Appendix F

Noise Technical Memorandum

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MEMORANDUM

To:	Dexter Liu and Patti Murphy, North Central Valley Energy Storage, LLC
From:	Mark Storm, Acoustic Services Manager, Dudek
Subject:	North Central Valley Energy Center Operations Noise Modeling Results
Date:	October 14, 2021
cc:	Jennifer Sucha, Dudek; Matt Towery, North Central Valley Energy Storage, LLC

The following is a summary of the regulatory requirements related to property line noise levels, sound propagation modeling methodology and key assumptions, and predicted aggregate noise from operation of planned onsite battery container cooling systems and inverters associated with the subject project ("Project"). This technical memorandum supersedes two previous memoranda (dated April 1, 2021 and August 17, 2021, respectively) and reflects consideration of an updated anticipated layout of Project features and major noise-producing onsite operating electromechanical equipment.

PROJECT SUMMARY

North Central Valley Energy Storage, LLC (Applicant) proposes to develop, construct, and operate the North Central Valley Energy Center (Project) located in San Joaquin County, California. The site encompasses five Assessor's parcels with a combined acreage of approximately 84.14 acres. Two parcels are privately owned and three parcels are owned by Pacific Gas & Electric (PG&E), as shown in Table 1 Land Ownership.

Table 1. Land Ownership

APNs	Ownership	Acreage
09310024	Private	39.55
09310020	Private	17.73
09310004	PG&E	13.26
09310005	PG&E	10.00
09310016	PG&E	3.60
Total		84.14

The Project consists of a 132-megawatt (MW) battery energy storage system (BESS), which will include battery storage containers and associated on-site support facilities including a project collector substation, inverters, collector lines, fencing, access roads, operations and maintenance building, a supervisory control and data acquisition (SCADA) system, and other ancillary facilities and equipment. The Project also includes a 115-kilovolt (kV) overhead generation transmission line (gen-tie line), to connect the BESS to the adjacent PG&E Bellota substation (Bellota substation). An expansion of the Bellota substation footprint will be required to support grid interconnection of the Project.

REGULATORY COMPLIANCE/ACOUSTICAL GOAL

Per San Joaquin County (County) Performance Standards 9-1025.9 for stationary noise sources, the sound levels to meet from such a facility are hourly energy-equivalent (L_{eq}) values as follows: 50 dBA during daytime hours (7 a.m. – 10 p.m.), and 45 dBA at night (10 p.m. – 7 a.m.). This County standard further notes as follows:

1. *"Where the location of outdoor activity areas is unknown or is not applicable, the noise standard shall be applied at the property line of the receiving land use."* Consistent with previous applications of this noise standard, such as found in the Draft Subsequent EIR noise section for the South San Joaquin Irrigation District (SSJID) Plan to Provide Retail Electric Service, Sphere Plan, MSR, and Annexation[i], this is understood to mean the daytime and nighttime hourly L_{eq} limits are assessed at the property lines of neighboring noise-sensitive receptors such as the one bounded (i.e., surrounded on three sides) by the Project and the one at the Project's southwestern corner.

2. *"Each of the noise level standards specified shall be reduced by 5 dB for impulsive noise, single tone noise, or noise consisting primarily of speech or music."* Neither speech or music would be contributed by the Project; and, due to the anticipated broadband acoustical contribution from the battery container cooling units (i.e., Bard "Wall-Mount" model W72AA air-conditioning units) and built-in ventilation technology for the inverters, it is unlikely the conditions to create a "simple tone" per typical industry definitions would be satisfied.

During temporary periods of work to perform Project facility maintenance, which could introduce new noise-producing equipment and activities onsite, Section 9.1025.9(c)(7) from the County code provides an exemption from the afore-mentioned noise limits.

