APPENDIX K

PROJECT NOISE EVALUTION

33 Moulton Street
Cambridge MA 02138
617 499 8000
acentech.com

April 15, 2021

Lynn Gresock
Haley & Aldrich, Inc.
3 Bedford Farms Drive | Suite 301
Bedford, New Hampshire 03110
Email: LGresock@haleyaldrich.com

Subject **Kingwood Solar Project Noise Evaluation**
Cedarville, Miami, and Xenia Townships, Greene County, Ohio
Acentech Project No. 633571

Dear Lynn:

Under contract to Haley & Aldrich, we have conducted a noise evaluation for Kingwood Solar (The Project), a new solar farm to be located in Cedarville, Miami, and Xenia Townships, Greene County, Ohio. To determine the impact of the solar farm, we developed an acoustic model to calculate the expected operational sound levels of each of the noise producing equipment at nearby community receivers. The equipment includes transformers, inverters, and solar panel tracker motors. We have also provided a narrative discussion on construction noise.

PROJECT NOISE GUIDELINES

OPSB

No noise rules or regulations exist at the state level in Ohio, but the project falls under the purview of the Ohio Power Siting Board (OPSB). The OPSB does not have any established noise criteria but rather uses the information in the application (background sound levels, affected areas, construction/operational noise impact, etc.) to evaluate the significance of the project impact.

Based on relevant project precedent elsewhere in Ohio, we have presented noise goals based on limiting the increase in sound levels to 5 dB over the ambient, where ambient overall A-weighted sound levels are defined by the average L_{eq}.

Other Local Ordinances

The Project area encompasses multiple local jurisdictions. A small portion of the western half of the Project area is in Xenia Township, which is the only local jurisdiction with a quantitative noise ordinance. Xenia Township's Zoning Ordinance defines residential limits of 65 dBA during daytime (7 am to 10 pm) and 55 dBA during nighttime (10 pm to 7 am).

The OPSB rules will supersede all local regulations, so the Xenia Township ordinance does not apply. More importantly, based on ambient conditions measured in the area, the design goal for this project is more conservative than the Xenia Township ordinance, as shown in the next section.

BACKGROUND NOISE SURVEY

With the help of a local representative of Haley & Aldrich, Acentech performed unattended noise measurements from January 21 to January 29, 2021 using Type 1 sound level meters (SLMs). The three locations of our SLMs are shown in Figure 1 below. We obtained data in 1-hr intervals, including L_{eq} and other statistical metrics (e.g., L_{01}, L_{10}, L_{90}).

