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Review of the Heron BESS Application Noise Study

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Review of the Heron BESS Application Noise Study

We have conducted a technical review of the predictive noise study report dated July 17, 2026 by Kimly Horn for the proposed Heron BESS facility, assessing the study's completeness, methodology, and consistency with applicable noise regulations and standard engineering practice. A copy of the noise study report is provided in APPENDIX A.

Noise Study Information

The application noise study prepared by Kimly Horn provides the following information:

Ambient Noise Monitoring

While not included in this application noise study, pre- and post-installation ambient sound level measurements will be conducted to document sound levels prior to the BESS facility installation, and again following installation, to ensure operational sound levels comply with the ordinance.

Noise Analysis

The predictive noise analysis was conducted using a computer program called SoundPLAN, utilizing the ISO 9613-2:2024 standard. The model was programmed to account for various input data, including topography, ground cover, and intervening structures. Ground outside the project area was modeled with an absorption factor of 1.0, while the project development area was assigned an absorption factor of 0. The noise generated from the proposed BESS facility is expected to include inverters, substation transformer, and battery storage cabinets as the primary sources.

Site and Equipment

The Heron BESS development is a large-scale energy storage facility that will occupy approximately 23 acres of agricultural land. The project is proposed to include seventy-eight (78) EPC Power M System inverters, one power transformer rated 115-34.5 kV BIL with ONAN/ONAF/ONAF ratings of 135/184/230 MVA, and three hundred twelve (312) battery storage cabinets.

The inverters were modeled using a reference sound pressure level of 75 dB(A) at 1 meter, with all sound energy placed within the 500 Hz octave band.

The transformer sound data was based on the NEMA TP 80050-2013 standard, with a modeled sound power value of 98 dB(A).

The battery storage cabinets were modeled using acoustic data for the LG JF2 DC LINK 5.1 unit, citing three (3) 7 kW chiller elements (each with a 79 dB(A) sound power rating) and four (4) 2 kW HVAC units (each with an 80 dB(A) sound power rating).

Results

The report provides graphical results of the predictive modeling for the proposed BESS installation, showing both numeric sound levels and color contour mapping of the predicted sound levels. The Kimley-Horn modeling results indicate that maximum sound levels are predicted to be approximately 57 dB(A) at the east property boundary. At all other property boundaries, sound levels are predicted to be less than 55 dB(A).

Noise Abatement Measures

The report states that a 10-foot-tall, 600-foot-long reflective sound barrier wall with an "STC of at least 40" will be needed along the east property boundary to "...reduce on-site operational noise levels to be near or below the established sound limit..." Additional graphical results are provided showing that, with the sound barrier wall in place, noise levels at the east property boundary are predicted to be less than 55 dB(A).

Review of Noise Source Modeling

The inclusion of ambient sound measurements before and after construction of the BESS facility is an important and favorable element of the project's development. The results of these measurements should be documented in follow-up sound study reports that relate the measured data to the study's noise predictions, evaluates the facility's relative sound impact on the surrounding area, and demonstrate compliance with the ordinance limits.

Overall, the general modeling methodology employed in the noise study appears reasonable and consistent with standard engineering practice. The use of ISO 9613-2 propagation modeling in SoundPLAN, incorporation of site topography, and the ground absorption factors applied ($G = 1.0$ outside the project area, $G = 0$ within the developed project area) are all reasonable and appropriately conservative assumptions for the proposed BESS site.

However, the study does not identify several modeling details necessary to fully evaluate its methodology, including how each noise source was defined (e.g., point, line, or area source), the elevation assigned to each source above grade, whether intervening structures were modeled alongside the sources, and the number of reflections calculated. This last item is of particular relevance to the battery storage cabinets, as discussed further below.

Furthermore, our review identified significant concerns with how two of the three primary noise sources, the inverters and the substation transformer, were characterized for input into the model. The sound power of the battery storage cabinets otherwise appears to have been modeled with reasonable accuracy.

Inverters

The study characterizes each of the 78 proposed inverters using a single reference sound pressure level of 75 dB(A) at 1 meter, with the entirety of that sound energy assigned to the 500 Hz octave band. This approach is problematic on two fronts.

First, placing the full A-weighted sound energy into a single octave band does not reflect the actual frequency content of inverter equipment, which commonly includes both switching-related tonal content at higher frequencies and lower-frequency components from cooling and enclosure vibration. Because ISO 9613-2 propagation losses are frequency-dependent, this simplification does not accurately represent how the source's actual sound energy would propagate to the nearest non-participating property boundary and is not a conservative assumption.

Second, a single sound pressure level at 1 meter does not adequately characterize a source of this physical size, nor does it necessarily account for multiple radiating surfaces (e.g., separate intake and exhaust faces) that may contribute independently to the total sound output. A single-position reference of this kind does not, on its own, establish a sound power level suitable for use as a point-source model input, and doing so would understate the sound energy produced by this noise source.

For these reasons, we consider the inverter noise modeling in its current form to be inaccurate and non-conservative, and unsuitable to support a determination of compliance with applicable noise criteria.

Substation Transformer

The study characterizes the substation transformer using a sound power level of 98 dB(A), attributed to a NEMA-based average sound level rating. Based on our independent review and calculations, this value appears to be understated; we estimate a sound power level for a transformer of this rating and voltage class more reasonably falls in the range of approximately 105 to 108 dB(A). A discrepancy of this magnitude is significant and calls into question the reliability of the transformer's modeled contribution to sound levels at the nearest non-participating property boundary.

The study also does not identify the octave band spectrum used to characterize the transformer in the propagation model. This is a notable omission, as transformer noise is well documented to include discrete tonal components at twice line frequency (120 Hz) and its harmonics, which will affect the model's propagation accuracy.

We consider the transformer noise modeling to be incorrect as presented and recommend that it be revisited and substantiated before the study can be relied upon to demonstrate compliance.