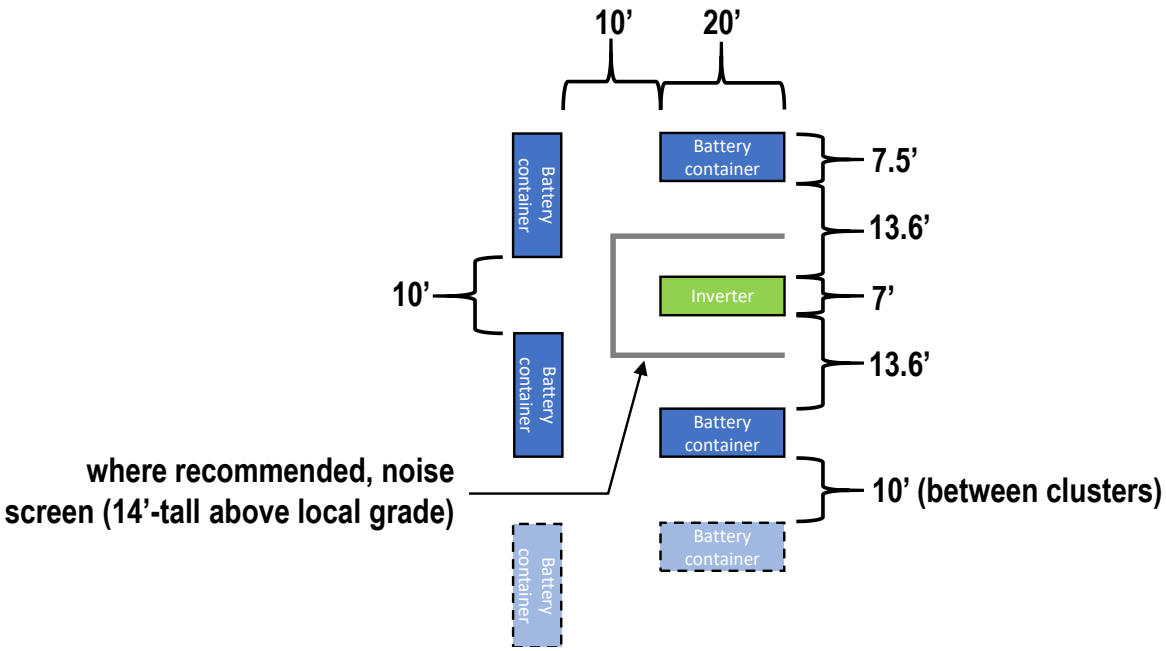
According to Applicant information, Project inverters may operate in charging or discharging modes at any time; hence, to accommodate such conditions under this quantitative noise level assessment, the focus of this study will be predicting compliance with respect to the County's nighttime hourly L_{eq} standard at the adjoining occupied property boundaries: 45 dBA. Assuming Project operation parameters pertaining to onsite noise emission would not change between daytime or nighttime conditions, predicted compliance with this nighttime threshold would therefore presume compliance with the less stringent daytime hourly L_{eq} standard of 50 dBA.

METHODOLOGY

Dudek has modeled the propagation of sound from a combination of Project noise sources with commercially available Datakustik CadnaA software, which incorporates relevant International Organization of Standardization (ISO) 9613-2 algorithms and reference data that are generally considered to be industry standard for outdoor noise modeling.[ii] Key modeling assumptions and parameters are as follows:

- There are approximately 152 battery containers, each featuring acoustic contribution from two (2) "silenced" Bard units that are represented as a pair of vertical area noise emission sources located on one of the two short sides of the battery container enclosure. The battery containers themselves are modeled as 10.5'-tall "building" blocks that obstruct sound paths. From manufacturer data, each sound-attenuated ("silenced") Bard unit exhibits 51.2 dBA L_{eq} at a distance of 5 feet. For comparison purposes, without the noise silencing on the return air and supply air ducts, the Bard unit demonstrates a noise level of 62 dBA L_{eq} at 5 feet.[iii]

