GR-4 Noise

Comments received on Chapter 2.6, Noise, of the Campo Wind Project with Boulder Brush Facilities (Project) Draft Environmental Impact Report (EIR), the Acoustical Analysis Report prepared by Dudek (Appendix G to the Draft EIR), and the addendum to the acoustical report (Appendix G) can largely be organized into the following categories:

- Comments that the existing outdoor sound environment was not accurately quantified for purposes of supporting the Draft EIR assessment of potential noise impacts, including comments regarding the Acoustical Analysis Report (Appendix G) methodology and its collection of data
- Comments and submittals of sound-level measurements from other parties
- Comments that the prediction of aggregate operation noise from the wind turbines proposed on the Campo Band of Diegueño Mission Indians Reservation (Reservation) was inadequate or under-reported potential significant impacts
- Comments regarding infrasound and low-frequency noise impacts from operational wind turbines
- Comments regarding amplitude modulation associated with operation of wind turbines

Each of these comment categories is addressed in this Global Response (GR-4). Comments regarding the health impacts of noise, including low-frequency noise and infrasound, are addressed in Global Response GR-2, Public Health. Questions and comments regarding noise are also addressed in several individual responses to specific comments.

Based on substantial evidence in the form of standard industry practice and the expert opinion of its noise consultants, the County of San Diego (County) concludes that the Draft EIR adequately quantifies and characterizes the baseline outdoor sound environment and conservatively predicts noise generated from operating Project wind turbines.

Existing Outdoor Sound Environment

Several comments received on the Draft EIR refer to the "Long-Term Ambient Sound Level Measurements" letter (report) prepared by dBF Associates Inc. (dBF), dated July 31, 2019 (dBF 7/31/19 report) on behalf of Backcountry Against Dumps Inc. The dBF 7/31/19 report is included as an attachment to Comment Letter O3. The dBF report discusses outdoor ambient sound levels that dBF measured in mid-July 2019 at monitoring positions associated with six existing residences on private land surrounding the Reservation (on which the proposed Campo Wind Project wind turbines would be operating). The report compares its measurements of average L_{90} and calculated day-night sound level (L_{dn}) metrics[1] with those from the 2018 Dudek survey, which the County relied on in preparing the Draft EIR. The dBF report states that its sound level metrics are lower—by several decibels (dB)[2]—at many of these positions than the metrics of the Dudek report, and thereby suggests that the noise significance conclusions in the Draft EIR that rely on these measured existing outdoor ambient sound levels are not accurate.

The County disagrees that the ambient noise measurements on which the Draft EIR relies are inaccurate. In 2018, Dudek conducted outdoor sound-level monitoring with American National Standards Institute (ANSI) Type 2 sound level meters at 13 Project vicinity locations and collected data over a 24-hour sampling period. This dataset was used to quantify and represent the existing (ambient) sound environment, so that a noise impact assessment based on increases in noise relative to existing conditions could be performed. In 2019, Dudek conducted additional outdoor sound-level monitoring with ANSI Type 1 sound level meters. As stated in Section 2.6.1.3 of the Draft EIR, the Type 1 sound meter has the capability of measuring lower outdoor environment sound magnitudes than those of the previously utilized Type 2 sound level meters. During the 2019 Dudek survey, outdoor ambient sound level data was collected using the Type 1 sound meters from 10 survey positions similar to the survey positions in the 2018 Dudek survey. This supplemental data (e.g., L_{90} values) measured with the ANSI Type 1 instruments was used to support the accuracy of the ambient noise data collected in 2018.

Microphone windscreens, as provided by the sound level meter (SLM) manufacturer as part of its standard kit, were used on the SoftdB Piccolo model (American National Standards Institute [ANSI] Type 2) SLM during the 2018 baseline field sound level survey conducted for the Project. During the 2019 baseline field sound level survey conducted by Dudek, when ANSI Type 1 SLMs were deployed at or near many of the original 2018 monitoring positions, microphone environmental "shrouds" (Larson-Davis model EPS 2106) were installed—with foam windscreens measuring 4" in diameter and over 12" in length (including bird-deterring spikes). Comparing the collected datasets of measured background sound level (A-weighted L_{90}) from these two field surveys, the value ranges are generally comparable. Because measured outdoor background noise level can and does increase with proximate ground wind speed (i.e., noise-generating air turbulence—due to wind flow around structures and terrain, as well as through grasses and other vegetation—gains quickly with increasing wind speed), it is reasonable to expect higher measured background sound levels to reflect acoustical contribution

1 The L_{90} value is a sound level exceeded 90% of the time over a specific period, so it tends to be a good representation of the indistinct "background" sound measured at a location; the L_{dn} value is an energy-averaged level for a 24-hour period, but adds 10 dB to sound levels during the nighttime (10:00 p.m. to 7:00 a.m.) to represent increased sensitivity to noise when people tend to be sleeping.

2 Decibels (dB) represent how sound magnitudes are typically discussed and relate them to the threshold of human hearing. Section 3 of the Acoustical Analysis Report explains these and other acoustical metrics and concepts.

from such naturally occurring wind-driven turbulence in the outdoor environment as measured by the windscreen-covered SLM microphones.

The County concludes that the ambient noise measurements in the Draft EIR taken in 2018 and 2019 by Dudek are representative, accurate, and supported by substantial evidence, as discussed below. Further, as discussed below, the dBF 7/31/19 report has presented some sound level values (e.g., L_{dn}) that may under-report measured outdoor ambient sound.

Ambient noise measurements can and do differ due to dissimilar sound level meters used during field surveys. Different environmental conditions can also be present during different field surveys that cause measurement results to vary. The fact that some dBF reported measurements taken in July 2019 were lower than measurements taken by Dudek in 2018 does not mean that the 2018 Dudek survey was inaccurate.

In addition, Dudek conducted an additional field survey in 2019 using Type 1 sound meters at sound level monitoring positions comparable to those from Dudek's 2018 survey. The 2019 Dudek data confirmed the accuracy of the 2018 Dudek data because the sound levels measured in 2019 are similar to the sound levels measured in 2018. For example, and as detailed in the Addendum to the Acoustical Report (Appendix G to the EIR), the measured existing hourly L_{eq} values[3] from the 2018 Dudek survey ranged from 31 to 70 A-weighted decibels (dBA). These values compare well with the 29 to 71 dBA measured hourly L_{eq} value range in the 2019 Dudek data and show general consistency on the basis of similar year-to-year seasonal field conditions, thereby supporting a finding of being generally representative of existing conditions. Further, while the 26 to 63 dBA L_{90} range measured in the 2019 Dudek survey has a lower bound than the 32 to 49 dBA L_{90} range measured in the 2018 Dudek survey, it has a higher bound that represents the field conditions at the time of the later survey. (The "bound" is the highest or lowest value in a range of values.) These differences are not unexpected, since field conditions can vary due to many factors such as weather and other factors in the measurable environment.