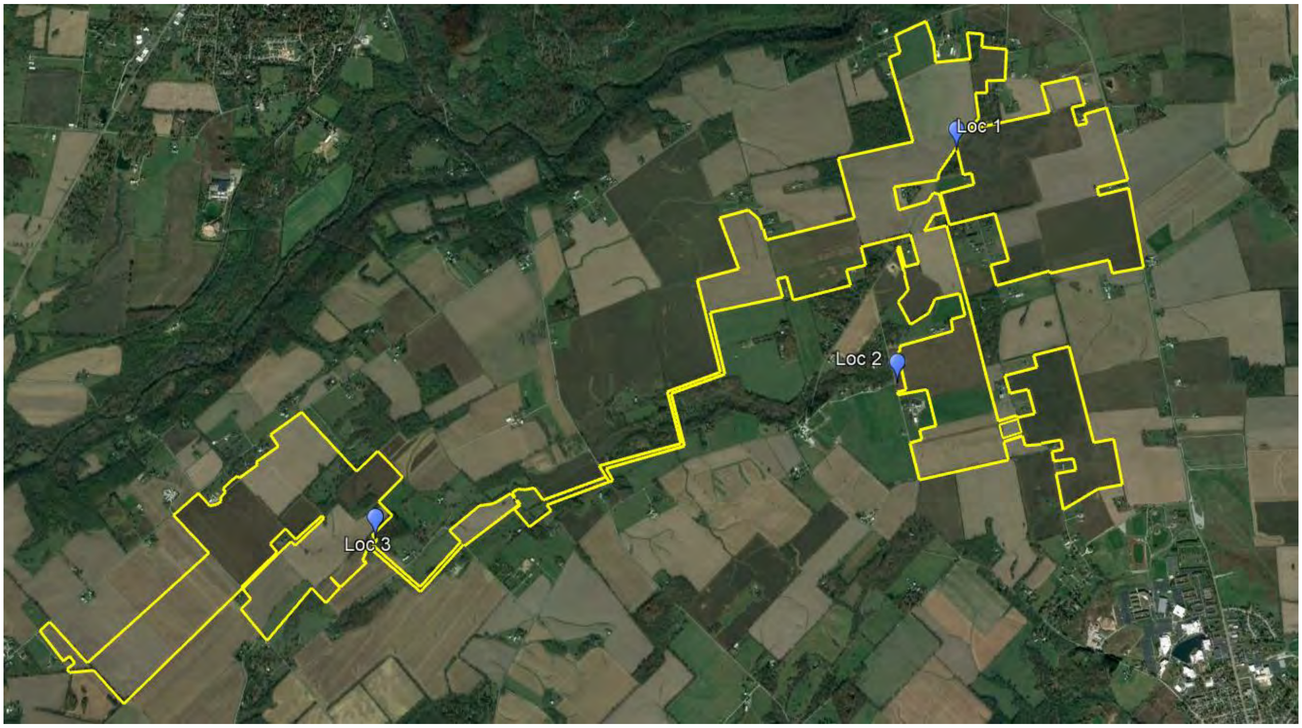


Figure 1: Measurement locations

Figures 2-4 show the equivalent A-weighted sound level, $L_{Aeq,\,1\text{-hr}}$. The $L_{Aeq,\,1\text{-hr}}$ includes both steady background sounds (e.g., distant traffic) plus short-term intrusive sounds (e.g., local car passby). In quiet rural areas, a short-term loud sound can dominate the $L_{Aeq,\,1\text{-hr}}$. This was most apparent at Location 3, which was near a private residential gun range; we have excluded these outliers from our average L_{Aeq}. Table 1 below summarizes the average L_{Aeq} at each location based on time of day.

Table 1: Summary of measured ambient sound levels

Location	Average L_{Aeq} (dBA)	
	Daytime (7 am – 10 pm)	Nighttime (10 pm – 7 am)
1	51	46
2	49	42
3	42	37

Noise Goals

The *Project-only* sound levels that correspond with a 5 dB increase above ambient at each monitoring location are summarized below in Table 2.

Table 2: Project-Only Sound Levels corresponding with a 5 dB increase over ambient

Location	Project-Only Sound Level Guideline (dBA)	
	Daytime (7 am – 10 pm)	Nighttime (10 pm – 7 am)
1	55	50
2	53	46
3	46	41

OPERATIONAL NOISE EVALUATION

Acentech developed an acoustic model of the proposed solar farm and surrounding neighborhood. The acoustic model was developed using Cadna/A software to estimate the contributions of various noise sources to the community sound levels. Cadna/A complies with international standard ISO 9613-2 "Attenuation of sound during propagation outdoors -- Part 2: General method of calculation."

The noise producing equipment at the proposed solar farm includes inverters (52), distribution transformers (52), a substation transformer (1), and tracker motors (127). The current site plan used in this modeling is enclosed. Table 3 provides the input sound power level (L_w) we have assumed for the equipment. This sound data is based on representative equipment selections, as currently the Project has not made final equipment selections.

Table 3: Equipment Octave Band Sound Power Level

Equipment	Octave Band Center Frequency (Hz)									Overall Sound Power (dBA)
	31.5	63	125	250	500	1,000	2,000	4,000	8,000	
	Sound Power Level (dB re 1 pico-watt)									
Distribution Transformer	68	61	70	72	64	56	43	34	29	66
Inverter Bank	86	85	87	86	90	81	80	88	81	92
Substation Transformer	126	119	111	99	93	84	78	73	68	99
Tracker Motor	79	66	60	57	55	52	47	43	41	57

Nighttime Operation

For nighttime operation, we understand that normally the inverters and tracker motors will be inactive, but the transformers will likely be energized and producing noise. This Project is unique in that the Project maintains the ability to activate inverters at night to interject power into the grid upon request. We understand that under project agreements, during the night the project will be limited to 60% of its daytime power capacity. This request can be met either through each individual inverter operating at 60% of its capacity, or alternatively by only 60% of all inverters operating at full capacity.

