction noise effects created in the Project Area would be a function of the noise generated by construction equipment, the location and sensitivity of nearby land uses, and the timing and duration of the noise-generating activities. Table 3.17-3 lists estimated noise levels produced by typical construction machinery, calculated at various distances.

Table 3.17-3 Estimated Noise Levels for Typical Construction Equipment

	Estimated Maximum Noise Levels, dBA @ Distance, meters							
Construction Equipment	15	50	100	200	500	1,000	2,000	5,000
Backhoe / Loader	85	74	68	62	52	44	33	10
Tracked Equipment (Bulldozer)	100	89	83	77	67	59	48	25
Drilling / Boring Rig	96	85	79	73	63	55	44	21
Crane	85	74	68	62	52	44	33	10
Pump	70	59	53	47	37	29	18	0
Welding Machine / Generator	72	61	55	49	39	31	20	0
Average for Equipment	91	80	74	67	58	49	38	15
Dump Truck	91	80	74	68	58	50	39	16
Flatbed Truck	85	74	68	62	52	44	33	10
Pickup Truck	70	59	53	47	37	29	18	0
Tractor Trailer	85	74	68	62	52	44	33	10
City Street Traffic	80	69	63	57	47	39	28	5
Average for Truck Traffic	85	74	68	61	52	43	32	9

Sources: EPA 1971; Plog 1988; BK 1971; Kenai 2007.

Construction of the wind farm would temporarily increase ambient noise levels in the immediate vicinity of the ROW through the use of on-road vehicles, off-road equipment, and aircraft (e.g., a 3-day helicopter charter).

Construction activity associated with the wind farm could temporarily cause ground-borne vibration. Ground-borne vibration would occur in the immediate vicinity of construction activities, particularly if rock drilling, pile driving, or blasting was required. Table 3.17-4 lists vibration levels produced by typical construction machinery and activities at 7.62 meters (25 feet) in units of vibration decibels (VdB).

Routine inspection and maintenance activities associated with the Echanis Project could increase ambient noise levels in the vicinity of the Project Area for brief periods of time.

Table 3.17-4 Vibration Source Levels for Construction Activity

Construction Equipment	Vibration (VdB)
Pile Driver (impact type)	104 - 112
Pile Driver (sonic or vibratory type)	93 - 105
Vibratory Roller	94
Large Bulldozer	87
Loaded Trucks	86
Jackhammer	79
Small Bulldozer	58

Source: FTA 2006

Notes: Vibration levels measured at 7.62 meters (25 feet).

MITIGATION

~~Due to the remote location of~~ The Echanis Project would be located on Steens Mountain, where the minimal number ~~absence~~ of proximate receptors would result in construction and maintenance noise and vibration having minimal impacts on the general public. ~~moot, therefore no mitigations would be needed. The Project design features (PDFs) and best management practices (BPMs) that were taken into account in the effects analysis in this section would further reduce noise effects (see Section 2 and Appendix A.3.10).~~ The following mitigation measures would be implemented during construction of the Echanis Project, as described in the indicated section of Appendix A of this EIS.

From Appendix A.3.8:

- The Applicant would explore opportunities to notify wilderness users prior to visiting the areas affected by noise by publication of the construction schedule in local media, posting the schedule at administering agency offices, posting the schedule at trailheads or other recreation access points to the Steens Mountain Wilderness Area, or other means of reaching visitors. This notification process would alert wilderness users to the potential temporary impacts of presence and sound of construction and Project operations on opportunities for experiences of solitude and primitive recreation settings, and allow the visitor to decide whether they want to re-schedule their visit.

From Appendix A.3.10:

- Construction noise will be limited to daytime, weekday hours (e.g., 6 a.m. to 10 p.m.).
- Noise reduction features (e.g., mufflers and engine shrouds) will be used on all pieces of construction equipment and will be no less effective than those originally installed by the manufacturer.
- Where feasible, construction traffic will be routed away from residences.
- Unnecessary construction vehicle use and idling time will be minimized. The ability to limit construction vehicle idling time is dependent upon the sequence of construction activities and when and where vehicles are needed or staged. A "common sense" approach to vehicle use will be applied; if a vehicle is not required for use immediately or continuously for construction activities, its engine will be shut off. (Note: certain equipment, such as large diesel-powered vehicles require extended idling for warm-up and repetitive construction tasks.)