Battery Storage Cabinets

The battery storage cabinets were modeled using manufacturer-published sound power level data for the LG JF2 DC LINK 5.1 unit's chiller and HVAC components. Because these values are represented directly as sound power levels from the equipment manufacturer, rather than derived or converted from a sound level reference measurement, this approach appears reasonably accurate and consistent with standard practice. We did not identify significant concerns with the characterization of this noise source.

However, the physical modeling of these sources raises a question the study does not address. The report states that *"it was assumed that the chillers and HVAC units are located facing the aisles between cabinets,"* implying that the battery storage cabinets themselves are assumed to provide acoustic shielding for these noise-producing components. The study does not identify whether the cabinets were modeled as physical obstacles within SoundPLAN, nor does it specify the number of reflections calculated, both of which would be necessary to confirm that this assumed shielding benefit, and the influence of reflections within the aisles between cabinets, were appropriately and conservatively represented in the model. Without this information, the net effect of the cabinet layout on the predicted sound levels at the property boundaries cannot be independently verified.

Conclusions

Based on our technical review, the predictive noise study submitted for the Heron BESS facility employs generally sound modeling methodology, including appropriate use of ISO 9613-2 propagation modeling, reasonable ground absorption assumptions, and adequate consideration of site topography and intervening structures. However, the study's characterization of the primary noise sources, along with several gaps in the documentation of the modeling methodology itself, calls into question the reliability of the predicted sound levels at the project's property boundaries.

The identified deficiencies in the inverter and transformer sources indicate an understatement of actual sound levels. The inverter modeling's single-band frequency assumption fails to account for lower-frequency source energy that would propagate with less attenuation than modeled, and the sound level reference at 1-meter does not confirm that the full radiated sound power of a multi-surface source was captured.

The transformer's sound power level, based on our independent calculations, appears understated by approximately 7 to 10 dB(A) relative to what would be expected for a unit of this size and rating. Errors of this magnitude in the underlying source terms are not minor. They compound in a direction that understates the cumulative sound level predicted at the nearest non-participating property boundaries, including the 57 dB(A) maximum level reported at the east property boundary, and the design basis for the proposed sound barrier wall.

Separately, the study's lack of documentation regarding source type, source elevation, treatment of intervening structures, and number of reflections calculated introduces additional uncertainty that cannot be resolved on the basis of the information provided, including whether the assumed acoustic shielding of the battery storage cabinet chillers and HVAC units was appropriately represented in the model.

Given these findings, we do not believe the noise study, in its current form, provides an adequate basis to confirm that the proposed Heron BESS facility will comply with the applicable noise ordinance at the nearest non-participating property boundaries. We recommend that the applicant's acoustical consultant revise the inverter and transformer source characterizations using properly substantiated sound power data and appropriate spectral information. Also, documentation of the source type, elevation, structural modeling, and reflection settings used for each noise source should be included. The design of the proposed sound barrier wall should be reassessed accordingly, noting that its current STC-based specification is used for indoor partition sound isolation specification and is not consistent with outdoor noise barrier attenuation performance.

Further, we recommend that the pre- and post-construction ambient monitoring referenced in the study be required as a condition of approval, with the resulting measurements documented in multiple follow-up reports. A report for the pre-construction measurements should show comparisons to the sound study's noise predictions and evaluate the facility's relative sound impact on the surrounding area. A report for the post-construction measurements should demonstrate compliance with the ordinance noise limit. We also recommend, if applicable, that the final certificate of occupancy be made contingent on compliance with the noise limits.

APPENDIX A

July 17, 2026

Simone Marletti
Heron Energy Storage LLC
c/o Copenhagen Infrastructure Service Co.

Subject: *Heron BESS – Noise Study*
Gun Plain Charter Township, Allegan County, Michigan

Executive Summary

The purpose of this technical memorandum is to summarize the evaluated sound levels associated with the operational equipment to be located at the proposed Heron Battery Energy Storage System (BESS) site located in Gun Plain Charter Township, MI. The proposed Heron BESS project site is located approximately 1.5 miles east of Plainwell, approximately 7.5 miles northwest of Richland, approximately 7.5 miles north of Kalamazoo, and 9 miles southwest of Delton. The site is generally located south of Allegan Street/M-43/M-89, east of 4th Street, and north of Riverview Drive/Industrial Parkway. Additionally, Grand Elk Railroad, LLC (GDLK) railroad tracks are located approximately 1.5 miles west of the site.

The Heron BESS site and properties located directly to the west and south are currently zoned as an Agricultural district with the properties located directly to the north and east zoned as Residential districts. According to the Gun Plain Charter Township Future Land Use Map, the Heron BESS site will be located on land designated as low density residential with low density residential land uses located directly west, north, and east of the site. Land uses located directly south of the site are designated as agriculture and open space. It is to be noted that the properties located directly west, north, and east of the site are currently undeveloped but may be developed with noise-sensitive uses in the future. The closest residential structure is located approximately 880 feet south of the BESS area, and an existing substation is located approximately 935 feet west of the site. The location of the proposed Heron BESS site is shown in **Figure 1**.