At this time we do not have sound data to characterize equipment sound levels at 60% capacity, so we have conservatively assumed the nighttime sound characteristics of the inverters is unchanged from the daytime performance.

RESULTS

We calculated noise levels at 50 existing non-participating residences (NP1 through NP50) in the surrounding neighborhood within 250 ft of the Project, shown in Figure 5. Calculated noise levels at non-participating residences further than 250 ft from the project are shown in the sound contours, described below. We calculated the sound level at these locations with receiver heights of 1.5 meters. We compared modeled noise levels to the noise guidance summarized above.

Sound Levels at Non-Participating Residences

Table 4, enclosed, presents the calculated daytime sound levels for the Project only, the combined future sound level (Project plus ambient), and the predicted increase over ambient at the 50 non-participating residences. Table 5, enclosed, presents the calculated nighttime sound levels in the same format.

We have predicted that Project sound sources will not increase daytime sound levels at non-participating residences within 250 ft by more than 2 dB above ambient.

We did predict a 4 dB increase over ambient sound levels for nighttime operation at NP5 and NP6, two receivers in the west of the project area. These increases are being controlled by nighttime operation of inverters near non-participating residences. We understand that this is an atypical operation status for the inverters, and that it does not take into account possible reductions in sound levels when the solar farm is only providing 60% of its power capacity.

Sound Contours

Figure 6 shows Project-only daytime sound contours for the rest of the Project area, calculated at a height of 1.5 meters, from 25 dBA to 50 dBA in 5-dB increments. Figure 7 shows Project-only nighttime sound contours.

Locations beyond the 25 dBA contour are not anticipated to have significant Project noise impacts.

CONSTRUCTION NOISE EVALUATION

Our evaluation of construction noise emissions to the surrounding community is based on documentation provided by Haley & Aldrich describing the construction phases for a similar solar farm project. We understand that construction is expected to take place over a period of 16 months. The phases described below may take place concurrently at different areas throughout the Project site, and thus will affect different residential receivers at different times.

- Phase 1: Grading and other site preparation
- Phase 2: Installation of array foundations (assumed by pile driving)
- Phase 3: Solar panel assembly
- Phase 4: Inverter pad and substation construction
- Phase 5: Array commissioning, waste removal, site clean-up

We based our analysis on our own understanding of typical equipment associated with these activities. Expected equipment includes graders, backhoes, pile drivers, dump trucks, cranes and various delivery trucks. We have identified sound levels associated with this equipment based on EPA guidance[1] and other relevant references, including Ohio solar farm OPSB submittals. Table 6 below presents the typical equipment and sound levels used in our assessment for each phase. All values are sound pressure levels at 50 ft. For our analysis, we have assumed that near any given non-participating receiver, only one (1) of each piece of equipment listed will be operating simultaneously at that particular location.

Table 6: Equipment sound levels

Phase	Equipment Maximum Sound Pressure Level at 50 ft (dBA)	Combined Maximum Sound Pressure Level of Expected Equipment at 50 ft (dBA)
1	Grader (85 dBA), Backhoe (83 dBA), Dump Truck (85 dBA)	89
2	Pile Driver (100 dBA), Backhoe (83 dBA), Dump Truck (85 dBA)	100
3	Backhoe (83 dBA), Crane (83 dBA), Dump Truck (85 dBA)	89
4	Concrete Truck (85 dBA), Backhoe (83 dBA), Crane (83 dBA)	89
5	Garbage Truck (85 dBA), Dump Truck (85 dBA), Backhoe (83 dBA)	85

[1] Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, EPA (1971).

