

BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF SOUTH DAKOTA

IN THE MATTER OF THE APPLICATION BY PREVAILING WIND PARK, LLC FOR A
PERMIT OF A WIND ENERGY FACILITY IN BON HOMME COUNTY, CHARLES MIX
COUNTY AND HUTCHINSON COUNTY, SOUTH DAKOTA, FOR THE
PREVAILING WIND PARK PROJECT

EL18-026

PREFILED TESTIMONY OF JERRY L. PUNCH

ON BEHALF OF INTERVENORS



1 **Q: Please state your name, title, affiliation, and address.**

2 A: My name is Jerry L. Punch, and I am a Professor Emeritus in the Department of
3 Communicative Sciences and Disorders (CSD) at Michigan State University (MSU) in East
4 Lansing, Michigan. As a retired faculty member, I maintain an office in the Department, which
5 is located in the Oyer Speech and Hearing Building, 126 Red Cedar Road, East Lansing, MI
6 48824. My home address is 4469 Satinwood Drive, Okemos, MI 48864.

7
8 **Q: What is the purpose of your testimony?**

9 A: I have been asked to provide testimony as an audiologist on behalf of Intervenors in the
10 matter of the Prevailing Wind Park wind project (“Project”). My testimony as an expert witness
11 will address the potential health risks posed by noise from the Project, if approved according to
12 the application and regulations described in Article 17 of Bon Homme County zoning ordinances
13 and the affidavit of Peter Pawlowski, dated August 9, 2018.

14
15 **Q: What is audiology?**

16 A: Audiology is the study of hearing and hearing disorders. It is a health-related discipline that
17 focuses on sound, the anatomy and physiology of the ear, hearing disorders, and the clinical
18 aspects involved in diagnosing and treating hearing disorders. As an audiologist, I am
19 knowledgeable of the anatomy and physiology of the ear; sound generation, propagation, and
20 perception; and the ear and how it processes sound. I also have knowledge of research design
21 and interpretation of research findings, and I have had a long-standing interest in community
22 noise issues. This background has led me to understand the relationships between noise and the
23 impacts it can have on human health.

24
25 **Q: What is your educational and professional background?**

26 A: My full CV is appended as Exhibit 1. I hold a PhD degree in Audiology from Northwestern
27 University and have held a number of professional positions in audiology over the past 50 years.
28 I have had an extensive and eclectic career as a clinical audiologist; clinical supervisor;
29 researcher; teacher; and administrator in academic, professional association, hospital, and
30 industrial settings. My academic coursework included the study of the biological sciences
31 through enrollment in MA and PhD-level courses in anatomy and physiology of hearing and

32 enrollment in a PhD-level course in physiological psychology. My work experiences include
33 internships and paid employment as an audiologist in multiple otolaryngology clinics as a
34 graduate student; instruction of ENT residents at Indiana University School of Medicine on the
35 clinical aspects of audiology; and instruction of undergraduate-level courses in the anatomy and
36 physiology of hearing. Over the years, I have taught a large variety of undergraduate- and
37 graduate-level courses in clinical audiology. Those courses include a graduate-level course on
38 Research Methods, which I taught at MSU for approximately five years prior to my retirement
39 in 2011. I have also taught a graduate-level seminar on ethics in research and clinical practice.
40 For seven years in the recent past, I served as a representative of the five departments of the
41 College of Communication Arts and Sciences on MSU's Institutional Review Board (IRB). The
42 IRB is charged with reviewing and approving research applications of MSU researchers, with the
43 aim of protecting human subjects who participate in research studies conducted in various
44 disciplines.

45

46 **Q: What are your current professional credentials and affiliations?**

47 A: I am a member of the American Speech-Language-Hearing Association (ASHA), the
48 American Academy of Audiology, the American Auditory Society, and the Acoustical Society
49 of America (ASA). I hold the Certificate of Clinical Competence in Audiology from ASHA,
50 which I have maintained since 1968 through various formal programs of continuing education. I
51 am also an ASHA Fellow. Fellowship is one of the highest honors the Association bestows. To
52 be awarded Fellowship, nominees must have made outstanding contributions to the discipline of
53 communication sciences and disorders. ASHA Fellows make up less than one percent of the
54 membership of that national organization. Although I am officially retired from MSU, I maintain
55 an office in my academic department and continue to conduct audiological research and to
56 consult on wind turbine projects as a health expert.