Analysis Findings

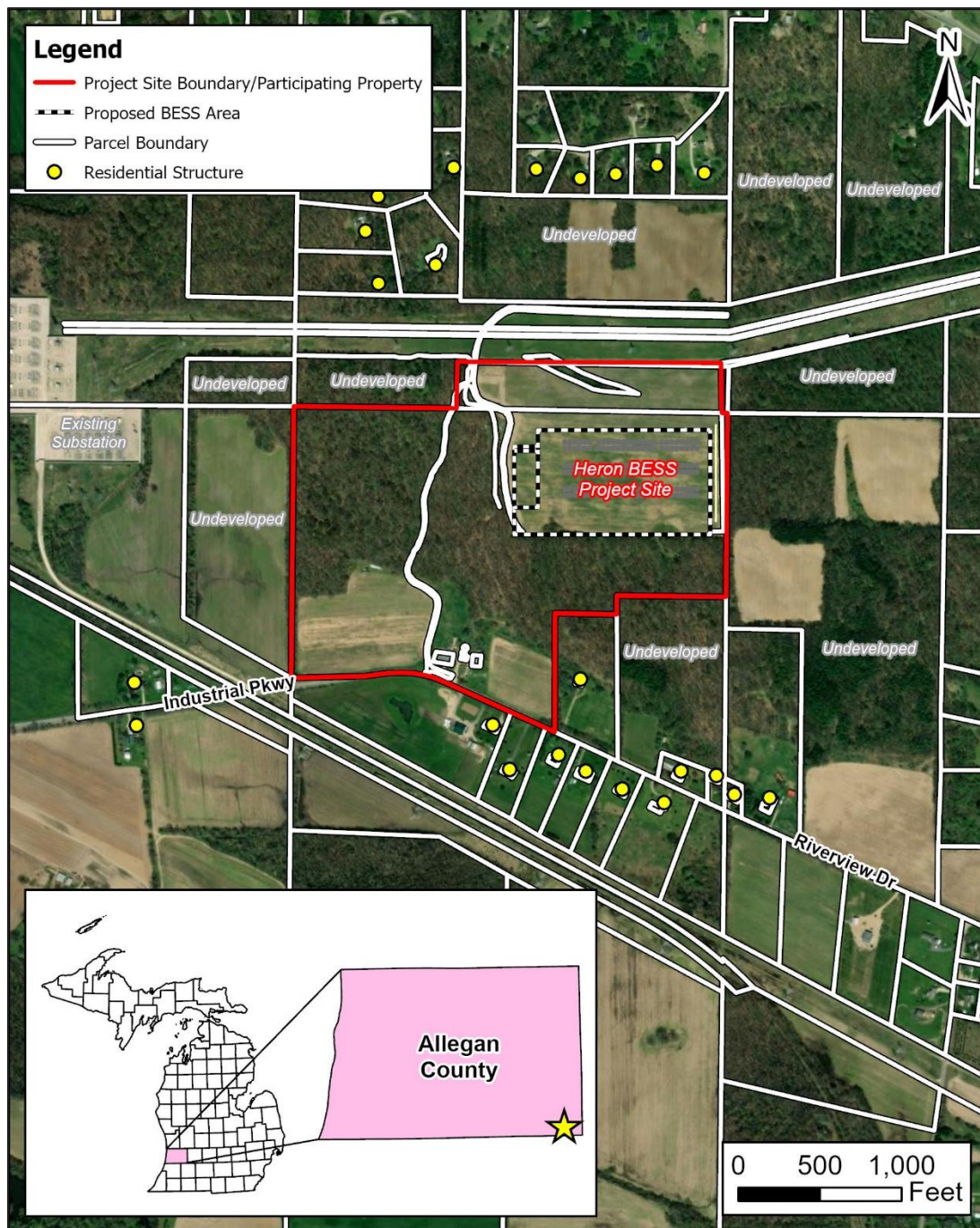
- The Gun Plain Charter Township Zoning Ordinance establishes an allowable sound level of 55 dB(A) as measured at the property line of an adjacent non-participating property. Unmitigated maximum equivalent operational noise levels at the project boundary were estimated to be near or below approximately 57 dB(A) during peak operations and near or below approximately 44 dB(A) at the nearest residential structure. It is to be noted that an exceedance is occurring at the eastern property boundary adjacent to vacant land. Impacts to existing noise-sensitive uses (i.e., residences) are not anticipated at this time. Mitigation is recommended if a noise-sensitive use is constructed in the future on the adjacent property to the east.*

Project Description

The proposed Heron BESS site will be constructed on nearly 23 acres of approximately 34 acres of land in Gun Plain Charter Township, MI. The proposed site will consist of a BESS area located towards the northeast corner of the property containing seventy-eight (78) EPC Power M System

inverters, three hundred twelve (312) LG JF2 DC Link 5.1 battery storage cabinets, and a substation containing a 5,300 kilo volt-ampere (kVA) rated transformer located directly west of the BESS area.

Figure 1: Site Location and Vicinity



Characteristics of Noise

Noise is generally defined as unwanted sound. It is emitted from many natural and man-made sources. Sound pressure levels are usually measured and expressed in decibels (dB). The decibel scale is logarithmic and expresses the ratio of the sound pressure unit being measured to a standard reference level. Most sounds occurring in the environment do not consist of a single frequency, but rather a broad band of differing frequencies. The intensities of each frequency add together to generate sound. Because the human ear does not respond to all frequencies equally, the method commonly used to quantify environmental noise consists of evaluating all of the frequencies of a sound according to a weighting system. It has been found that the A-weighted decibel [dB(A)] filter on a sound level meter, which includes circuits to differentially measure selected audible frequencies, best approximates the frequency response of the human ear.

The degree of disturbance from exposure to unwanted sound – noise – depends upon three factors:

1. The amount, nature, and duration of the intruding noise
2. The relationship between the intruding noise and the existing sound environment; and
3. The situation in which the disturbing noise is heard