We also note that not all phases and their respective activities will be carried out at the same distances from receivers. Grading, for instance, will be performed throughout selected areas of the entire Project site, including at property boundaries as close as 30 ft from non-participating residences. Grading is expected to be minimal. In contrast, the closest inverter pad to a non-participating residence is 275 ft and the closest solar panel is approximately 165 ft from a non-participating residence. These varying distances are reflected in Table 7, which shows predicted noise levels for each phase at four distances.

For a number of reasons, the predicted sound levels in Table 7 are conservative, representing a "worst case scenario" for noise emission. First, the relatively high emission of the grading phase is due to the proximity of this activity to the property line. In practice, the noise levels will only be this high at receivers very close to the property line and only for a period of a few hours or less. For example, Phase 2 activities include pile driving, which control the combined maximum sound pressure level reported below, but pile driving will not occur for 100% of the time during Phase 2. All of our sound level predictions are also conservative in that they do not take into account ground absorption, atmospheric attenuation, or natural barriers. Furthermore, the combined sound levels assume that multiple pieces of equipment associated with a particular phase will be operating at the same time and in close proximity.

Table 7: Construction Estimated Sound Levels by Phase

Phase	Combined Maximum Sound Pressure Level of Expected Equipment at 50 ft (dBA)	Predicted Maximum Sound Level (dBA)			
		Receiver at 30 ft	Receiver at 165 ft	Receiver at 275 ft	Receiver at 1500 ft
1	89	94	79	74	59
2	100	-	90	85	71
3	89	-	79	74	59
4	89	-	-	74	59
5	85	-	75	70	55

* * * * *

Please contact me at 617-499-8027 or aodom@acentech.com with any questions or comments.

Sincerely,

ACENTECH INCORPORATED

Alex Odom
Consultant

Josh Brophy
Consultant

Cc: Michael Bahtiarian (Acentech)
Jacqueline Bruce (Haley & Aldrich)