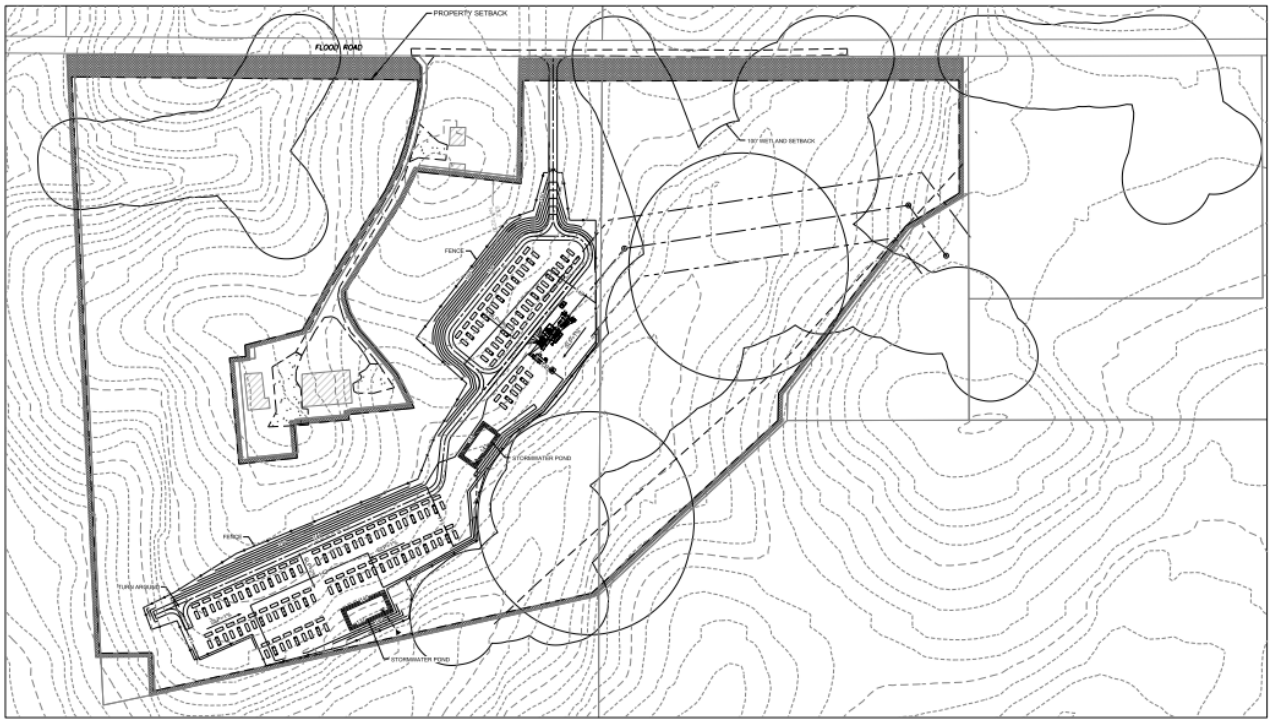
- Arranged in clusters with equipment orientations and spacings that approximate the sample dimensions appearing in Figure 1, each set of four (4) battery containers is served by a single inverter. The inverter is also modeled as a building block (9 feet tall, including the ground pad or other support structure), with noise emission depicted as a vertical area source on each of the four vertical surfaces of the inverter enclosure. The aggregate sound power (PWL) attributed to these four vertical area sources for an individual modeled onsite inverter results in estimated sound pressure levels (SPL) that match (on average, within +/-1 dB) the "total sound pressure" A-weighted levels (at a distance of one meter, confirmed by the Applicant) for each of the five "measurement surface[s]" appearing in the Summary of Results section of the On-Site Acoustic Testing report dated June 2019 for an "HEM" model Power Electronics inverter. This acoustic test report was furnished to Dudek by the Applicant on January 7, 2021 for purposes of quantifying the individual sound emission from each onsite Project inverter.



Source: Dudek, based on information from North Central Valley Energy Storage, LLC 2021

Figure 1. Project site sample equipment grouping for proposed layout (not to scale)