57

58 **Q: What experiences have you had that qualify you as a health expert in cases involving**
59 **wind turbine noise?**

60 A: I have had a considerable number of such experiences. Since about 2009, I have coauthored a
61 review article on wind turbine noise in *Audiology Today*, served as Chairperson of the Wind and
62 Health Technical Work Group, at the invitation of the Michigan Department of Energy, and

63 presented invited comments in public hearings and hearings of zoning boards and commissions
64 in several states, including Michigan, Illinois, Indiana, and New York. I coauthored a three-part,
65 invited blog on the *HearingHealthMatters.org* website (Punch & James, 2014). I have been
66 qualified as a health expert in MI by meeting the legal challenge in a Daubert hearing, and served
67 as a health-expert witness in legal cases at local, state, and federal levels in Ohio, Wisconsin,
68 Michigan, Iowa, Illinois, Oregon, Indiana, and New York. This information is detailed in the
69 Forensic Activities section of my CV. I have interviewed multiple individuals and families who
70 have reported adverse health effects, including some who have abandoned homes or are
71 considering abandonment because of health complaints due to wind turbine noise. I have
72 conducted ongoing reviews of the scientific literature on the health effects of wind turbine noise,
73 and in 2016 I coauthored an extensive peer-reviewed article on the *HearingHealthMatters.org*
74 website with Richard James. The title of that article is *Wind turbine noise and human health: a*
75 *four-decade history of evidence that wind turbines pose risks*, which I append as Exhibit 2. That
76 paper contains all of the literature references in my testimony. The purpose of the 2016 article
77 was to review the scientific literature that disputes 12 positions commonly taken by the wind
78 industry. Among those positions are statements suggesting that acoustic energy below audible
79 threshold cannot harm people (“What you can’t hear can’t hurt you”), the complaints are based
80 on psychological expectations, and that there is not sufficient scientific evidence to establish a
81 cause-effect relationship between wind turbine noise and adverse health effects.

82

83 **Q: What materials have you reviewed in this matter?**

84 A: I have reviewed Bon Homme County’s Article 17, drafted on July 27, 2015 to regulate wind
85 energy systems (WES); the sound study conducted by Burns & McDonnell Engineering
86 Company, dated May 18, 2018; the 45-dBA Contour maps of the Project; the direct testimony of
87 Chris Howell, summarizing his noise assessment in the matter of Prevailing Wind Park; the
88 direct testimony of David M. Hessler, dated May 4, 2018, regarding the Dakota Range Wind
89 Project; the pre-filed supplemental testimony of Dr. Mark Roberts regarding Prevailing Wind
90 Park; the direct testimony of David M. Hessler, dated March 28, 2018, regarding the Crocker
91 Wind Farm; and the affidavit of Peter Pawlowski, signed August 9, 2018.

92

93 **Q: After reviewing those materials, what is your overall impression regarding any potential**
94 **health risks posed by the proposed Project?**

95 A: In my opinion, those materials paint an overly optimistic picture by indicating or suggesting
96 that limiting wind turbine noise to an average level of 45 dBA will avoid significant adverse
97 health impacts and significant community annoyance. Based on my professional background and
98 experience with people living near existing wind projects, numerous anecdotal reports, the
99 scientific literature, papers presented at scientific and professional meetings, and governmental
100 and agency reports, I believe that a substantial proportion of people living in the vicinity of the
101 proposed Project can be expected to experience not only annoyance, but also a variety of adverse
102 health effects. Those effects, which vary widely among affected individuals, are commonly
103 observed worldwide. They include sleep disturbance, annoyance, headaches, dizziness, vertigo,
104 nausea, motion sickness, ear and bodily sensations, fatigue, stress, depression, memory deficits,
105 inability to concentrate, and reduced quality of life. In a given individual, these effects can
106 occur alone or in combination with other effects. In short, a design goal of a 45 dB average
107 level will not adequately protect the health of residents who live in the boundaries of the
108 proposed Project.