Encl: Figures 2-7
Tables 4-5
Appendix A: Site Plan

FIGURE 2: Sound Levels Measured at Location 1

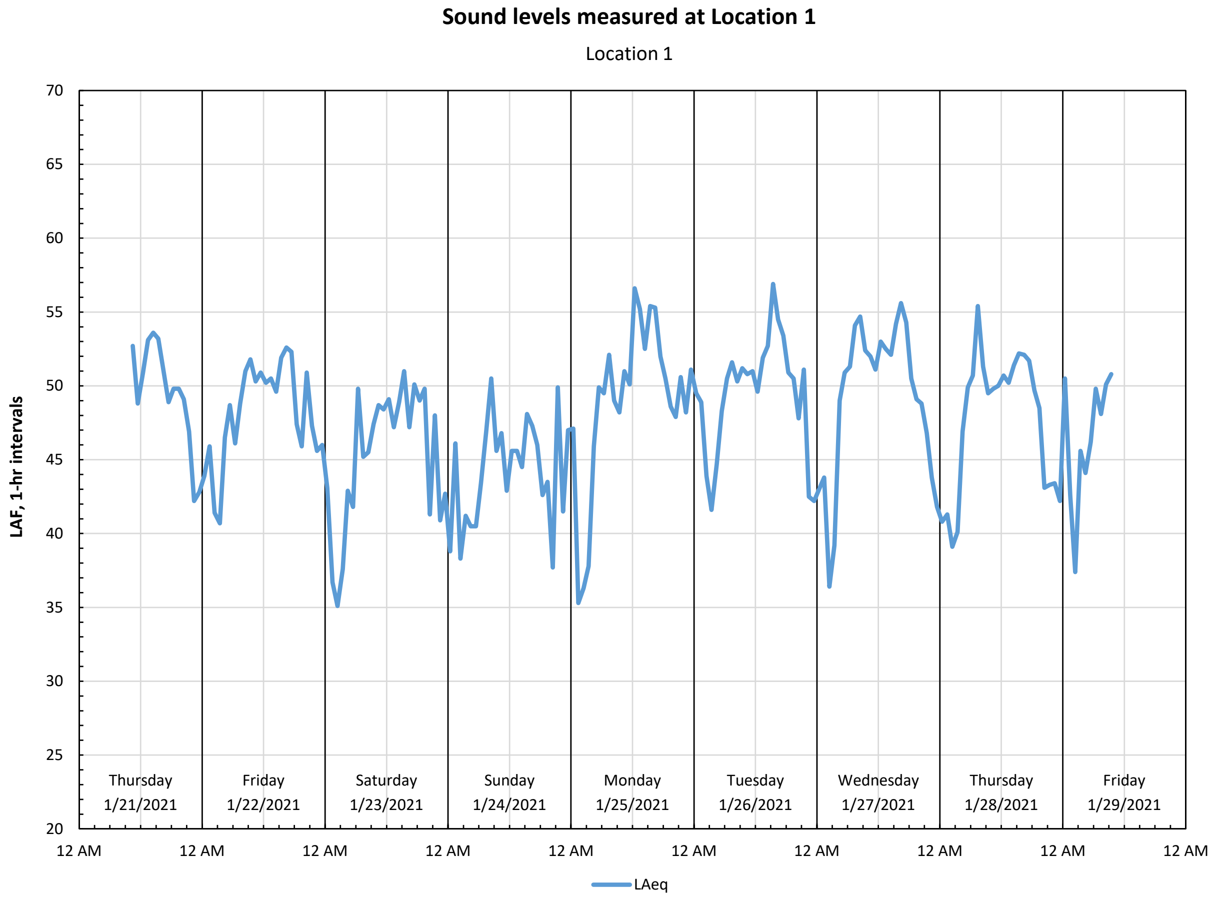