Thus, the general consistency between 2018 and 2019 survey results shows that the sound level data collected by Dudek over 2 consecutive years is representative of existing environmental conditions and is appropriate to use as the basis for analyzing the magnitude and scope of likely changes to the noise environment due to construction and operation of the Project. Dudek's noise measurements were taken with standard equipment using standard methodologies. The County is entitled to rely on Dudek's noise reports as expert evidence of ambient noise conditions.

The County further concludes that it was reasonable to rely on the collection of A-weighted L_{90} data to calculate its Residual Background Sound Criterion (RBSC), which is used to assess wind

[3] L_{eq} is the steady-state or "equivalent" sound level having the same sound energy as contained in the time-varying sound being measured over a defined time period (e.g., hour, 8-hour, 24-hour).

turbine low-frequency noise per its County Zoning Ordinance Section 6952 provisions, as discussed further below.

Commenters also stated that the noise measuring instruments should have been placed closer to residences to be more representative of ambient conditions. Because L_{90} is a statistical value that shows what sound pressure level (SPL) over a given time period is exceeded 90% of the time, it is sensitive to nearby continuous sources of noise such as operating air-conditioners, generators, pump motors, or other powered appliances located at or near an occupied residential land use. To help illustrate this sensitivity, a generic sample scenario (i.e., not to be construed as an actual survey sample associated with this Project) is shown in Figures GR-4-A, GR-4-B, and GR-4-C. These figures show a hypothetical example of how placement of a sound level meter near a typical residential use which has a continuously operating air conditioner can skew the results of ambient outdoor noise measurements upwards.

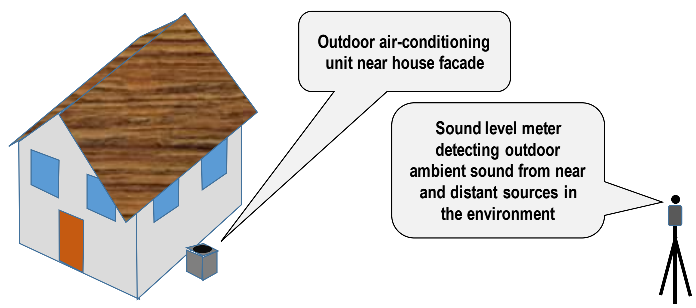

Figure GR-4-A. Hypothetical scenario: sound level meter positioned near a residence, which features an air-conditioning unit

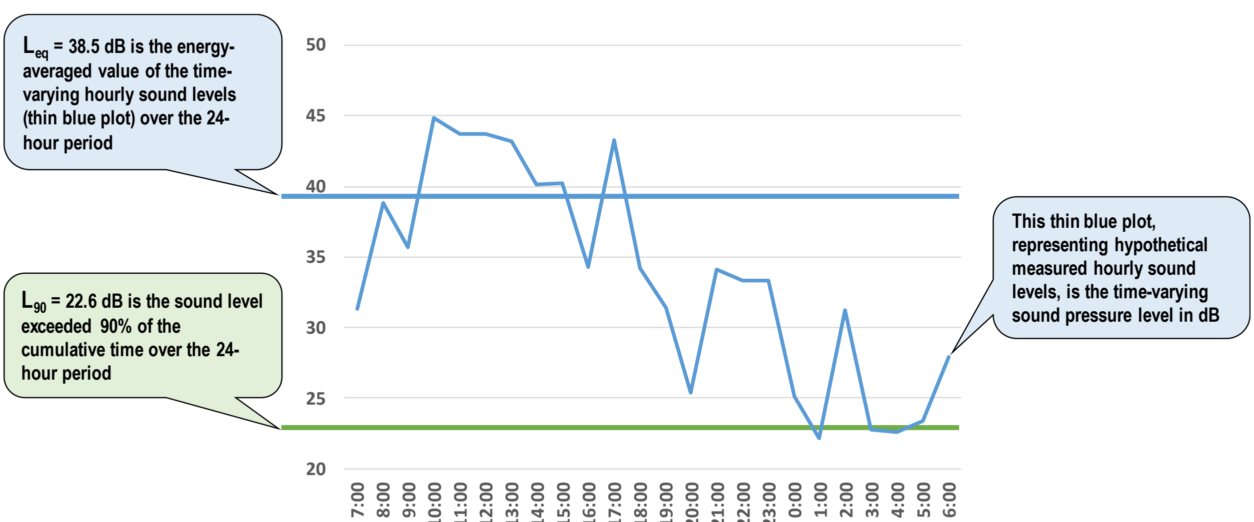

Figure GR-4-B. Hypothetical outdoor hourly sound level (over a 24-hour period) measured near the residence, air-conditioner not operating, with overall hourly decibels (dB) plotted versus consecutive hours