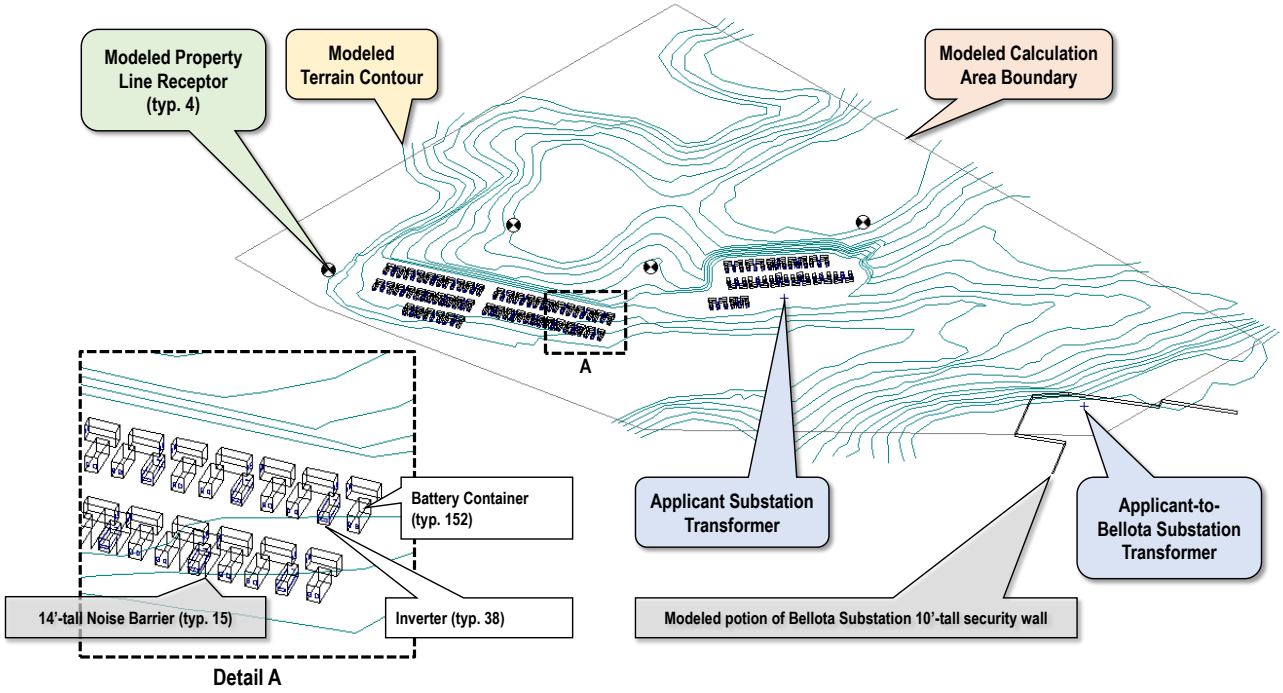
- The positions of battery containers, inverters, onsite substation transformer and other Project feature footprints were geographically arranged in a manner emulating what appears in the Project site plan. The site plan is reproduced herein as Figure 2.



Source: North Central Valley Energy Storage, LLC 2021

Figure 2. Project Site Plan (and proposed Project transmission line tie-in to adjoining Bellota Substation with its planned westerly expansion)