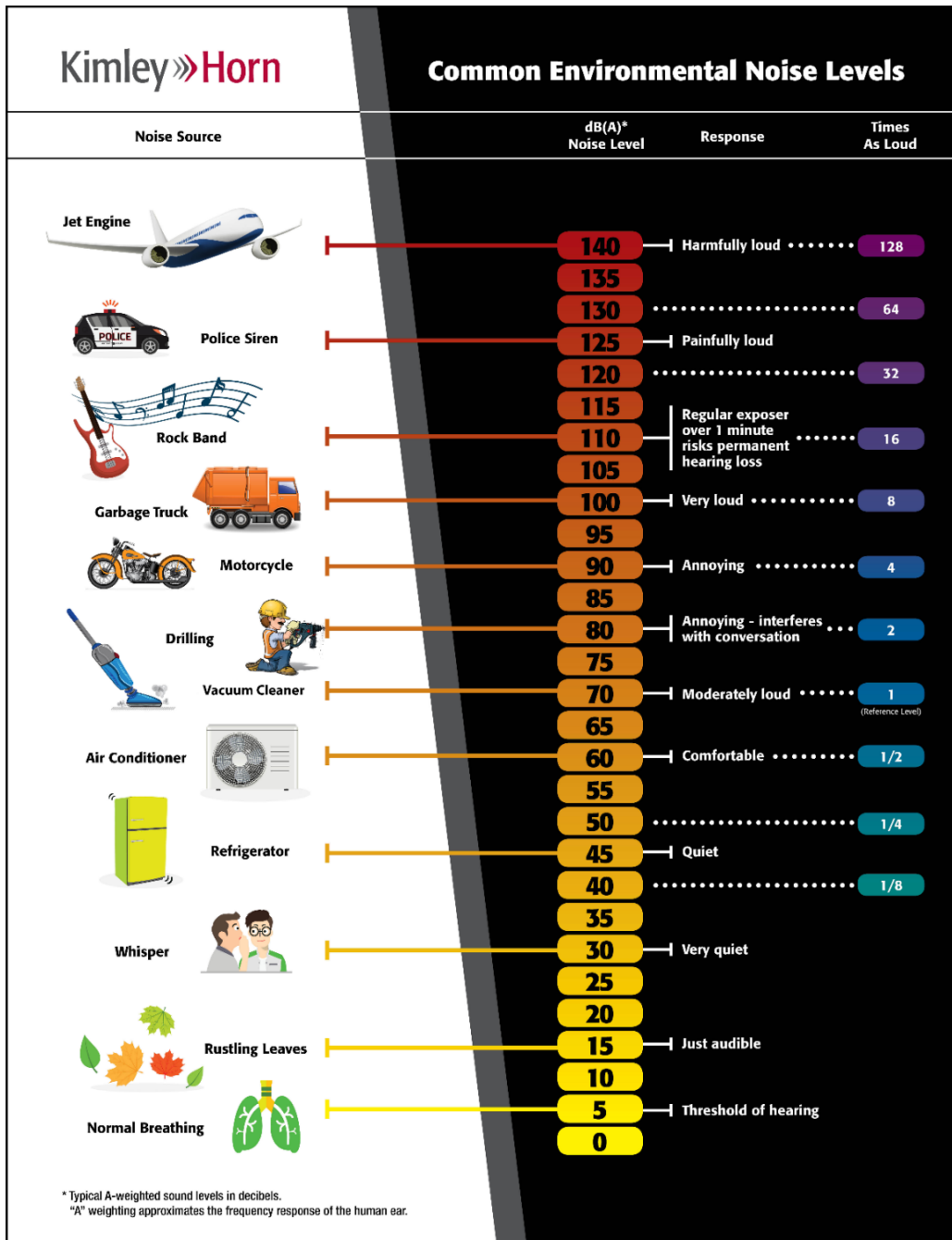
In considering the first of these factors, it is important to note that individuals have varying sensitivity to noise. Loud noises bother some people more than other people, and some individuals become increasingly upset if an unwanted noise persists. The time patterns and durations of noise(s) also affect perception as to whether or not it is offensive. For example, noises that occur during nighttime (sleeping) hours are typically considered to be more offensive than the same noises in the daytime.

With regard to the second factor, individuals tend to judge the annoyance of an unwanted noise in terms of its relationship to noise from other sources (background noise). A car horn blowing at night when background noise levels are low would generally be more objectionable than one blowing in the afternoon when background noise levels are typically higher. The response to noise stimulus is analogous to the response to turning on an interior light. During the daytime an illuminated bulb simply adds to the ambient light, but when eyes are conditioned to the dark of night, a suddenly illuminated bulb can be temporarily blinding.

The third factor – situational noise – is related to the interference of noise with activities of individuals. In a 60 dB(A) environment such as is commonly found in a large business office, normal conversation would be possible, while sleep might be difficult. Loud noises may easily interrupt activities that require a quiet setting for greater mental concentration or rest; however, the same loud noises may not interrupt activities requiring less mental focus or tranquility.

As shown in **Figure 2**, most individuals are exposed to fairly high noise levels from many sources on a regular basis. To perceive sounds of greatly varying pressure levels, human hearing has a non-linear sensitivity to sound pressure exposure. Doubling the sound pressure results in a three decibel change in the noise level; however, variations of three decibels [3 dB(A)] or less are commonly considered “barely perceptible” to normal human hearing. A five decibel [5 dB(A)] change is more readily noticeable. A ten-fold increase in the sound pressure level correlates to a 10 decibel [10 dB(A)] noise level increase; however, it is judged by most people as only sounding “twice as loud”.

Figure 2: Common Noise Levels



Over time, individuals tend to accept the noises that intrude into their lives on a regular basis. However, exposure to prolonged and/or extremely loud noise(s) can prevent use of exterior and interior spaces and has been theorized to pose health risks.

Ambient Noise Monitoring

At the time of this report, ambient noise monitoring has not been conducted. However, pre-construction and post-construction ambient noise monitoring will be conducted as a condition of approval to confirm baseline levels and to ensure that operational levels are compliant.

Noise Regulations

The proposed Heron BESS site is located in Gun Plain Charter Township, MI. According to Chapter 17, Section 17.36, Section II(7) of the Gun Plain Charter Township Zoning Ordinance, “The [energy storage] system may not generate a maximum sound in excess of 55 average hourly decibels as measured at the property line of an adjacent non-participating property.”