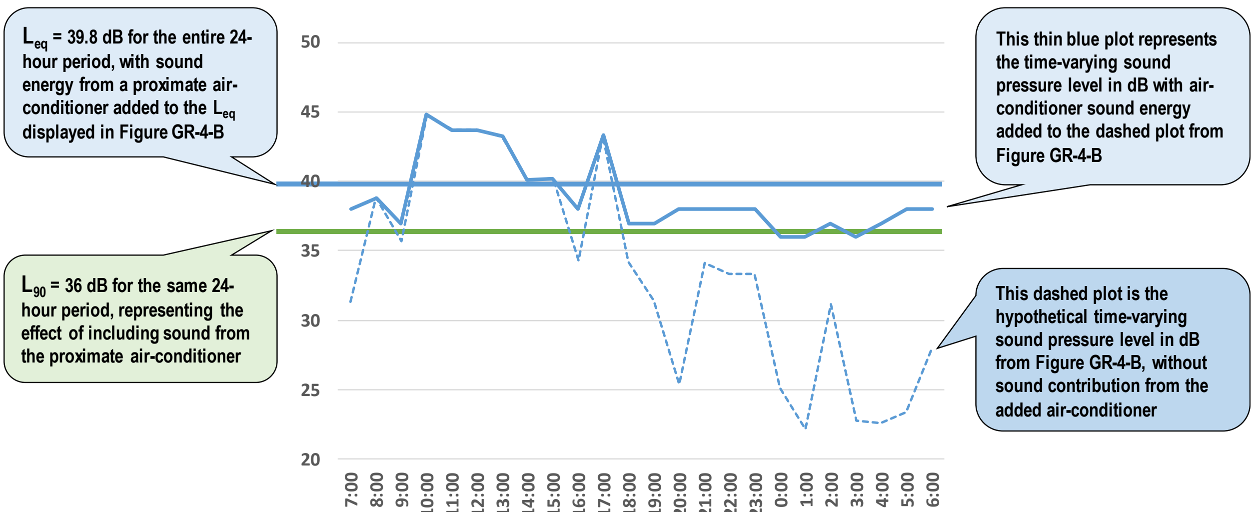

Figure GR-4-C. Hypothetical outdoor hourly sound level (over a 24-hour period) measured near the residence, air-conditioner operating, with overall hourly decibels (dB) plotted versus consecutive hours

Figure GR-4-B shows the outdoor hourly sound level for a hypothetical scenario in which a residence's air conditioner is not operating, while Figure GR-4-B shows the sound levels for a scenario with the air conditioner operating. The sound levels plotted in Figure GR-4-C illustrate what would happen if the measurement position is placed near a hypothetical residence's air conditioner, or another continuous or "steady-state" source of noise. With the air conditioner operating, the L_{90} value rises substantially and thus risks not being representative of the outdoor ambient environment. Consistent with this reasoning, Dudek 2018 and 2019 field survey positions were selected to be on publicly accessible land or on the borders of occupied properties so that the collected L_{90} values represent the amalgam of all outdoor sound contributors and are not skewed upwards by continuous noise sources typical of residential uses.

In regard to the sound metrics calculated by dBF and presented in the dBF 7/31/19 report, the sound levels are not likely to be representative of the predominant ambient noise levels for two reasons: (1) the placement of dBF sound level meters appears to have been selected to minimize ambient sound levels, and (2) some collected data (attributed to noisy events) was excluded from derivation of 24-hour sound level values without sufficient explanation as to why the exclusion was needed or appropriate.

In regard to dBF's selected measurement locations, as noted on page 3 of the dBF 7/31/19 report, "Measurement positions were selected to *minimize* [emphasis added] sound from human activities and wind through vegetation." It should be noted, however, that sound from human activities and wind through vegetation are two observable acoustical contributors to the outdoor ambient sound environment in the Project vicinity. The dBF selected measurement positions that minimize these contributors' influence on the SPL detected by the instrument microphone resulted in monitoring quiet survey locations that may potentially be unrepresentative samples. Dudek's measurement locations, in contrast, were often nearer to intermittent noise-producing human activities (such as all-terrain vehicles, motorcycles, cars, and trucks) and nearer to naturally vegetated settings (where birds, insects, and other wildlife may be found, and through which winds may cause leaves to rustle). These human-caused and natural contributors to the outdoor ambient sound environment are characteristic of the Project Site and its vicinity. As a result, dBF's measured levels tended to be lower than Dudek's measurements because Dudek placed its sound level meters nearer to characteristic natural and human-caused acoustical contributors to the outdoor ambient sound environment.

Also, Table 1 on page 3 of the dBF 7/31/19 report compares measurement data and calculated L_{dn} values from its Morrison residence location to that of 2018 Dudek field survey LT10 monitoring location. The dBF report also compares its data from the DeGroot residence to data from the 2018 Dudek LT7 position. However, these pairs of monitoring positions should not be readily compared. The dBF sound meters were located approximately 6,500 feet and 13,000 feet respectively from the 2018 Dudek field survey LT7 and LT10 positions. The differences in results are not unexpected because the GPS coordinates of the dBF survey position representing the DeGroot residence is over 3,500 feet from Old Highway 80, an existing source of roadway traffic noise that should be included in ambient noise measurements, while Dudek's LT7 position was 100 feet away from this source of roadway traffic noise. Dudek's LT7 position was also less than 450 feet away from the nearest apparent residential land use south of the highway, which is not true for the DeGroot residence. The comparison of the data between these two survey locations is therefore inappropriate. Dudek's LT7 monitoring position properly collected outdoor ambient data near Old Highway 80, which is part of the Project Site environment and would thus likely be representative of the existing sound environment for other receptors sharing similar geographic conditions and proximity to roadways. The dBF DeGroot location is remote from such roadway-related noise and would thus underestimate ambient noise levels at such receptors near Old Highway 80.

In regard to dBF's excluding certain higher noise levels from its measurements, the dBF report (page 4) says that "adjustments were made to the measured sound level data" by removing hourly L_{eq} contributions due to what was described as levels being "artificially high due to a short-term event." Although the data tables at the end of the dBF report show what elevated dB values were measured during these time periods, there is no explanation offered about what caused them to be "artificially high" and why it would be appropriate to exclude them from the calculation of L_{dn} values that would undoubtedly be higher if they were not excluded.

If these "artificially high" levels due to short-term events referred to in the dBF report were caused by natural and/or human-caused sources that would be considered representative of the typical environment, then they should not be excluded. Removing such hourly L_{eq} contributions can have a substantial effect on the calculated L_{dn} value. For instance, dBF reports a calculated L_{dn} value of 39 dBA at the Tisdale residence monitoring location. Although it is unclear from the dBF report what set of consecutive 24 measured hourly L_{eq} values were used to arrive at this finding, the monitored 24-hour period starting at 12:00 p.m. (noon) on July 17, 2019, and ending at 12:00 p.m. (noon) on July 18, 2019, would yield a calculated L_{dn} value of 49.7 dBA. By removing the acoustical contribution of the three excluded hours noted in the dBF report during this 24-hour period (i.e., 7/17, 23:00–00:00; 7/18, 06:00–07:00; and 7/18, 07:00–08:00), the calculated L_{dn} value was 39 dBA. Without these exclusions, the calculated L_{dn} value would be 49.7 dBA. This L_{dn} value is less than 2 dBA different from the 51 dBA L_{dn} reported for the Dudek LT1 position from its 2018 field survey. A difference of 2 dBA is a barely perceptible difference to the average healthy human ear.