109
110 **Q: You seem to imply that not all residents will be affected adversely. In what percentage**
111 **of residents would you expect these adverse reactions to occur?**

112 A: Certainly, not everyone will experience or report negative consequences. Landowners who
113 lease their farmland to host wind turbines (“participants”) are less likely than others to
114 complain, partially because they earn an income from their leasing agreements with the wind
115 company, but also because they are often constrained by lease agreements that restrict them
116 from complaining or speaking negatively about their experiences. Likewise, not all non-
117 participants will experience negative impacts, or they may not overtly complain if they do.
118 Some of these individuals have signed waiver agreements with the wind company,
119 occasionally accompanied by a financial payment, which virtually ensures that they will be
120 less likely to complain. One factor that makes the noise tolerable for many people is that the
121 noise is intermittent because the wind is often not sufficiently strong to run the turbines. For
122 almost all exposed residents, though, the turbines inevitably generate relatively a loud
123 thumping, or whooshing, noise, and some residents experience ill effects from the low-

124 frequency noise and infrasound. The result, for what I would estimate at being around 15%-
125 25% of exposed residents, is extreme annoyance and sleep disturbance. In the longer term,
126 some of the other symptoms I've mentioned begin to emerge. In some cases, a few residents
127 may suffer serious cardiovascular problems such as high blood pressure.

128

129 **Q: Some of the symptoms you describe seem naturally to occur with aging. How can wind**
130 **turbine noise be distinguished from aging and pre-existing conditions as the cause of such**
131 **complaints?**

132 A: One line of evidence comes from the World Health Organization (WHO, 2009), which
133 focuses primarily on low-frequency community noise. That organization states that, based on
134 multiple research studies, such noises can lead to stress, and subsequently to health problems.
135 The pathways from noise to adverse health effects may be direct or indirect. It indicates that
136 several studies have established a closer relationship between subjective responses to
137 community noise and cardiovascular outcomes when the annoyance is sleep-related than when
138 it is non-sleep-related (p. 78). In addition, there are many anecdotal and scientific reports of
139 residents who have experienced sleep disturbance, as well as headaches, dizziness, ear pain or
140 pressure, and inability to concentrate, when near the turbines. When they leave the project area
141 temporarily or for a few days or more, their symptoms subside, and when they return, those
142 symptoms, including sleep disturbance, reappear. Similar observations can be made regarding
143 pre-existing conditions, which are sometimes reported to worsen after turbines become
144 operational. If it can be determined that the additional stresses experienced when near the
145 turbines can be relieved by leaving the area, and that they reoccur when the individual returns to
146 the area, that is a good indication that the turbines are responsible for their deteriorating state of
147 health. The scenario in which symptoms subside and recur with changes in location with
148 respect to the turbines, which many have experienced repeatedly, is similar to the research
149 design known the case-crossover design. Case-crossover studies are described in the 2016
150 Punch and James paper (Exhibit 2). The types of evidence I've described indicate that there is
151 a strong association between exposure to wind turbines and the health complaints, and they
152 strongly suggest that the link is causative. The main point is that all possible precautionary
153 steps need to be taken to ensure the Project will not substantially impair the health of those
154 living in and around the Project.

155

156

157 **Q: How do you view your role in this matter, as it relates to an ability to establish a**
158 **causative link between wind turbine noise and adverse health impacts?**

159 A: I distinguish between general causation and specific causation, as they differ based on the
160 targets of interest: the general population versus targeted individuals, respectively. Physicians,
161 including those with epidemiological backgrounds, have the medical expertise to diagnose and
162 treat the health symptoms of their individual patients who have been exposed to wind turbine
163 noise. The chief recommendation of physicians who have become involved with patients who
164 suffer adverse health effects from wind turbine noise is to move away from the source of the
165 problem. On the other hand, acousticians, audiologists, occupational health and safety experts,
166 and environmental experts have the expertise to analyze the available research and other
167 evidence needed to conclude that wind turbine noise causes adverse health impacts in the
168 general population. These individuals are often called upon as experts in legal proceedings
169 such as this one. That is the role in which I see myself in this matter.