Noise Analysis

Operational sound levels from the proposed Heron BESS site were evaluated using SoundPLAN Essential, Version 5.1. This program computes predicted sound levels at noise-sensitive areas through a series of adjustments to reference sound levels. SoundPLAN also accounts for topography, groundcover type, and intervening structures. Topography within 1,000 feet of the site boundary was integrated into the model. Additionally, a ground factor of 1 (soft ground) was used for ground absorption outside of the project development area, which was assigned a ground factor of 0 (hard ground). Intervening structures were not present between the site and noise-sensitive receptors and were not considered in this model. It should be noted that sound propagation from the proposed on-site noise sources was modeled according to ISO 9613-2: 2024. Sound levels generated from inverters, battery storage cabinets, and the transformer at the substation are anticipated to be the main sources of sound from the proposed BESS site. Other potential sources of noise from the proposed BESS site include auxiliary switchboards and transformers, fire splice boxes, and fiber junction boxes but were not included in this analysis as the noise levels from this equipment are considered negligible when compared to the inverters, battery storage cabinets, and the transformer at the substation.

It should be noted that noise from surrounding roadways was not modeled in this analysis, although Allegan Street/M-43/M-89, 4th Street, Riverview Drive/Industrial Parkway, and other nearby roadways are anticipated to contribute to the ambient noise environment throughout the entire day. According to the Federal Railroad Administration (FRA) Rail Crossing Inventory, the GDLK railroad tracks located west of the project site are anticipated to have approximately two (2) train pass-by events during daytime hours and approximately one (1) train switching event daily. However, noise from train pass-by and switching events was not modeled in this analysis.

Inverters

Inverter equipment can generate steady, unvarying sound that may create issues when located near noise-sensitive areas. According to the current site layout, seventy-eight (78) inverters will be located on the site directly north or south of the battery cabinets. Based on noise emission information provided for the EPC Power M System Inverter, a reference sound pressure level of 75 dB(A) at 1 meter (i.e., 3 feet) for each inverter was used. Octave band data for the EPC Power M System inverter was not available for use; therefore, the sound pressure level was modeled at 500 hertz,

which is a typical center frequency used for noise sources without detailed octave band data. The sound from the simultaneous operation of the inverter equipment was calculated at the closest adjacent non-participating property boundary using SoundPLAN. See **Appendix A** for the manufacturer specification sheets for the EPC Power M System inverter.

Transformers

Transformers can also generate steady, unvarying sound that may create issues when located near noise-sensitive areas. It was assumed that one (1) 115-34.5 kV BIL (Basic Impulse Insulation Level) transformer would be located at the substation directly west of the BESS area. The proposed transformer has ONAN/ONAF/ONAF ratings of 135/184/230 MVA, respectively. Based on the National Electrical Manufacturers Association (NEMA) average sound level for the proposed transformer's ONAN/ONAF/ONAF ratings, a reference sound power level of 98 dB(A) was used, which is anticipated to be the highest potential emission level for the transformer. The sound from the operation of the transformer was calculated at the closest adjacent non-participating property boundary using SoundPLAN. See **Appendix A** for the NEMA specifications.

Sound generated by the transformer is not anticipated to significantly contribute to the existing environmental sound levels surrounding the site. Also, sound generated by the transformer is expected to be mitigated by providing sufficient offsets between the transformer and surrounding noise-sensitive land uses.

Battery Storage Cabinets

Battery storage cabinets can also generate steady, unvarying sound that may create issues when located near noise-sensitive areas. According to the current site layout, three hundred twelve (312) JF2 DC LINK 5.1 battery storage cabinets will be located on the site in the BESS area in the northeast portion of the site. Each battery storage cabinet consists of three (3) M-LINKs and one (1) E-Panel. Installed on each door of the M-LINK is a 7kW chiller and 2kW HVAC. One 2kW HVAC is also mounted to the door of the E-panel. Based on noise emission information provided for the LG JF2 DC Link 5.1 by the manufacturer, a reference sound power level of 79 dB(A) for each 7kW chiller was used, and a reference sound power level of 80 dB(A) for each 2kW HVAC was used. Octave band data was input into SoundPLAN to calculate the noise emission levels from the battery storage cabinets. The sound from the simultaneous operation of the battery storage cabinet chillers and HVAC units was calculated at the closest adjacent non-participating property boundary. It was assumed that the chillers and HVAC units are located facing the aisles between cabinets. See **Appendix A** for the manufacturer noise emissions documents for the LG JF2 DC Link 5.1 battery storage cabinet.

Noise-Sensitive Receivers

Noise-sensitive receivers were modeled at the project boundary lines, at adjacent non-participating property lines, and at residential structures surrounding the site. Each receiver point was modeled at approximately 5 feet above ground level to account for typical human ear height.

Results

The SoundPLAN-predicted maximum equivalent operational sound levels at the closest property line of an adjacent non-participating property are anticipated to be near or below approximately 57 dB(A) which slightly exceeds the established noise level limit of 55 dB(A). However, it is to be noted that the exceedance is occurring at the eastern property boundary adjacent to vacant land. Impacts to existing noise-sensitive uses are not anticipated at this time. Mitigation is recommended if a noise-sensitive use is constructed in the future on the adjacent property to the east. Additionally, the SoundPLAN-predicted maximum equivalent operational sound levels at the nearest residential structure are anticipated to be near or below approximately 44 dB(A). The anticipated operational noise levels are shown in **Figure 3**, and the anticipated operational noise contours are shown in **Figure 4**.