FIGURE 3: Sound Levels Measured at Location 2

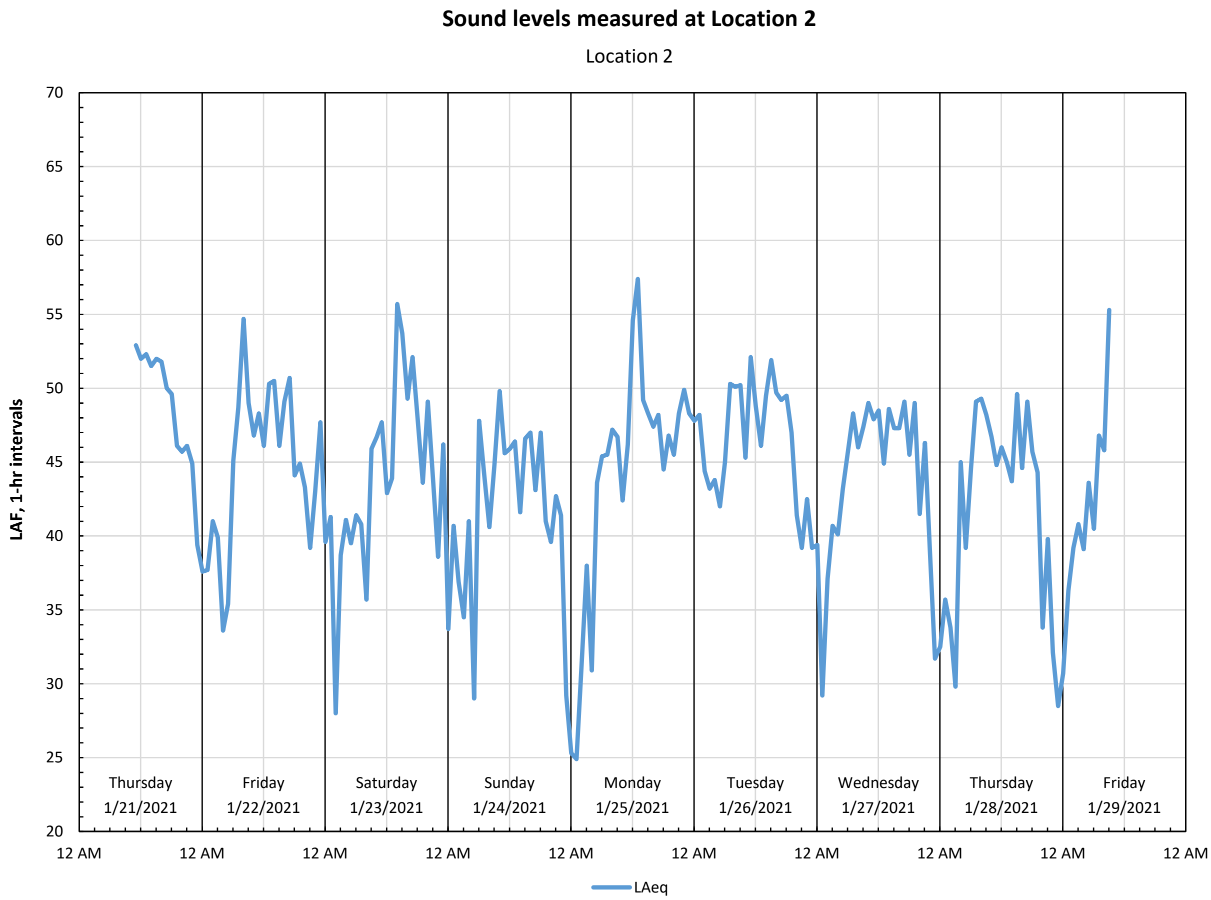