170

171 **Q: Dr. Mark Roberts, in his supplemental direct testimony, has testified on the role of**
172 **epidemiological research in establishing a causative link between wind turbine noise and**
173 **AHEs. What is your reaction to that testimony?**

174 A: My reaction is essentially the same as that already described in Exhibit 2. Dr. Roberts'
175 testimony rests primarily on his credentials in epidemiology and apparently not on his first-
176 hand experience with people who have been exposed to wind turbine noise over long periods
177 of time. Also, he appears to be acquainted with only that body of literature on the subject that
178 is favorable to the wind industry, and to his testimony in its behalf. He points to peer-reviewed
179 epidemiological research as the only basis for proof of cause-effect relationships. Although he
180 espouses the Bradford Hill criteria as relevant, he essentially dismisses most of the nine criteria
181 by naming them, without discussing their implications. Those criteria, with descriptions from
182 Punch & James, 2016, were: (1) strength (strength of observed relationships), (2) consistency
183 (consistency, or repeatability, of relationships, based on observations by different persons, in
184 different places, under different circumstances, and at different times), (3) specificity
185 (causation is indicated if the association is limited to specific individuals and to particular sites

186 and types of disease and there are no associations with other factors), (4) temporality (there is a
187 clear temporal relationship between outcomes and periods of exposure and non-exposure), (5)
188 biological gradient (a dose-response relationship exists), (6) plausibility (causation is more
189 likely when certain outcomes are biologically plausible, or possible, a caveat being that
190 plausibility depends on the biologic knowledge of the day; this element is best expressed in the
191 statement: “When you have eliminated the impossible, whatever remains, however improbable,
192 must be the truth” (p. 10), (7) coherence (the cause-and-effect interpretation of data should not
193 seriously conflict with generally known facts of the natural history and biology of the disease),
194 (8) experiment (experimentation or semi-experimental evidence, even if only occasional, can
195 reveal the strongest kind of evidence for causation), and (9) analogy (the recognition that
196 similar cause-effect relationships have occurred under similar conditions). Hill states:

197 What I do not believe (is) ...that we can usefully lay down some hard-and-fast rules of
198 evidence that must be obeyed before we can accept cause and effect. None of my nine
199 viewpoints can bring indisputable evidence for or against the cause-and-effect hypothesis and
200 none can be required as a sine qua non. What they can do, with greater or less strength, is to
201 help us to make up our minds on the fundamental question – is there any other way of
202 explaining the set of facts before us, is there any other answer equally, or more, likely than
203 cause and effect?... No formal tests of significance can answer those questions. Such tests can,
204 and should, remind us of the effects that the play of chance can create, and they will instruct us
205 in the likely magnitude of those effects. Beyond that they contribute nothing to the ‘proof’ of
206 our hypothesis (p. 299).

207
208 Hill makes this final observation in his essay:

209 All scientific work is incomplete – whether it be observational or experimental. All scientific
210 work is liable to be upset or modified by advancing knowledge. That does not confer upon us a
211 freedom to ignore the knowledge we already have, or to postpone the action that it appears to
212 demand at a given time (p. 300).

213
214 In summary, my reaction to that portion of Dr. Roberts’ testimony is that, like many of his
215 epidemiological colleagues who testify on behalf of wind energy projects, he chooses to
216 disregard Hill’s intent to emphasize that experimentation (Hill’s eighth of nine criteria) is only
217 one of many criteria that are useful **is establishing causation between external agents and**
218 **disease processes.**

219
220 **Q: Can you give specific examples of how the Bradford Hill criteria apply to wind turbine**
221 **noise and adverse effects on health?**

222

223 A: Yes, I believe that the available evidence, which includes both research and common-sense
224 observations, meets all nine of the Bradford Hill criteria, and that, in their totality, that
225 evidence supports a causative relationship between wind turbine noise and adverse health
226 effects. This evidence includes, respectively: (1) widespread reports of complaints, (2)
227 consistency of reported symptoms, (3) and (4) concurrence of symptoms with wind turbine
228 operation, (5) an observable dose-response relationship between exposure levels (or distance)
229 and symptoms, (6) the role of disturbances of the hearing and balance mechanisms of the inner
230 ear in causing identified symptoms, (7) coherence with WHO (2009) and other relevant
231 guidelines, (8) in addition to cross-sectional studies, experimentation is established by the fact
232 that symptoms decline or disappear when receptors leave the area and recur when they return
233 to the area, and (9) Sick Building Syndrome as the analogy. Based on these observations, Dr.
234 Roberts' efforts to raise epidemiology as the only cause-and-effect threshold sets the standard
235 so high that we may never expect to reach resolution on this and many similar matters. Dr. Carl
236 Phillips, also an epidemiologist, states in a paper prepared for the Wisconsin Public Service
237 Commission (dated July 3, 2010):