Figure 3: Anticipated Operational Noise Levels

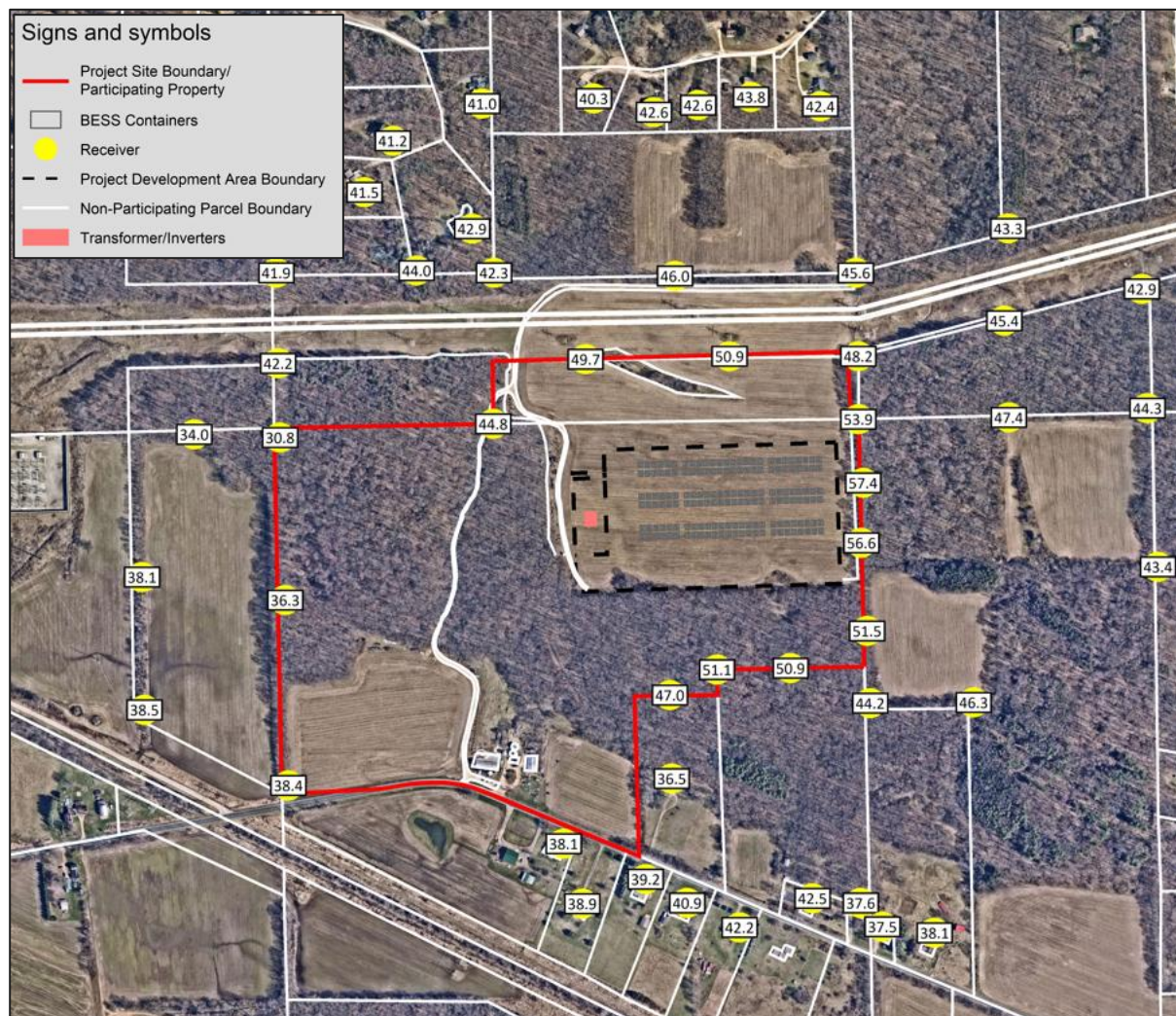
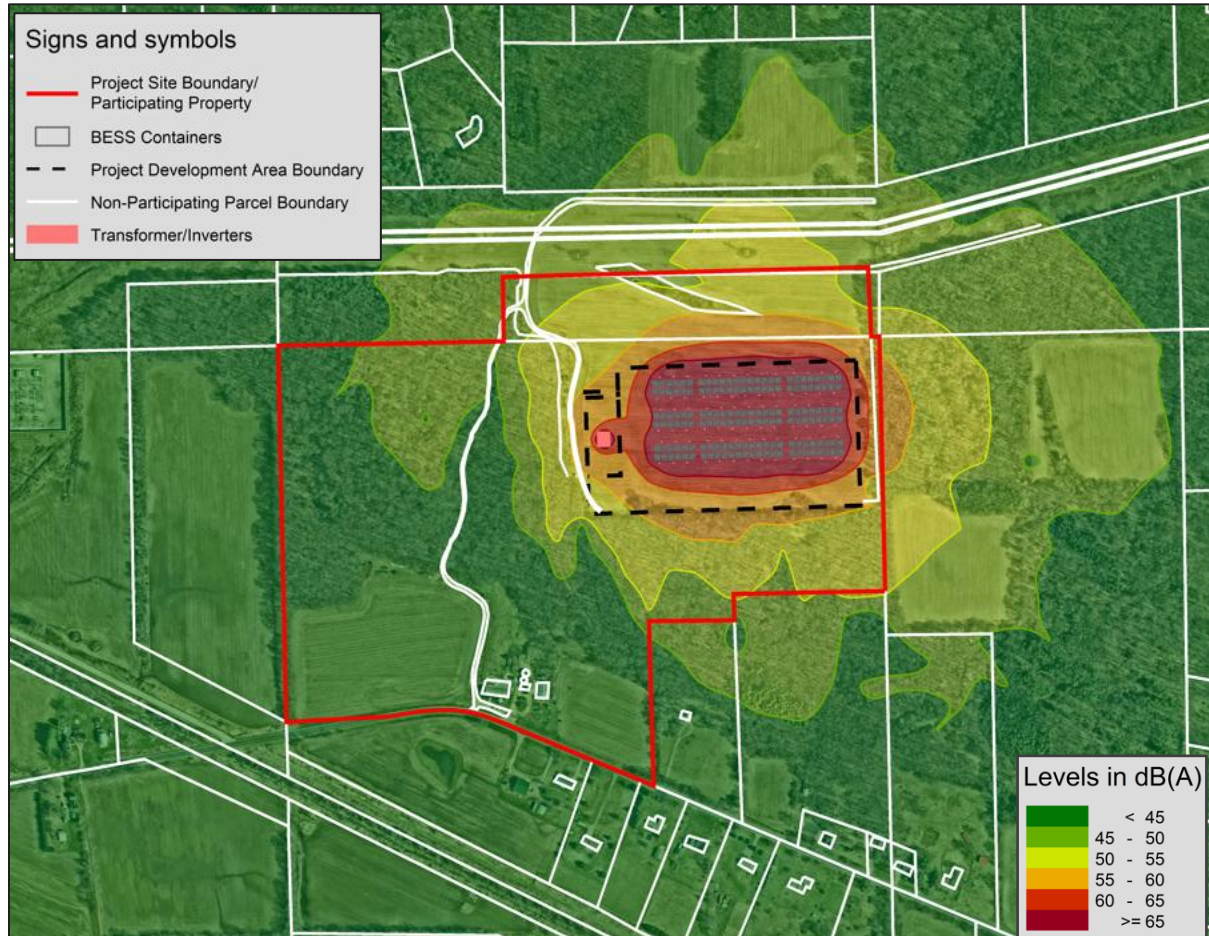