FIGURE 4: Sound Levels Measured at Location 3

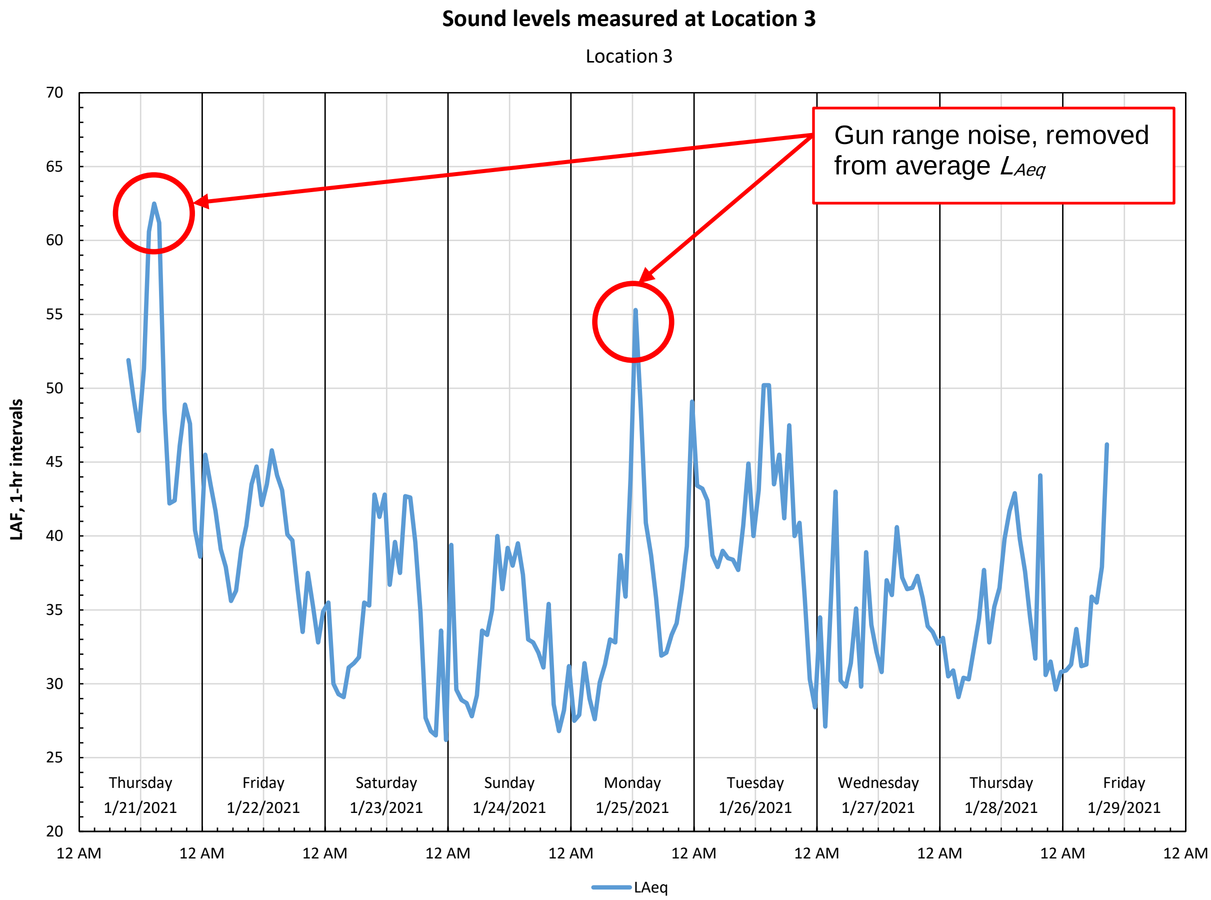


FIGURE 5: Non-participating Residences (NP1 - NP50)