Neither the 2018 nor 2019 Dudek field surveys excluded any short-term events that were not due to investigator presence (e.g., to setup, inspect, or retrieve the instrument). If measured hourly L_{eq} was relatively higher during a given hour than those of other monitored hours at the same position, and the cause of the elevated L_{eq} was not due to investigator presence, then that contribution was still included in Dudek's derivation of L_{dn} values.

In summary, there is substantial evidence in the record (including use of accepted industry standards and appropriately sensitive instruments placed in reasonable locations) for the County to conclude that the methodology used by Dudek in 2018 and 2019 to collect ambient noise data represented an adequate basis by which to assess the Project's noise impacts in the Draft EIR. Dudek's ambient noise measurements are representative of normal site conditions. While dBF's ambient noise measurements might differ, the dBF measurements do not undermine the reasonableness of relying on Dudek's noise measurements.

Finally, even if the County were to rely on some or all of the dBF outdoor ambient level data, there would be little or no effect on the findings of significant noise impacts as presented in the Draft EIR for the following reasons.

1. First, both On-Reservation and Off-Reservation construction noise impacts are assessed with respect to "fixed" values that are independent of the existing or future outdoor ambient sound level. For the former, the Federal Transit Administration guidance of 80 dBA hourly L_{eq} is used in the assessment, and for the latter, the County's construction noise limit is 75 dBA L_{eq} over an 8-hour period.
2. Second, reliance on dBF's lower ambient noise levels would not have changed the Draft EIR's prediction of aggregate wind turbine operation noise with respect to the property lines of Off-Reservation receptors. Section 36.404(a) of the County Noise Ordinance

defines set hourly L_{eq} limits that are independent of the existing and future outdoor ambient noise level, specifically daytime and nighttime hourly limits of 50 dBA and 45 dBA respectively. Per 36.404(d), these default limits are allowed to increase to ambient + 3 dBA if ambient noise levels are higher than the default limits. For example, if the daytime limit at a “Rural Residential” (RR)-zoned property line was 50 dBA hourly L_{eq} per 36.404(a), and the measured hourly L_{eq} was 54 dBA, then the allowable noise level at that location would be 54 dBA + 3 dBA = 57 dBA. Aside from LT-7 from the 2018 Dudek field survey, which was near Old Highway 80, none of the monitored locations from the 2018 and 2019 Dudek surveys consistently measured outdoor ambient hourly L_{eq} values higher than the County’s daytime and nighttime hourly L_{eq} limits of 50 dBA and 45 dBA, respectively. Since the same could be said for the hourly data presented in the dBF report of its July 2019 field survey results, its measured ambient levels would not change the County’s 36.404(a) thresholds for the purpose of assessing whether the operational noise from the Project meets the County’s noise limits.

3. Third, the Draft EIR concludes (see Table 14 and Figure 7 in Appendix G of the Draft EIR) that there are anticipated average hub height wind speed[4] conditions under which the calculated difference between the predicted C-weighted[5] aggregate wind turbine operation noise level and the RBSC at some Off-Reservation locations could exceed the County standard. By way of example, such exceedance is predicted for the LT1 residence. And while measurement data from dBF may present an A-weighted L_{90} value for a set of surveyed environmental conditions at or near this location that are lower than that measured and reported by Dudek during the 2018 survey, such a difference would only suggest that—under those conditions, if replicated at some future time—a noise exceedance could occur for a lower average wind speed received by the wind turbine at hub height. In other words, reliance on the lower dBF values would not change the conclusion regarding the difference between the predicted C-weighted aggregate wind turbine operation noise level and the RBSC in the Draft EIR.

Prediction of Wind Turbine Operational Noise

As explained in the Acoustical Analysis Report for the Project (Appendix G to the Draft EIR), wind turbine operation noise emission is from the gearbox at the nacelle and from the aerodynamic effects associated with blade rotation through the incoming wind. The acoustical report for the Project predicted the aggregate noise emission from 76 turbine locations on the Reservation and assessed potential impacts to proximate noise-sensitive land uses. As explained in the acoustical

4 “Average hub height wind speed” means the average wind velocity received by an operating wind turbine at its hub height above grade (in other words, the rotor hub position or nacelle of the turbine)—this is a representation of the wind that will turn the rotor to generate electricity.

5 C-weighting is a curve of dB adjustments that is often used to evaluate low-frequency noise, since as shown in Table 1 (page 6) of the Acoustical Analysis Report, it discounts sound levels at lower octave-band center frequencies (below 1 kilohertz) by far fewer dB than the A-weighting curve that mimics human hearing response.

report and Chapter 2.6 of the Draft EIR, while 76 turbine locations were evaluated, only 60 turbine locations would be constructed in accordance with the Campo Lease. Therefore, the prediction of wind turbine operational noise overstates effects at some noise-sensitive land uses as it provides a conservative "worst-case" for consideration.

Comments received on the Draft EIR with respect to prediction of Project wind turbine operational noise include concerns that can be summarized as follows:

- the wind turbine model used as a source of reference sound power data was considered inappropriate
- potential under-prediction of impacts due to model accuracy
- the lack of one-third octave band detail to help assess "pure tone" conditions
- a lack of clarity regarding where and when potential noise impacts may occur

The County concludes that the Campo Wind Facilities aggregate operating wind turbine noise analysis as disclosed in the Draft EIR is thorough and conservative for the following reasons.

1. In its conclusions, the Research Systems Group (RSG) "Massachusetts Study on Wind Turbine Acoustics" (Feb. 18, 2016) report (already cited by the EIS Acoustical Analysis) states with respect to the International Organization of Standardization (ISO) 9613 sound propagation modeling technique for estimating wind turbine noise: "The ISO 9613 with mixed ground (G=0.5) plus 2 dB is the most precise at modeling the one-hour L_{eq}." This ISO 9613 based technique was used in both the computer program called CadnaA (Computer Aided Noise Abatement) and the Excel-based model predictions of Project aggregate operating wind turbine noise, with comparable results as reported in the EIS prepared for the Project. Additionally, as appearing on the Datakustik website (https://www.datakustik.com/noise-outdoors/industry-noise/), the provider of CadnaA software:

    > "Many relevant experts working in the wind energy field are using CadnaA for the feasibility study of potential sites… CadnaA includes state of the art calculation standards widely used to simulate the noise propagation from wind turbines such as ISO 9613-2, Harmonoise or Nord2000, including meteorological effects."