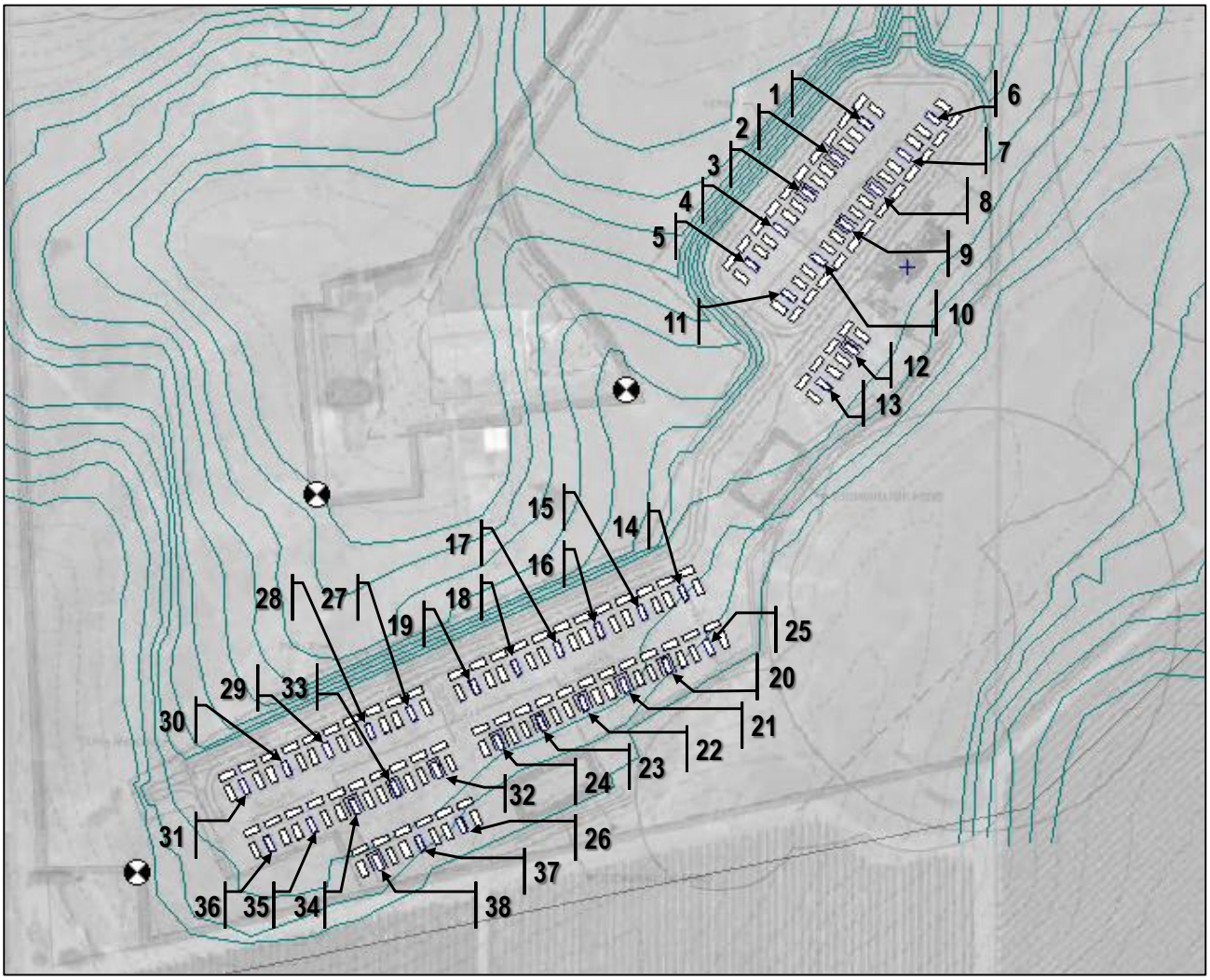
- Portions of the Project site topography have been modeled with selected natural terrain and proposed site grading contour lines from those appearing in Figure 2, representing two-foot increments in relative elevation ranging from zero feet to 24 feet.
- Noise sources operate for a full hour, so that the energy-equivalent level (L_{eq}) may be compared directly with the County's standard. Note that if actual Project equipment operation was less than an hour during actual operation, its sound energy would be "diluted" across a full hour of time and result in a lower L_{eq} value. By way of example, and consistent with acoustical principles, if the Project only operated for half of a full hour, the resulting hourly L_{eq} value would be 3 dB less than that of the L_{eq} representing a full hour of steady-state operation.
- The model calculation area encompasses the Project and the Bellota substation to the east. Figure 3 displays an isometric view, as rendered in the CadnaA software program, of the modeled elements and includes modeled topographic contours that define the ground elevation beneath them.



Source: Dudek 2021

Figure 3. Isometric view of the Project equipment layout model rendered in CadnaA software, looking northwest, with zoom-in Detail A to help identify sample features

- Per the current proposed Project design, the model includes a limited quantity (15 in total) of proposed "U-shaped barrier" elements that are fourteen feet (14') in height with respect to grade and placed to occlude direct sound emission from the three loudest facings of an operating inverter (front, back, and left). An example is called out in Detail A of Figure 3, with a plan view showing horizontal dimensions appearing in Figure 1. The physical manifestation of these barriers could be one of several material and assembly options that would have sufficient solidity and density, and installed properly in the field, to yield the expected and modeled noise reduction performance. The 15 modeled inverters anticipated to feature such U-shaped barriers are numerically tagged in Figure 4 as follows: 2, 3, 8, 9, 12, 20, 21, 22, 23, 24, 25, 32, 33, 34, and 38.
- For twenty-one (21) other inverters, installation of the above-mentioned U-shaped barriers will not be expected. As shown on Figure 4, two of these 23 inverters are tagged as 26 and 37. The remaining twenty-one (21) without recommended U-shaped barriers, however, represent inverters that will feature noise control upgrades (e.g., close-fitting enclosure surrounding the inverter cabinet, with sound-attenuated ventilation ports) yielding 12 dB of broad-band sound reduction and thus overall lower SPL when compared to an "off-the-shelf" inverter such as 26, 37, and those previously listed that will be expected to have a U-shaped barrier surrounding them.