Figure 4: Anticipated Operational Noise Contours



Noise Abatement Measures

Passive noise abatement measures are effective because they absorb sound energy, extend the source-to-receptor sound transmission path, or both. Sound absorption is a function of abatement medium (e.g. earth berms absorb more sound energy than noise walls of the same height because earth berms are more massive). The source-to-receptor path is extended by placement of an obstacle, such as an earth berm or concrete wall, that sufficiently blocks the transmission of sound waves that travel from the source to the receptor.

Sound barriers are primarily constructed as earth berms or solid-mass walls adjacent to sources of noise that are in proximity to noise-sensitive land use(s). To be effective, a sound barrier must be long enough and tall enough to shield potentially impacted areas. Generally, the noise barrier length must be eight times the distance from the barrier to the receptor. For example, if a receptor is 200 feet from the noise source, an effective barrier would be approximately 1,600 feet long – with the noise-sensitive land use in the horizontal center.

Since on-site operational noise levels are predicted to exceed the allowable sound level established in the Gun Plain Charter Township Zoning Ordinance in the eastern portion of the Heron BESS site, noise abatement was analyzed to reduce noise levels from the anticipated operations to be near or below 55 dB(A).

A sound wall, along the eastern edge of the project boundary near the proposed BESS area in the northeast portion of the site, was determined to reduce the anticipated on-site operational noise by up to approximately 2 dB(A) at the project property boundary, which is anticipated to reduce on-site operational noise levels to be near or below the established sound level limit of 55 dB(A). It is to be noted that SoundPLAN takes into account noise shadowing effects from barriers. Based on the SoundPLAN predicted noise contours, the shadowing effect from the proposed barrier is not anticipated to cause negative impacts to the property located east of the project. Additionally, a reflection loss of 1 dB(A) was used for the noise barrier in SoundPLAN. A reflection loss of 1 dB(A) corresponds to a wall type that is an acoustically hard surface (i.e. concrete, glass). This equates to a Sound Transmission Class (STC) of at least 40. The proposed wall would be 10 feet in height and approximately 600 feet in length. The anticipated operational noise levels at surrounding property lines with a wall are shown in **Figure 5**, and the anticipated operational noise contours with a wall are shown in **Figure 6**.