    For these reasons, we believe usage of the CadnaA sound propagation modeling program is appropriate for evaluating wind turbine operation noise.

2. CadnaA was used to predict the aggregate sound propagation from Project wind turbine operation. As stated in the Acoustical Analysis Report (Appendix G to the Draft EIR), input parameters to CadnaA included wind turbine sound power level data. The per-turbine A-weighted sound power level data reflects the values associated with a General Electric (GE)

2.X-127 60 hertz (Hz) model wind turbine. This GE model was conservatively used as the reference input data for each turbine. What "conservative" means here is that the overall A-weighted sound power levels for this GE model are louder than those of other larger and more powerful wind turbines commercially available and under consideration for this Project. For instance, at 10 meters per second (mps) hub-height wind speed, the GE 2.X-127 sound power level is rated at 110 dBA, while other wind turbines under consideration are rated between 106.9 dBA and 103.9 dBA. This represents a 3–6 dBA difference that provides additional margin for prediction accuracy over and above three forms of error margin that the wind turbine operation noise prediction method already incorporates, and as disclosed in the Acoustical Analysis Report for the Project, Appendix G to the Draft EIR, as follows:

- 2 dB are added per the wind turbine manufacturer recommendations
- 2 dB are added based on the recommendations of the Resource Systems Group study, Massachusetts Study on Wind Turbine Acoustics, that is cited in Project acoustical report
- Usage of the International Organization of Standardization 9613-2 algorithm for sound propagation prediction assumes a "downwind" condition in all directions (i.e., it assumes noise and wind are flowing in the same direction to the receiver, as opposed to an "upwind" condition that would slightly reduce noise).

In addition, the predictive wind turbine operation noise analysis intentionally over-counts the quantity of operating wind turbines expected on the Reservation: 76 were modeled, instead of 60 as allowed under the Campo Lease. Therefore, the potential dBA reduction in aggregate wind turbine noise exposure level (A-weighted) at a receptor could be substantial with a reduction in nearby turbines. By way of example, if the studied layout of 76 modeled wind turbines would have two that are equidistant to a residence, and all other modeled operating wind turbines are sufficiently far away so as to make their acoustic contribution negligible compared to the aggregate noise level, then the consequence of just one of these two nearby wind turbines not actually being built (i.e., to satisfy the 60 wind turbine quantity cap) would cause a 3 dBA (and thereby perceptible) reduction in noise exposure.

3. The anticipated Project wind turbine operation noise would not feature characteristics that would meet the conditions for a "pure tone" as defined by Section 6952.f.3 of the County's Zoning Ordinance. Figure GR-4-D presents three examples of what such pure tones might look like if plotted, per the Ordinance 10262 Section 6952.f.3 language as follows:

> A 'pure tone' exists if one-third of the octave band sound pressure level in the band, including the tone, exceeds the arithmetic average of sound pressure levels of the two contiguous one-third octave bands by five dBA for center frequencies of 500 Hz or more, by eight dBA for center frequencies between 160 Hz and 400 Hz, or by 15 dBA for center frequencies less than or equal to 125 Hz.

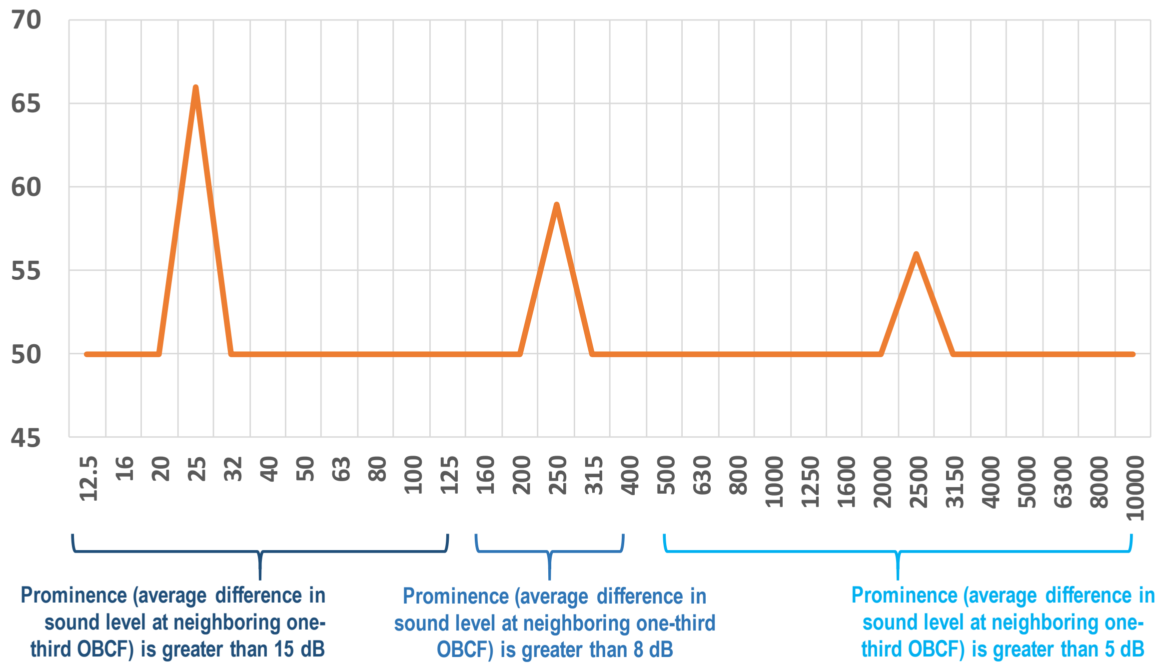

Figure GR-4-D. Sample pure tone plots (dB versus one-third octave band center frequency [OBCF]), each meeting County pure tone definition criteria per Ordinance 10262 Section 6952.f.3 (*left*: within one-third OBCF less than or equal to 125 Hz; *middle*: for one-third OBCF between 160 Hz and 400 Hz; *right*: for one-third OBCF greater than or equal to 500 Hz)

Using available one-third octave band center frequency (OBCF)[6] resolution data for the aforementioned GE 2.X-127 model, Figure GR-4-E displays plots of predicted A-weighted SPL at various distances between this sample wind turbine and a residence. The calculation accounts for both distance and frequency-dependent atmospheric absorption (i.e., air attenuates sound more readily at higher frequencies). Any attenuation due to ground effects are conservatively ignored. None of the plotted SPL appearing in Figure GR-4-E feature instances of peaks or prominence that resemble pure tones as defined by Ordinance 10262 and shown in Figure GR-4-D. Instead, the plots appearing in Figure GR-4-E are smooth curves, indicating that pure tone criteria per the County's definition are not satisfied.