- To the extent possible, construction crews will not conduct pile driving or blasting within 100 feet of fragile structures or areas with sensitive uses.

- To the extent possible, construction equipment will not be operated within 25 feet of fragile structures or areas with sensitive uses.

In addition to the above measures, the following mitigation measures that were identified in the EIS literature search could also be implemented:

- All equipment would be maintained in good working order.

- All mobile or fixed noise-producing equipment used on the Project that is regulated for noise output by a local, state, or federal agency, would comply with such regulations while in the course of Project activity.

- The use of noise-producing signals, including horns, whistles, electronic alarms, sirens, and bells, would be for safety warning purposes only. Unless required for such safety purposes, and as allowable by applicable regulations, no construction-related public address, loudspeaker, or music system would be audible at any adjacent noise-sensitive land use.

- The Contractor would implement a noise complaint process and hotline number for the surrounding community. Echanis LLC would have the responsibility and authority to receive and resolve noise complaints.

- Coordinate construction vehicle travel to reduce the number of passes by sensitive receivers.

- Schedule noisy activities to occur at the same time since additional sources of noise generally do not add a significant amount of noise.

3.17.3.3 Alternative B – West Route (Proposed Action)

The noise effects and proposed mitigation measures for the Alternative B – West Route are described below.

PERMANENT EFFECTS

TRANSMISSION LINE OPERATIONS NOISE

Three sources of noise from the operation of transmission lines include the corona effect, noise from inspection and maintenance activities, and noise from substations. Audible noise from transmission lines is primarily due to point source corona (crackling and hissing with small amounts of light) resulting from inconsistencies found along the line. Such noise routinely occurs when air is ionized around a gap, burr (raised area), irregularity, or some non-insulated component during the conductance of electricity through power lines. Corona is also produced when transmission lines break down over time and their fastener components loosen, resulting in an air gap. Corona noise is most prominent during periods of rain, fog, or high humidity. In addition to corona noise, wind blowing across power lines and power poles can generate noise when airflow is non-laminar or turbulent. Noise from substations would include operation of transformer banks and circuit breakers that also produce corona noise, and diesel emergency backup generators for safety-related equipment, if present. Table 3.17-5 lists the estimated noise levels for a transmission line, calculated at various distances for different weather conditions.

Table 3.17-5 Estimated Noise Levels of the Transmission Line

	Estimated Maximum Noise Level, dBA at Distance, meters							
Transmission Line	15	50	100	200	500	1,000	2,000	5,000
Dry Weather	40	29	23	17	7	0	0	0
Humid Weather	50	39	33	27	17	9	0	0
Wet Weather	60	49	43	37	27	19	8	0
Average for Equipment	53	43	37	30	21	12	1	0

Source: CPUC 2009

Corona noise resulting from operation of the Proposed Action could increase ambient noise levels. However, such increases would be small and generally not noticeable at typical distances from the right-of-way. The proposed transmission line would cause a small permanent noise increase as a result of the corona effect. However, the precise location of the greatest possible corona noise cannot be known until after commencing operation, because conductor surface defects, damage, and inconsistencies influence the generation of corona noise, along with weather factors. The nearest receptor to Alternative B would be Receptor #26, which would be approximately 171 meters (561 feet) from the transmission line. At this location, the increase in ambient noise level caused solely by corona noise, if present, is estimated to remain between 18 and 38 dBA and would be only 3 dBA above the assumed existing maximum ambient noise level (26 to 35 dBA). The corona performance of the Proposed Action was also predicted by T. Dan Bracken, Inc. using the BPA Corona and Field Effects Program. Corona-generated audible-noise levels were calculated for average voltage and average conductor heights for fair- and foul-weather conditions. The predicted median audible noise level (L_{50}) during foul weather for the nearest residential receptor to the Alternative B Project Area would be about 38 dBA (Bracken 2010). Consequently, corona noise would be compliant with local standards; therefore, operational effects associated with corona noise are considered minor.