Figure 5: Anticipated Operational Noise Levels with Wall

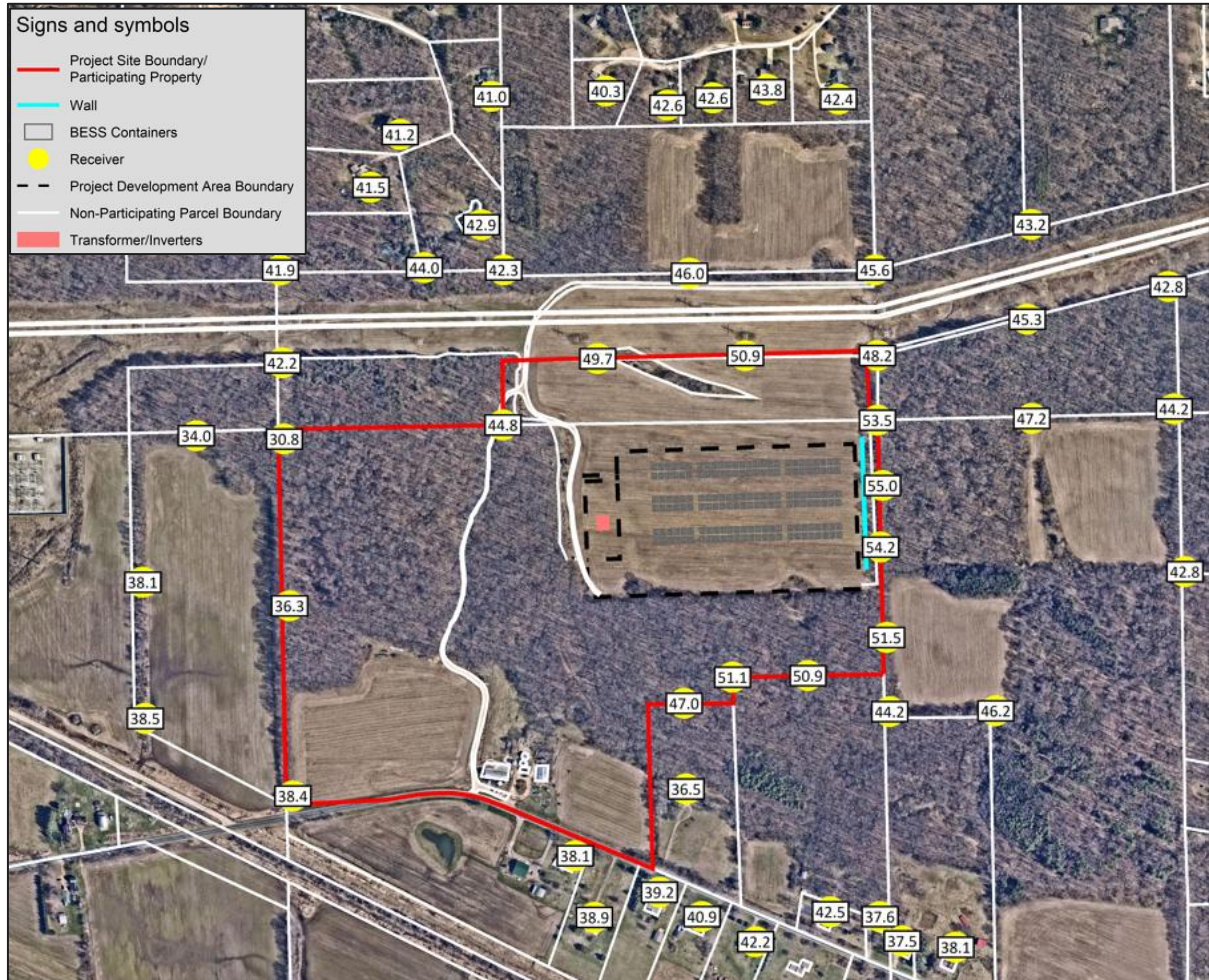
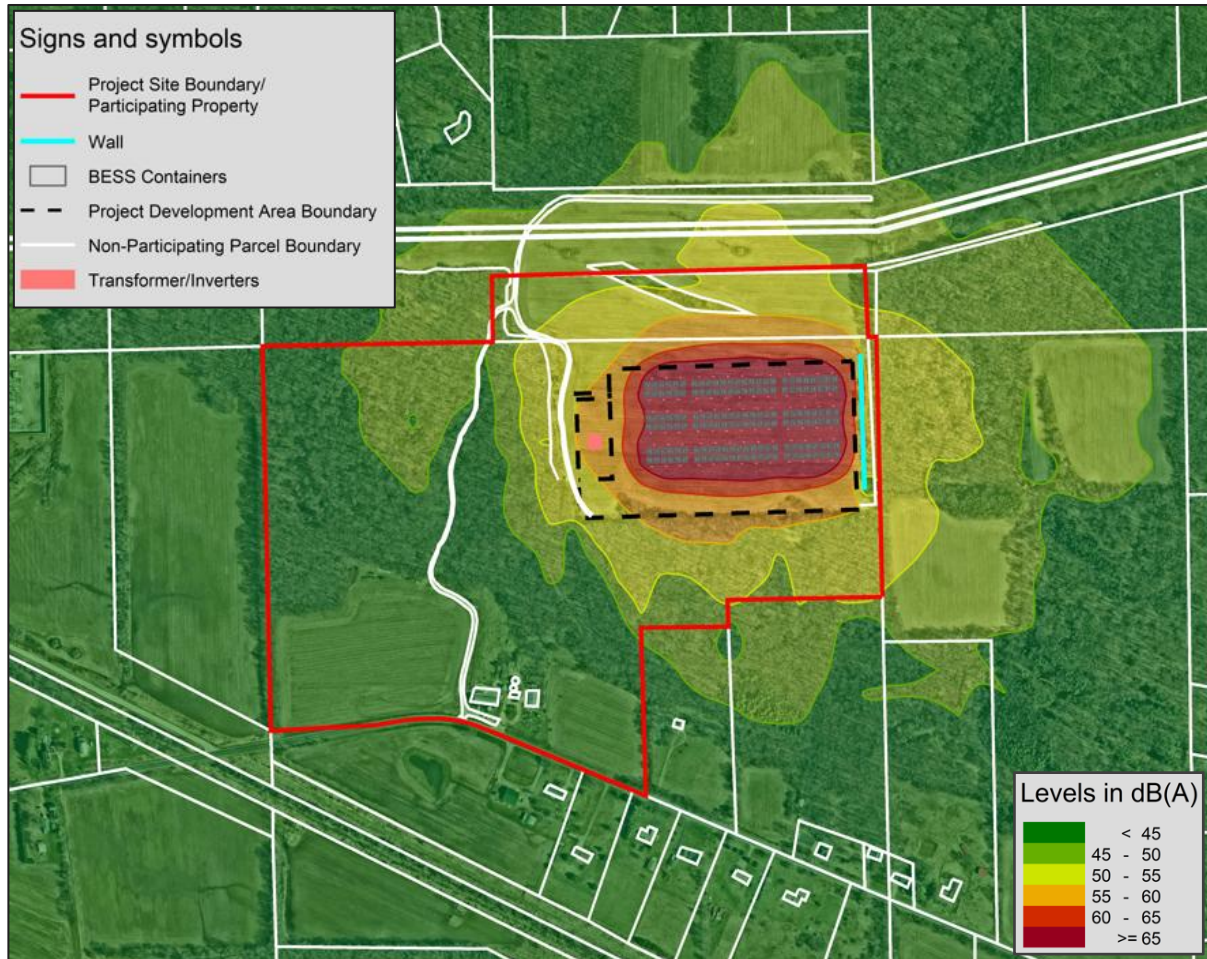


Figure 6: Anticipated Operational Noise Contours with Wall



Conclusions

After modeling and analyzing the anticipated worst-case operational scenarios from the proposed Heron BESS site, it was determined that on-site operational noise levels are anticipated to slightly exceed the noise level limit established in the Gun Plain Charter Township Zoning Ordinance at the eastern property boundary, which is adjacent to vacant land. However, impacts to existing noise-sensitive uses are not anticipated at this time. Mitigation is recommended if a noise-sensitive use is constructed in the future on the adjacent property to the east.