The prediction method used to generate the SPL plots in Figure GR-4-E assumes an operating wind turbine receives wind at hub height with an average velocity of 10 mps, which represents the loudest noise emission for the operating wind turbine. Using the same prediction method, and for the same presented sample wind turbine-to-receptor distances as appearing in Figure GR-4-E, predicted SPL from the turbine operating under conditions of lower received average wind velocities (e.g., ranging from 4 mps to 9 mps) also do not exhibit pure tone conditions. These

[6] OBCF are shown in page 6, Table 1 of the Acoustical Analysis Report. One-third OBCF represent a more granular description of sound and, like the OBCF, are defined with standard center frequencies in Hertz.

findings, including the plots displayed in Figure GR-4-E, provide support for the County's conclusion that pure tone conditions are not expected to occur; thus, the County noise criteria in Section 36.404 would not need to be reduced by 5 dBA, and the thresholds discussed in the Draft EIR are accurate as-is and properly reflect County hourly L_{eq} requirements.

The prediction method used to plot the SPL shown in Figure GR-4-E was also used to conservatively assesses the concurrent operational noise level at a single residence from as many as six operating wind turbines (receiving hub height average wind speed at 10 mps) at a variety of sample distances displayed in Figure GR-4-E: three at a distance of 1,000 feet, one at 2,000 feet, one at 4,000 feet, and one at 8,000 feet. For this and many other studied hypothetical scenarios of multiple operating wind turbines at different distances from a common receptor, pure tone conditions do not arise. This non-tonal acoustical feature predicted for the GE 2.X-127 model wind turbine would also be expected for other wind turbine models commercially available and under consideration.

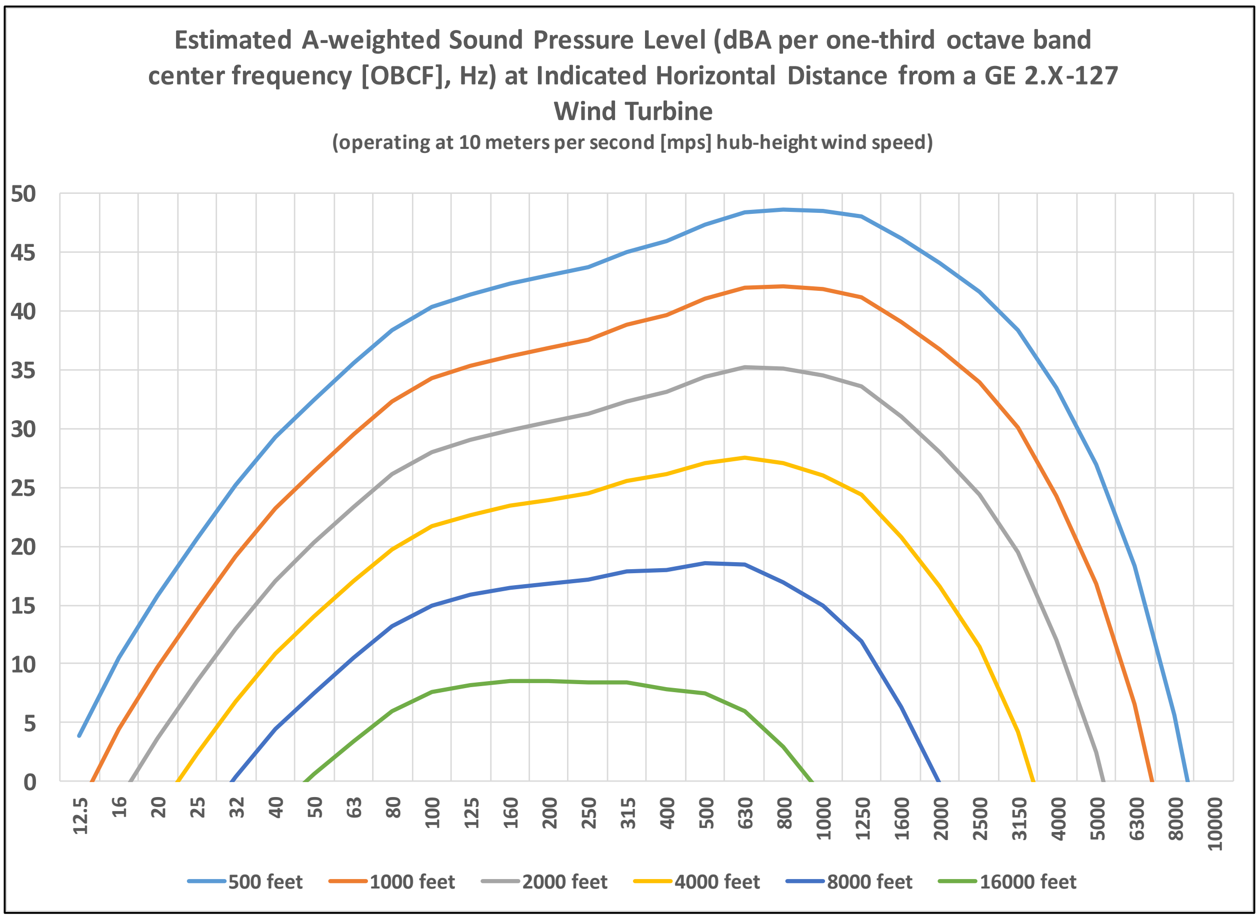

Figure GR-4-E. A-weighted curves of sample predicted wind turbine operation noise, at one-third octave band center frequency (OBCF) spectral resolution, for various distances from the wind turbine

4. The noise analysis realistically acknowledges that wind speeds experienced in the Project area, expressed as the wind velocity in meters per second received by the studied wind turbine at its hub height, are not constant over the course of a year. The wind velocity at hub height can be—under the right conditions—substantially greater than what may be experienced at or near ground level.