TEMPORARY EFFECTS

Temporary effects from the Proposed Action would be similar to those described above in the Effects Common to all Action Alternatives section.

TRANSMISSION LINE CONSTRUCTION EQUIPMENT NOISE

Construction of the Proposed Action would temporarily increase ambient noise levels in the immediate vicinity of the ROW through use of on-road vehicles, off-road equipment, and aircraft (e.g., 3-day helicopter charter). The nearest receptor to Alternative B would be Receptor #26, which would be approximately 171 meters (561 feet) from the transmission line. This residence would be the only one within 200 meters (656 feet) of the ROW for this alternative. The estimated noise levels at this receptor would be about 63 to 69 dBA average, for a few days at most. Consequently, the construction activities, although temporary, would be above the OEQC L_{10} (intrusive noise) and L_{50} (median noise) standards, but below the L_1 (annoying noise) standard for daytime. In addition, there would be an increase in the ambient statistical noise levels, L_{10} or L_{50}, of more than 10 dBA in any one hour.

TRANSMISSION LINE CONSTRUCTION ACTIVITY VIBRATION

Construction activity associated with the Proposed Action could temporarily cause ground-borne vibration. Ground-borne vibration would occur in the immediate vicinity of construction activities, particularly if rock drilling, pile driving, or blasting was required.

Based upon the distance to the nearest residential receptor, Receptor #26 would be approximately 171 meters (561 feet) from the transmission line in Alternative B, vibration levels would be about 70 to 80 VdB, which would be well below the FTA damage threshold of 100 VdB for buildings. People may feel minor ground movement at greater distances, but because the construction activities would be temporary and there would be negligible potential for damage to fragile structures, this would not constitute more than a negligible effect.

TRANSMISSION LINE MAINTENANCE NOISE

Routine inspection and maintenance activities associated with the proposed transmission line could increase ambient noise levels in the vicinity of the Project Area for brief periods of time. Inspection and maintenance activities would include insulator washing, substation maintenance, generator and gearbox rebuilds/replacements, and access road repair which would involve occasional truck or earthmoving equipment activity along the transmission line ROW. The nearest residential receptor to Alternative B would be Receptor #26, which would be approximately 171 meters (561 feet) away. Noise from these sources should not result in perceptible noise level increases at the nearest sensitive receptor. However, some construction equipment used in road repairs could cause ambient background noise levels to temporarily increase beyond 10 dBA in any one hour.

MITIGATION

MITIGATION FOR TRANSMISSION LINE CONSTRUCTION EQUIPMENT AND ACTIVITY NOISE

Mitigation measures that could be implemented to address potential impacts from construction of Alternative B, would be the same as those described above for the temporary impacts of the Echanis Project. ~~No additional mitigation measures would be required because project design features (PDFs) and best management practices (BMPs) were incorporated into the action alternatives and would be implemented to reduce the noise effects (see Section 2 and Appendix A.3.10).~~

MITIGATION FOR TRANSMISSION LINE MAINTENANCE ACTIVITY NOISE

As described in Appendix A.1.1, the following mitigation measure would be implemented during operation of Alternative B:

- The proposed hardware and conductor will limit the audible noise, radio interference (RI), and television interference (TVI), due to corona. Tension will be maintained on all insulator assemblies to assure positive contact between insulators, thereby avoiding sparking. Caution will be exercised during construction to avoid scratching or nicking the conductor surface, which may provide points for corona to occur.

~~No additional mitigation measures would be required because project design features (PDFs) and best management practices (BMPs) were incorporated into the action alternatives and would be implemented to reduce the noise effects (see Section 2 and Appendix A.3.10).~~

South Diamond Lane Route Option

The South Diamond Lane Route Option for Alternative B would only change the noise effects for Receptor #27. The preferred West Route would locate the transmission line approximately 503 meters (1,650 feet) from Receptor #27, while the South Diamond Lane Route would locate the transmission line approximately 2,177 meters (7,142 feet) from the residence. Consequently, the noise effects would be reduced for Receptor #27 at this greater distance with this option. However, all other effects to the other sensitive receptors would remain the same as those for the proposed West Route.