238 Some recent commentators (Colby et al. 2009; Roberts and Roberts 2009) have attempted to
239 dismiss this evidence because none of it is based on the epidemiologic study types that they
240 understand. It is true that other study designs would have told us more, and still could. But
241 dismissing the evidence we have makes little sense given that a huge portion of all knowledge,
242 including formal scientific inference, is based on data that is not from studies designed
243 according to certain preferred approaches. It should be obvious that "does not tell us
244 everything we want to know" does not mean "has no information content". Those making this
245 argument either do not understand scientific inference or are pretending they do not. Claiming
246 that there is no evidence even though there are reports of individuals suffering is akin to
247 claiming that there is no evidence that people get injured as a result of text-messaging while
248 engaged in other activities because, even though the pathway is obvious and there are
249 numerous accidents occurring from some activities, there is often not a "real study" that allows
250 us to make various quantitative estimates. (p. 7).

251

252 **Q: Do you have additional reactions to Dr. Roberts's supplemental direct testimony in this**
253 **case?**

254 A: Yes, I would like to make one other point. Dr. Roberts raises the nocebo argument. He is
255 arguing that the complaints people make regarding adverse effects of wind turbine noise are
256 psychologically motivated by expectations resulting from negative messages surrounding

257 turbines. That argument continues to persist as one of the wind industry's primary explanations
258 for adverse health impacts. In our 2016 paper, James and I, after evaluating these claims,
259 concluded that none of these explanations is as plausible as the notion that a variety of adverse
260 reactions are *physiological* effects caused directly or indirectly from exposure to low-frequency
261 noise and infrasound from wind turbines. While psychological expectations and the power of
262 suggestion can influence perceptions of the effects of wind turbine noise on health status, no
263 scientifically valid studies have yet convincingly shown that psychological forces are the major
264 driver of such perceptions. We describe in some detail in our article the scientific
265 shortcomings of the several studies that have been done, all of which conclude that the nocebo
266 effect is the culprit. I encourage interested individuals to read those details.

267

268 **Q: How does your background qualify you to testify on the general causal mechanism that**
269 **explains these adverse health effects?**

270 A: First, I would note that two of the seven panelists commissioned by the American Wind
271 Energy Association to conduct the 2009 review of literature by Colby and colleagues on the
272 noise and health effects of wind turbines were audiologists. Audiologists have the educational
273 background to understand the functioning of the inner ear, and it is that knowledge that led me to
274 become interested, over the last decade, in the relationship between ear physiology and the
275 health impacts of infrasound and low-frequency noise from wind turbines on people. Like many
276 others who have studied this relationship, I believe that most of these adverse reactions are
277 mediated by disturbances of the hearing and balance mechanisms of the inner ear resulting from
278 the low-frequency noise emitted by industrial wind turbines. The inner-ear components affected
279 include the cochlea, which is the organ of hearing, and the vestibular system, which includes the
280 semicircular canals, utricle, and saccule. These organs are responsible for balance, or
281 equilibrium. While the cochlea is responsible for the perception of audible sounds, the
282 vestibular system is sensitive to movement and changes in head position, and can be stimulated
283 by infrasound to induce perceptions of unsteadiness, dizziness, vertigo, and motion sickness in
284 some people.