   Based on a full year of collected meteorological data and as disclosed in Table 9 on page 34 of the Acoustical Analysis Report, Appendix G of the Draft EIR, the probability of anticipated average hub-height wind speed in the Project Area is described with two metrics: percentage of days (365) for a year and the count of day/night cycles. Table 9 from Appendix G also shows the corresponding individual modeled wind turbine operation noise level at the indicated average hub-height wind speed, based on manufacturer sound power data. This information helps show how frequently maximum operating wind turbine noise is likely to occur during a year. The Draft EIR then predicts the potential for exceedances of the County noise standards at these same seven average wind speeds, ranging from cut-on speed (i.e., minimum wind speed at which a wind turbine rotor would begin spinning and thus generate electricity and start making noise) to 10 mps (the wind speed at which highest noise emission occurs). The analysis thus shows that exceedances of the County's noise standards are predicted. The bar charts below in Figure GR-4-F show how many cumulative days per year (i.e., they are not all sequential) that the County's daytime and nighttime hourly L_{eq} limits would be exceeded for residentially zoned Off-Reservation properties near three studied representative locations. As shown in the bar charts:

   - Daytime exceedances are predicted to occur fourteen (14) days per year at LT-10 when average hub height wind speeds are greater than 10 mps; fourteen (14) days per year at LT-1 when average hub height wind speeds are greater than 10 mps; and, fifteen (15) days per year at LT-1 when average hub height wind speeds are within 9 to 10 mps.
   - Nighttime exceedances are predicted to occur fourteen (14) days per year at LT-10 when average hub height wind speeds are greater than 10 mps, fifteen (15) days per year when average hub height wind speeds are within 9 to 10 mps, and twelve (12) days per year when average hub height wind speeds are within 8 to 9 mps.
   - At LT-1, nighttime exceedances are predicted to occur fourteen (14) days per year when average hub height wind speeds are greater than 10 mps, fifteen (15) days per year when average hub height wind speeds are within 9 to 10 mps, twelve (12) days per year when average hub height wind speeds are within 8 to 9 mps, and twenty-five (25) days per year when average hub height wind speeds are within 7 to 8 mps.

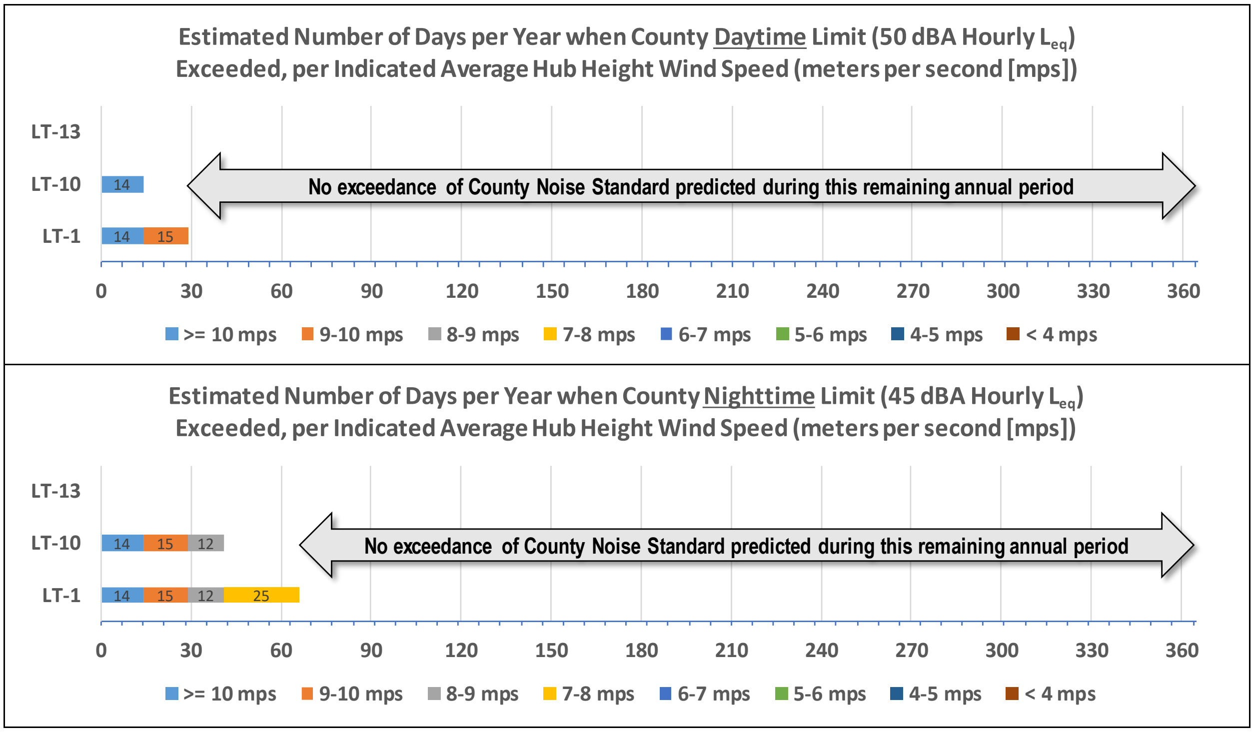

Figure GR-4-F. Predicted number of days per year when County daytime and nighttime hourly L_{eq} thresholds would be exceeded at representative study locations LT-1, LT-10, and LT-13

Infrasound and Low Frequency Noise

Infrasound refers to acoustic oscillations that occur at frequencies below 20 Hz, which is generally considered below the range of human hearing. Natural sources of infrasound include wind or weather patterns causing air oscillations, ocean waves, and aerodynamic turbulence. A frequency-weighting characteristic, designated "G," is generally used for the determination of weighted SPLs whose spectrum lies partly or wholly within the frequency band from 1 Hz to 20 Hz. This G-weighted measurement is referred to as dBG. The County does not have any regulations or standards pertaining to infrasound levels. The proposed wind turbines are anticipated to be the primary sources of infrasound during Project operations.

Low-frequency noise comprises audible SPLs ranging between 20 Hz to 200 Hz. A young non-pathological ear can perceive sounds ranging from 20 Hz to 20,000 Hz. In its zoning ordinance for large wind turbines (Ordinance 10262, Section 4), the County uses the "C" frequency-weighting scale to evaluate sound with "large low frequency components," which would include sound in the 20 Hz to 200 Hz range of the audible spectrum. Please refer to Figure GR-4-G for a side-by-side comparison of the A-, C-, and G-weighting decibel adjustments from 0.1 Hz to 100 Hz. Note that from 20 Hz to 100 Hz, the C-weighting dB adjustments are modest (approximately 0 to 7 dB reductions), while the A-weighting adjustments are much more substantial (e.g., ranging from −50 dB at 20 Hz to −20 dB at 100 Hz). This is why the C-weighting scale, applied to unweighted SPLs, is more suitable for assessing low-frequency noise than the A-weighting scale typically used for environmental noise assessment.