Source: Dudek 2021

Figure 4. Numerical tagging of inverters
(for purposes of modeled anticipated U-shaped barrier or equipment noise control upgrade need)

- Acoustical ground absorption of the Project site and the surrounding topography is set at 1.0, which on a zero (reflective) to one (absorptive) scale approximates a combination of the grass-covered soils that generally surround the Project area and any anticipated loosely graveled Project site cover.
- The Project substation transformer and Applicant-to-Bellota transformer planned for the Bellota Substation western expansion are, for purposes of this quantitative assessment, assumed to yield a sound power level no greater than 89.4 dBA and 95.0 dBA, respectively. Accounting for SPL to PWL conversion of 8 dB, this transformer noise level is generally consistent with the following expression that approximates SPL from the transformer MVA rating: 26+8.5*LOG(MVA).[iv]
- The Bellota Substation site has, and as part of the planned western expansion per information received from PG&E, a 10-foot tall solid security wall around much of its perimeter. As shown in Figure 3, a portion of the security wall on the west side of the Bellota Substation site has been modeled. Other portions of the

secure boundary, including gaps in the solid wall that are either gates or chain-link fence that would be considered acoustically open or porous (i.e., not provide barrier noise reduction effect) are not included.

- Meteorological conditions presume "calm" wind conditions (i.e., less than 0.5 meters per second in any direction) and average air temperature and relative humidity of 68 degrees Fahrenheit and 50%, respectively.

- The model "configuration" settings include reflection order set to "1", which can be interpreted to mean that a sound emission path from a source will continue to be analyzed after impingement upon and reflection from the first intervening structure or barrier.

PREDICTION RESULTS

Two different scenarios of aggregate Project operation noise emission were modeled for a single proposed layout of Project operating battery containers and inverters, as depicted in Figure 2, and are distinguished as follows:

A. **"Project Only, Silenced Bard Units"** – this prediction model assumes all Project noise sources are active, and includes the onsite substation transformer; the battery storage container Bard units are presumed to be the noise-attenuated models (i.e., each 51.2 dBA L_{eq} at five feet, per manufacturer data).

B. **"Project plus Applicant-to-Bellota Transformer, Silenced Bard Units"** – similar to scenario "A" above, this prediction model assumes all Project noise sources are active, and includes the onsite substation transformer; in addition, the Applicant-to-Bellota transformer planned as part of the Bellota Substation western expansion has been included.