Hog Wallow Route Option

The Hog Wallow Route Option for Alternative B would only change the noise effects for Receptor #27. The preferred West Route would locate the transmission line approximately 503 meters (1,650 feet) from Receptor #27, while the Hog Wallow Route would locate the transmission line approximately 512 meters (1,680 feet) from the residence. Consequently, the noise effects would be slightly less for Receptor #27 at this greater distance with this option. However, all other effects to the other sensitive receptors would remain the same as those for the proposed West Route.

115-KV Transmission Line Option

Potential permanent and temporary noise and vibration effects and mitigation measures for construction, operation, and maintenance activities for a 115-kV transmission line would be similar to those described above for the Proposed Action or the two route options.

3.17.3.4 Alternative C – North Route (Preferred Alternative)

Potential permanent and temporary noise and vibration effects and mitigation measures related to construction, operation, and maintenance activities that would occur for the Alterative C – North Route would be similar to those described for the Alternative B – West Route. However, the nearest residential receptor to Alternative C would be Receptor #15, which would be approximately 66 meters (217 feet) from the transmission line. This receptor and six others (Receptors #7, #9, #11, #13, #18, and #19) are all within 200 meters (656 feet) of the Project ROW. The distances from the sensitive receptors to Alternative C are closer than those from the Alterative B.

Corona noise, if present, at Receptor #15 is estimated to be 27 to 47 dBA. The corona performance of the Proposed Action was also predicted by T. Dan Bracken, Inc. using the BPA Corona and Field Effects Program. Corona-generated audible-noise levels were calculated for average voltage and average conductor heights for fair- and foul-weather conditions. The predicted median audible noise level (L_{50}) during foul weather for the nearest residential receptor to Alternative C would be about 43 dBA (Bracken 2010). Consequently, corona noise would be compliant with local standards; therefore, operational effects associated with corona noise are considered minor.

The estimated construction noise levels at the nearest sensitive receptor, Receptor #15, would be approximately 71 to 78 dBA average. The construction activities, although temporary, would be above the OEQC L_{10} (intrusive noise) and L_{50} (median noise) standards for daytime, and at times would be above the L_1 (annoying noise) standard of 75 dBA for daytime. In addition, there would be an increase in the ambient statistical noise levels, L_{10} or L_{50}, of more than 10 dBA in any one hour. As a result, the mitigation measures identified for the Echanis Project and Alternative B would also be recommended to mitigate some of the construction noise associated with this alternative.

Vibration levels for construction activity at Receptor #15 would be below the FTA damage threshold of 100 VdB for buildings. This is based upon the vibration source levels for construction equipment at 7.62 meters (25 feet) in Table 3.17-4, compared to this alternative's nearest sensitive receptor at a distance of 66 meters (217 feet). To ensure that vibration associated with construction activity would be minimized to the extent feasible, mitigation measures described above and PDFs and BMPs identified in Section 2 and Appendix A would be followed.

Routine inspection and maintenance activities for the proposed transmission line could increase ambient noise levels in the vicinity of the Project Area for brief periods of time. Although most noise sources should not be perceptible at the nearest sensitive receptor, some construction equipment used in road repairs could cause ambient background noise levels to increase beyond 10 dBA in any one hour. The mitigation measures identified for the Echanis Project and Alternative B would also be recommended to mitigate noise associated with road repair activity.

115-KV Transmission Line Option

Potential permanent and temporary noise and vibration effects and mitigation measures for construction, operation, and maintenance activities for a 115–kV transmission line would be similar to those described above for Alternative C.