285

286 **Q: Earlier, you emphasized sleep as being critical to health. How does wind turbine noise**
287 **lead to sleep disturbance, in your opinion?**

288 A: Wind turbine noise is a significant disruptor of sleep because our ears, unlike our eyes, are
289 always open, especially to unusual or novel stimuli, including “bumps in the night” that might
290 threaten our safety. During operation, the turbines produce audible noise, mostly in the
291 infrasonic and low-to-mid-frequency range. That audible noise results in the perception of both
292 a relatively constant whirling sound and a periodic whooshing sound, caused by a combination
293 of the blade movement against the air and the blades passing in front of the tower. When the
294 three blades are rotating at a typical 20 revolutions per minute, that sound occurs once per
295 second. Those audible sounds can annoy people and disrupt their sleep patterns. The turbines
296 also generate a pulsating sound at infrasonic rates that are based on blade rotational speed,
297 meaning that the sound spikes, or peaks intermittently. These noises, and the unpredictability of
298 the prevailing winds, are responsible for sleep disturbance in a substantial number of people.
299 The peakiness of the noise is especially annoying and disturbing, and is the reason sleep
300 disruption is not adequately predicted from, or correlated with, long-term average decibel
301 levels, designated as LAeq.

302

303 **Q: If dB LAeq is not used to quantify noise levels of wind turbines, what metric might**
304 **better predict sleep disturbance?**

305 A: LAm_{ax}, or the maximum noise level produced during a given nighttime period, appears to
306 be the optimal measurement metric to protect sleep. The WHO (2009) Night Guidelines suggest
307 that a 40 dB LAm_{ax} level should be the maximum allowable level during nighttime hours. That
308 document uses the term “LAm_{ax}” a total of 93 times, which is an indication that the WHO
309 considers the concept highly important as a metric for quantifying nighttime noise. If used, any
310 compliance-monitoring procedures should allow some degree of repetition to occur, and to
311 eliminate other noise sources as the origin of the emissions, before noncompliance is declared.
312 Because there are sufficient audible differences among wind turbine noise and other sources of
313 noise—including traffic noise, thunder, wind, and wildlife—the various sources are easily
314 distinguishable.

315

316 **Q: Are there other noise measurement metrics that could effectively protect sleep?**

317 A: Yes, possibly. Dr. Paul Schomer currently recommends that wind turbine noise should be
318 limited to an average level of 36-38 dBA, based on a 24-hour measurement period. Although he

319 offers that recommendation for the purpose of avoiding substantial annoyance at all hours of the
320 day and night, it is a potential alternative to 40 dB L_{Amax} in an effort to minimize or avoid
321 sleep disturbance. Dr. Schomer's credentials as the former Director of the Standards Division of
322 the Acoustical Society of America, and his use of four independent sources in deriving his
323 recommendation, give considerable weight to his recommendation. The major concern I have
324 with that approach is that verification is required to show that a 24-hour metric can sufficiently
325 protect sleep during nighttime hours. Wind companies typically prefer to use the Leq metric
326 because it is more easily compared to available data, and generally resist accepting levels lower
327 than 45 or 40 dBA as a design goal for its wind projects.

328

329 **Q: The Charles Mix County zoning commission seemingly has joined Bon Homme County**
330 **in establishing minimum setback distances. Rather than establishing the highest**
331 **permissible noise level to protect the health of residents, would it not be simpler to establish**
332 **the minimum permissible distance?**

333 A: Undoubtedly, distance is the most effective means of avoiding negative health impacts from
334 wind turbine noise. The short distances from the property line, such as the 500 feet or 1.1 times
335 the system height, whichever is greater, and from residences, such as the 2,000 feet or 3.5 times
336 the system height, whichever is greater, that have been agreed to in this Project are entirely
337 inadequate. Such short distances are intended to reduce risks from physical failures such as
338 blade throw, ice throw, or falling towers. They do almost nothing to protect residents from
339 exposure to low-frequency noise and infrasound. Researchers who have offered distance as an
340 index to obviate health effects have typically recommended 2 kilometers, or 1.25 miles, as a
341 minimally safe distance from the nearest turbine. Although that distance will not prevent
342 annoyance and health effects for everyone, I think it is a reasonable compromise aimed at
343 protecting health and well-being. We have to recognize, though, that studies have shown that
344 some residents within several miles of an industrial wind project complain that the noise is
345 disturbing, presumably because infrasound travels great distances and is not easily attenuated.
346 The problem with distance as a predictor is that different residences at the same distance from
347 the turbines will experience different noise emissions, depending on the turbine array,
348 topography, variable wind speeds, and other factors. In the end, the actual level of noise

349 emissions is the critical variable that needs to be controlled, as distance in itself cannot assure
350 that the noise will not be invasive for residents in the footprint of the wind project.