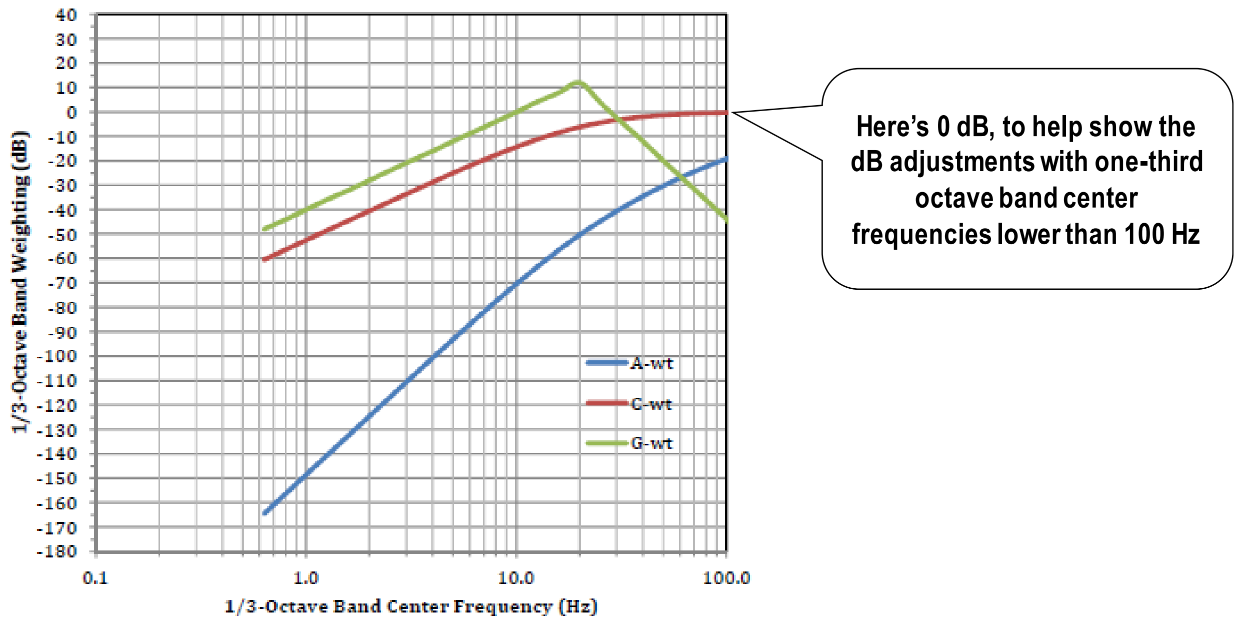

Figure GR-4-G. Comparison of A-, C-, and G-weighting decibel (dB) adjustment curves below 100 Hz

Source: Wilson Ihrig, Kumeyaay and Ocotillo Wind Turbine Facilities Noise Measurements, report submitted to Stephan C. Volker, Esq., 25 February 2014.

As summarized in the Acoustical Assessment Report (Appendix G) of the Draft EIR, Section 6952.f.1 of the County's zoning ordinance for large wind turbines requires that an acoustical study compare predicted C-weighted noise from an operating large wind turbine with the aforementioned A-weighted RBSC value to assess potential annoyance. When the decibel difference between these two differently weighted values exceeds 20 dB at the Project property line, a noise impact would be predicted. The proposed wind turbines are anticipated to be the primary sources of low-frequency noise during Project operations.

The County concludes that the Draft EIR has adequately measured pre-existing A-weighted RBSC at representative receptor positions, predicted C-weighted aggregate Project wind turbine operation noise at several average hub-height wind speeds, and provided estimates of where and under what wind speed conditions during a typical year the contrast of low-frequency sound from the Project operating wind turbines and the existing RBSC would exceed the County's 20 dB differential standard.

Amplitude Modulation

Some comments on the Draft EIR raise concerns regarding amplitude modulation (AM). Both the March 18, 2019, Wilson-Ihrig report and December 16, 2019, dBF reports state that AM was measured at the same Boulevard area residence (Guy residence). The Wilson-Ihrig 3/18/19 report states that “several of the residents commented on” a “whooshing” sound from wind turbines. The report attributes this “whooshing sound” to AM. To support this, pages 50–51 of Wilson-Ihrig 3/18/19 report present four plots of a single 26-second duration measurement at the Guy residence. Three plots (Figure C-19 from the report) are associated with the 160 Hz, 200 Hz, and 250 Hz one-third octave band center frequencies, and a fourth plot (Figure C-20 from the report) is marked as “SPL – dBA.” However, no explanation is offered as to why the measurement plots conclusively exhibit AM, excessive or otherwise. The report also does not provide any explanation as to why the measurement plot is not attributed to other potential effects such as other sound sources in the environment, wind gusts, or other natural and human-caused phenomena. The report does not provide a clear link between wind turbine blade passage frequency, on which AM is based, and the presented sole measurement sample that is apparently only 26 seconds in duration—less than 3% of the time within what Table 1 from the report suggests should have been at least a 15-minute measurement. The report also does not indicate when the sample of AM occurred.

The dBF report, dated December 16, 2019, similarly states that “several area residents have commented on” a “whooshing” sound from wind turbines and attribute it to AM. To support this, the last page of this dBF 12/16/19 report presents what appears to be just a single, 1-minute duration measurement at the Guy residence, showing only a plot of presumably dBA at the 250 Hz octave band center frequency. (The plot metric is not specified or labelled, and the introductory paragraph “Amplitude Modulation” on page 8 of the report uses both dB and dBA.) Like the aforementioned Wilson-Ihrig 3/18/19 report, no explanation is offered as to why the measurement plot conclusively exhibits AM, excessive or not, nor is there any explanation why the measurement plot is not attributed to other potential effects such as other sound sources in the environment, wind gusts, or other natural and human-caused phenomena. The report does not provide a clear link between wind turbine blade passage frequency, on which AM is based, and the presented sole measurement sample that may have started shortly after midnight on August 17, 2019.

Based on these two studies, the County concludes there is a lack of sufficient evidence to support claims that AM attributed to operation of existing wind turbines in the Boulevard region is a concern that needs to be addressed.