MITIGATION

MITIGATION FOR TRANSMISSION LINE CONSTRUCTION EQUIPMENT AND ACTIVITY NOISE

Mitigation measures that could be implemented to address potential impacts from construction of Alternative C, would be the same as those described above for the temporary impacts of the Echanis Project and Alternative B. ~~No additional mitigation measures would be required because project design features (PDFs) and best management practices (BMPs) were incorporated into the action alternatives and would be implemented to reduce the noise effects (see Section 2 and Appendix A.3.10).~~

MITIGATION FOR TRANSMISSION LINE MAINTENANCE ACTIVITY NOISE

Mitigation measures that could be implemented to address the potential impacts from maintenance of Alternative C, would be the same as those described above for the impacts of Alternative B. ~~No additional mitigation measures would be required because project design features (PDFs) and best management practices (BMPs) were incorporated into the action alternatives and would be implemented to reduce the noise effects (see Section 2 and Appendix A.3.10).~~

3.17.3.5 Residual Effects after Mitigation

Residual effects from construction of the Proposed Action would include noise in excess of ambient levels and maybe exceeding OEQC standards to the limited number of recreationists using the southern portion of the Lower Stonehouse WSA and western LWC, disturbance to nearby residences, and disturbance to and displacement of some species of wildlife.

3.17.3.6 Summary Comparison of Alternatives

The effects to noise and vibration from development of the Echanis Project, primary access road, and action alternatives is compared in Table 3.17-6 and summarized in Table 3.17-7. The table includes the effects to

noise and vibration along the primary access road to the Echanis Project, in addition to effects from each alternative.

Table 3.17-6 Comparison of Effects to Noise and Vibration

		Alternative B			
	Alternative A - No Action	West Route (Proposed Action)	S. Diamond Lane Route Option	Hog Wallow Route Option	Alternative C - North Route (Preferred Alternative)
Permanent Noise Effects at Nearest Receptor					
~~Wind Farm Operations~~	~~N/A~~	~~31 - 38 dBA~~	~~31 - 38 dBA~~	~~31 - 38 dBA~~	~~31 - 38 dBA~~
Transmission Line Operations	N/A	18 - 38 dBA	18 - 38 dBA	18 - 38 dBA	27 - 47 dBA
Temporary Noise Effects at Nearest Receptor					
Wind Turbine Construction and Maintenance	N/A	14 - 20 dBA	14 - 20 dBA	14 - 20 dBA	14 - 20 dBA
Transmission Line Construction and Maintenance	N/A	63 - 69 dBA	63 - 69 dBA	63 - 69 dBA	71 - 78 dBA
Temporary Vibration Effects at Nearest Receptor					
Wind Farm and Transmissions Line Construction	N/A	70 - 80 VdB	70 - 80 VdB	70 - 80 VdB	< 100 VdB