351

352 **Q: In your opinion, is there any important information omitted from, neglected, or**
353 **erroneously stated in the documents you reviewed for the Prevailing Wind Park project?**

354 A: Yes. Similar to Mr. Hessler’s observation in his Dakota Range report, I noticed that an
355 important component missing from the Burns & McDonnell Engineering Company’s sound
356 study for this Project is a discussion of the annoyance and adverse health impacts of the Project.

357 Like almost all reports commissioned by wind companies, it does not discuss the fact that
358 annoyance can lead to adverse health effects, as established by Berglund et al. (1999); the WHO

359 (2009); Shepherd, Hanning, and Thorne (2012); and Fast et al. (2016). The WHO (2009) has
360 described annoyance as a critical health effect, in that in some people it is associated with stress,
361 sleep disturbance, and interference with daily living. In fact, the Burns & McDonnell report

362 ignores much of the information in the WHO 2009 guidelines, which were revised downward
363 from the 1999 guidelines as a result of new medical research into adverse health symptoms due
364 to noise. Burns & McDonnell describe wind noise as a masker that can “drown out” the sounds
365 created by the turbines. Although this may be true in rare cases, it is typically not true at night
366 when wind speeds are high at the turbine heights and low at ground level. Also, the design goal
367 of 45 dBA (Bon Homme County ordinance), or 43 dBA (Charles Mix County— Pawlowski
368 affidavit) is higher than what most independent researchers consider protective of health.

369

370 **Q: Did you find any shortcomings in Mr. Howell’s study of background sounds?**

371 A: Yes, in several respects. To me, the most surprising point Mr. Howell made is that he reports
372 measured L90 background sound levels as high as 45 dBA, which is unusually high for a rural
373 area. A table showing all measured levels would have revealed the frequency of such
374 occurrences. Instead, he reports only a range of 21.5-45 dBA. He also understates the sound
375 impact of wind turbine noise by comparing it to levels of normal conversational speech.

376 Comparing the noise from wind turbines to speech using an A-weighted scale is misleading
377 because the levels of low-frequency noise and infrasound from turbines is substantially greater
378 than for speech, as speech energy begins to drop off precipitously at about 150 Hz and below,
379 and the levels of turbine noise continue to rise below that frequency. Using A-weighting

380 attenuates low frequencies below 1000 Hz, and effectively filters out infrasound, leading to a
381 gross underestimate of infrasonic energy. Also, related to the fact that Bon Homme County does
382 not specify how sound measurements should be performed, Mr. Howell does not indicate
383 whether the design goal is met by measurements over a specified time period. They could be
384 taken over hours, minutes, or days, and could cover the daytime hours, nighttime hours, or a full
385 24-hour day. Again, it is essential to limit sound levels to those that fully protect residents' sleep,
386 as sleep is a major determinant of good health.

387

388 **Q: Based on your professional experience and expertise, what restrictions should be**
389 **placed on the Project to ensure that it will not substantially impair the health of those**
390 **living around it?**

391

392 A: As a general rule, no wind turbine should be located closer than 1.25 miles from the property
393 line of any residence. This distance should preferably be applied to all residences, both
394 participating and non-participating. If placed closer to participating residences than 1.25 miles,
395 those residents should be adequately informed, in writing, of the potential for high annoyance
396 and health risks. With regard to permissible noise levels, the WHO recommendation of 40 dBA
397 Leq(night,outside) should not be exceeded at any residence, particularly at non-participating
398 households. To provide adequate protection from sleep disturbance, nighttime noise levels
399 should be limited to 40 dB LAmax. A metric of dB LA10(night, outside), the noise level
400 exceeded 10% during nighttime hours and measured at the façade of the residence, may be a
401 reasonable substitute for LAmax if considered by acoustical experts to be easier to apply for the
402 purpose of compliance.

403

404 **Q: Does this conclude your testimony?**

405 A: Yes.

406

407

408 The foregoing written testimony is to be presented to the South Dakota Public Utilities
409 Commission for SD PUC Docket EL 18-026.

410

411 Dated this 6th day of September 2018.

A handwritten signature in cursive script, appearing to read "Jerry L. Punch", written in black ink on a light-colored background.

412

413

414 Jerry L. Punch