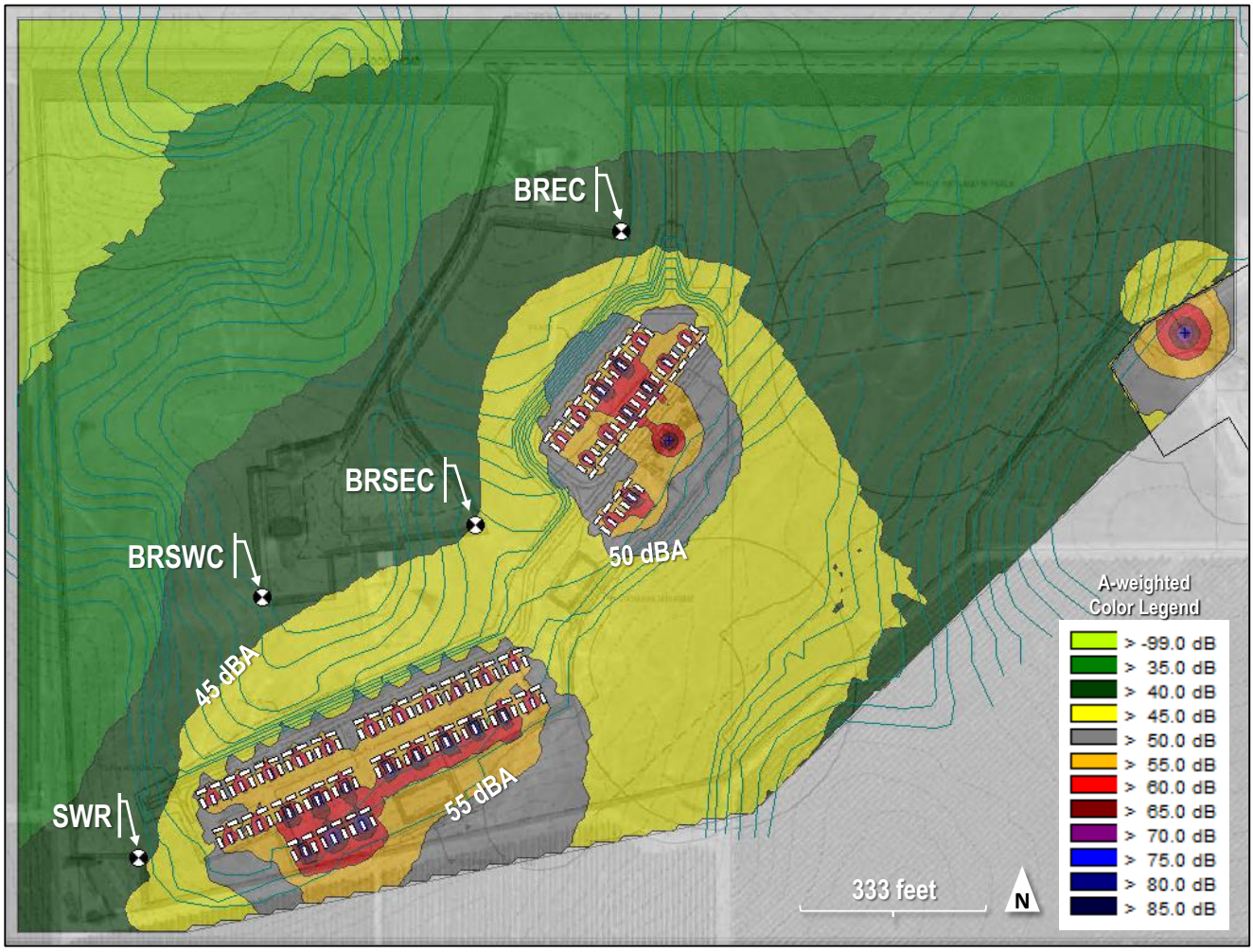
The following Figure 5 displays the predicted results of Scenario B, showing predicted sound pressure levels (SPL, in hourly L_{eq}) across a horizontal plane five feet above the Project site and its surroundings at a granularity of approximately 10' x 10' and color-coded per the legend so as to help visually convey the attenuation of aggregate sound of Project operating equipment with distance. Predicted SPL at the four nearest representative property line receptor locations are also listed in Table 2.

Table 2. Predicted Project Operation Noise at Representative Receptor Positions

Representative Receptor Location (as tagged on Figure 5)	Scenario A (dBA, L_{eq})	Scenario B – Figure 5 (dBA, L_{eq})
Southwest Receptor (SWR)	44	44
Southwest corner of Bounded Receptor (BRSWC)	44	44
Southeast corner of Bounded Receptor (BRSEC)	45	45
East corner of Bounded Receptor (BREC)	43	43

Notes: dBA = A-weighted sound decibels; L_{eq} = energy-equivalent sound level

Based on these modeled operation scenarios, Dudek concludes that Project operation noise is expected to be compliant with the County's noise level thresholds at the receiving property lines of existing residential land uses.



Source: Dudek 2021

Figure 5. Predicted operation noise associated with Scenario "B"
(Project plus Applicant-to-Bellota Transformer, Silenced Bard Units)

[i] https://www.sjgov.org/lafco/ssjid/deir%20cd/dseir/3-08_noise.pdf
[ii] ISO 9613-2:1996. Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation. https://www.iso.org/standard/20649.html
[iii] Information, including Bard W72AA series model selected for Project, received from NEER on November 18, 2020.
[iv] Beranek & Ver, 1992, Noise and Vibration Control Engineering – Principles and Applications, John Wiley & Sons, page 660.