Table 3.17-7 Summary of Effects to Noise and Vibration

		Alternative B			
Alternative A – No Action	Echanis Wind Energy Project	West Route (Proposed Action)	S. Diamond Lane Route Option	Hog Wallow Route Option	Alternative C – North Route (Preferred Alternative)
Under the No Action Alternative, the proposed transmission line and wind turbines would not be installed; therefore, no effects would occur from noise related to these actions.	Construction of the Echanis Project would temporarily increase ambient noise levels in the immediate vicinity of the ROW through use of on-road vehicles, off-road equipment, and aircraft (3-day helicopter charter). Construction activity associated with the Echanis Project could temporarily cause ground-borne vibration. Ground-borne vibration would occur in the immediate vicinity of construction activities, particularly if rock drilling, pile driving, or blasting was required. Routine inspection and maintenance activities associated with the Echanis Project could increase ambient noise levels in the vicinity of the Project Area for brief	Temporary effects from Alternative B would be similar to those described in the effects of the Echanis Project. The estimated construction-related noise levels at the one residence within 200 meters of the ROW would average about 63 to 69 dBA for a few days at most. Consequently, the construction activities, although temporary, would be above the OEQC L10 (intrusive noise) and L50 (median noise) standards, but below the L1 (annoying noise) standard for daytime. In addition, there would be an increase in the ambient statistical noise levels, L10 or L50, of more than 10 dBA in any one hour. Vibration levels at the nearest residential receptor (561 feet away) would be about 70 to 80 VdB, which would be well below the FTA damage threshold for buildings of 100 VdB. People might feel minor ground movement at greater distances, but because the construction activities would be	The South Diamond Lane Route Option of Alternative B would only change the noise effects to one receptor. The transmission line would be located 7,124 feet from it, as opposed to 1,650 feet from it in Alternative B. The noise effects at this receptor would be reduced. All other effects to the other sensitive receptors would remain the same as those for the proposed West Route. The potential permanent and temporary noise and vibration effects and mitigation measures for construction, operation, and maintenance activities that would occur on the South Diamond Lane Route	The Hog Wallow Route Option of Alternative B would only change the noise effects for one receptor. The transmission line would be located 1,680 feet from it, as opposed to 1,650 feet in Alternative B. The noise effects would be slightly less for this receptor with this option. All other effects to the other sensitive receptors would remain the same as those for the proposed West Route. The potential permanent and temporary noise and vibration effects and mitigation measures for construction, operation, and maintenance activities that would occur on the Hog	Potential permanent and temporary noise and vibration effects and mitigation measures for construction, operation, and maintenance activities that would occur for the Alterative C - North Route would be similar to those described for the Alternative B - West Route. However, the nearest residential receptor to Alternative C would be approximately 217 feet from the transmission line. This receptor and six others would all be within 200 meters of the Project right-of-way. The distances from the sensitive receptors to the Alternative C Project Area would be closer than those from the Alterative B. The estimated construction noise levels at the nearest sensitive receptor would be approximately 71 to 78 dBA average. The construction activities, although temporary, would be above the OEQC L_{10} (intrusive noise) and L_{50} (median noise) standards for daytime, and at times would be above the L_1 (annoying noise) standard of 75 dBA for daytime. In addition, there would be an

Table 3.17-7 Summary of Effects to Noise and Vibration

		Alternative B			
Alternative A – No Action	Echanis Wind Energy Project	West Route (Proposed Action)	S. Diamond Lane Route Option	Hog Wallow Route Option	Alternative C – North Route (Preferred Alternative)
	periods of time. The nearest residential receptor to the wind turbines is approximately 2.9 miles away. ~~At this location, the increased noise level caused solely by wind turbine operation was estimated to be 29 to 36 dBA~~. The nearest sensitive recreational receptor to the wind turbines is approximately 2.6 miles away~~. At this location, the increase noise level caused solely by wind turbine operation was estimated to be 31 to 38 dBA.~~	temporary and there would be negligible potential for damage to fragile structures, this would not constitute an effect. At the nearest receptor (approximately 561 feet from the transmission line), the increase in ambient noise level caused solely by corona noise, if present, as estimated to remain between 18 and 38 dBA and would be only 3 dBA above existing ambient noise levels. Corona noise appears compliant with local standards; therefore, operational effects associated with corona noise are considered minor. Noise from routine inspection and maintenance activities should not result in perceptible noise level increases at the nearest sensitive receptor. However, some construction equipment used in road repairs might cause ambient background noise levels to temporarily increase beyond 10 dBA in any one hour.	Option would be similar to those described for the proposed West Route.	Wallow Route Option would be similar to those described for the proposed West Route. .	increase in the ambient statistical noise levels, L_{10} or L_{50}, of more than 10 dBA in any one hour. Vibration levels of construction activity at the nearest receptor (217 feet) would be below the FTA damage threshold for buildings of 100 VdB. This is based upon the vibration source levels for construction equipment at 7.62 meters (25 feet) compared to this alternative's nearest sensitive receptor at a distance of 66 meters (217 feet). Corona noise, if present, at the nearest receptor (217 feet) is estimated to be 27 to 47 dBA. Corona noise appears compliant with local standards; therefore, operational effects associated with corona noise are considered minor. Although most noise sources from routine inspection and maintenance activities should not be perceptible at the nearest sensitive receptor, some construction equipment used in road repairs might cause ambient background noise levels to increase beyond 10 dBA in any one hour.