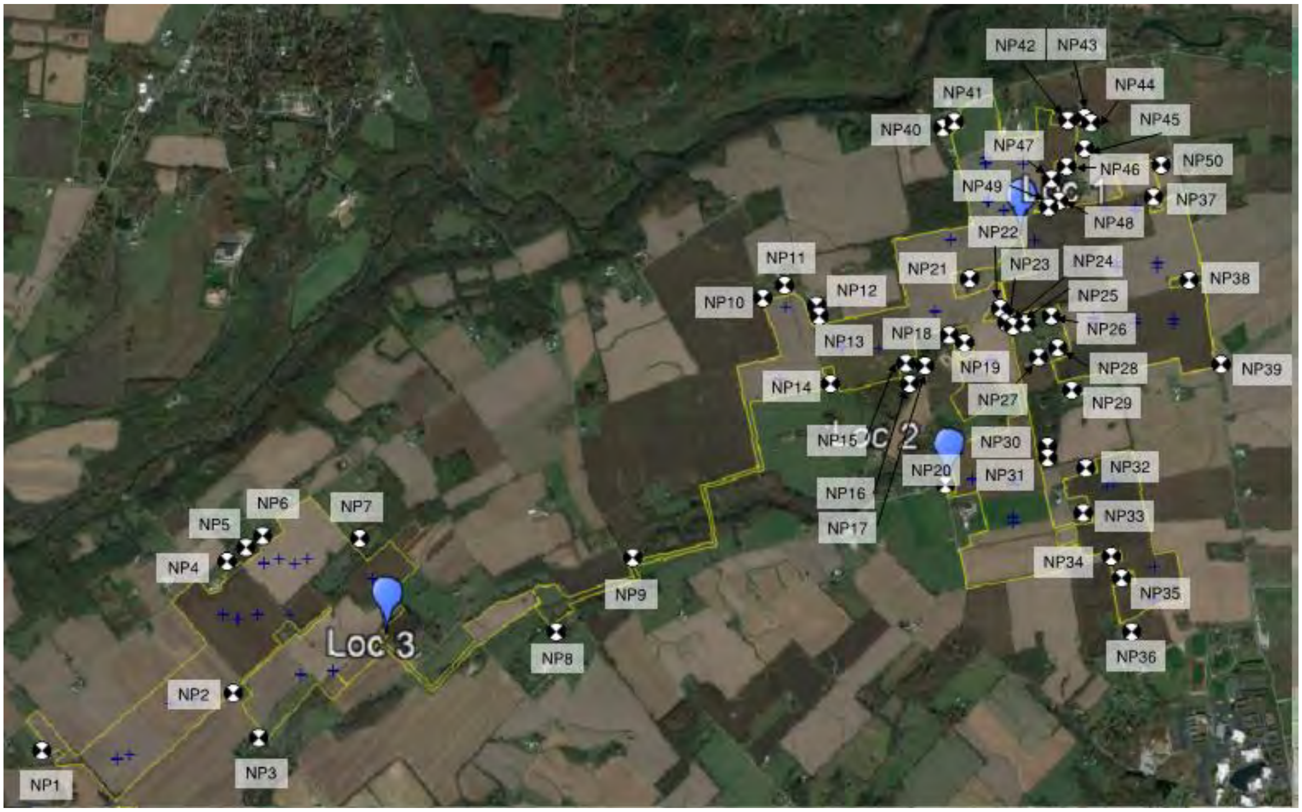


Table 4: Modeling Results - Daytime

Receiver	Ambient (dBA)	Project Only Sound Level (dBA)	Combined Sound Level (dBA)	Increase over Ambient (dB)
NP1	42	28	42	-
NP2	42	36	43	1
NP3	42	32	42	-
NP4	42	37	43	1
NP5	42	39	44	2
NP6	42	39	44	2
NP7	42	35	43	1
NP8	42	19	42	-
NP9	42	15	42	-
NP10	51	36	51	-
NP11	51	37	51	-
NP12	51	36	51	-
NP13	51	36	51	-
NP14	51	37	51	-
NP15	51	38	51	-
NP16	51	35	51	-
NP17	51	35	51	-
NP18	51	39	51	-
NP19	51	38	51	-
NP20	49	37	49	-
NP21	51	39	51	-
NP22	51	38	51	-
NP23	51	38	51	-
NP24	51	38	51	-
NP25	51	38	51	-
NP26	51	40	51	-
NP27	51	37	51	-
NP28	51	38	51	-
NP29	49	35	49	-
NP30	49	36	49	-
NP31	49	37	49	-
NP32	49	39	49	-
NP33	49	37	49	-
NP34	49	35	49	-
NP35	49	36	49	-
NP36	49	32	49	-
NP37	51	42	52	1
NP38	51	40	51	-
NP39	51	34	51	-
NP40	51	35	51	-
NP41	51	36	51	-
NP42	51	36	51	-
NP43	51	35	51	-
NP44	51	35	51	-
NP45	51	37	51	-
NP46	51	39	51	-
NP47	51	41	51	-
NP48	51	42	52	1
NP49	51	43	52	1
NP50	51	36	51	-

Table 5: Modeling Results - Nighttime

Receiver	Ambient (dBA)	Project Only Sound Level (dBA)	Combined Sound Level (dBA)	Increase over Ambient (dB)
NP1	37	28	38	1
NP2	37	36	40	3
NP3	37	32	38	1
NP4	37	37	40	3
NP5	37	39	41	4
NP6	37	39	41	4
NP7	37	35	39	2
NP8	37	19	37	-
NP9	37	15	37	-
NP10	46	36	46	-
NP11	46	37	47	1
NP12	46	36	46	-
NP13	46	36	46	-
NP14	46	37	47	1
NP15	46	38	47	1
NP16	46	35	46	-
NP17	46	35	46	-
NP18	46	39	47	1
NP19	46	38	47	1
NP20	42	37	43	1
NP21	46	39	47	1
NP22	46	38	47	1
NP23	46	38	47	1
NP24	46	38	47	1
NP25	46	38	47	1
NP26	46	40	47	1
NP27	46	37	47	1
NP28	46	38	47	1
NP29	42	35	43	1
NP30	42	36	43	1
NP31	42	37	43	1
NP32	42	39	44	2
NP33	42	37	43	1
NP34	42	35	43	1
NP35	42	36	43	1
NP36	42	32	42	-
NP37	46	42	47	1
NP38	46	40	47	1
NP39	46	34	46	-
NP40	46	35	46	-
NP41	46	36	46	-
NP42	46	36	46	-
NP43	46	35	46	-
NP44	46	35	46	-
NP45	46	37	47	1
NP46	46	39	47	1
NP47	46	41	47	1
NP48	46	42	47	1
NP49	46	43	48	2
NP50	46	36	46	-

FIGURE 6: Project-Only Daytime Sound Contours (dBA)

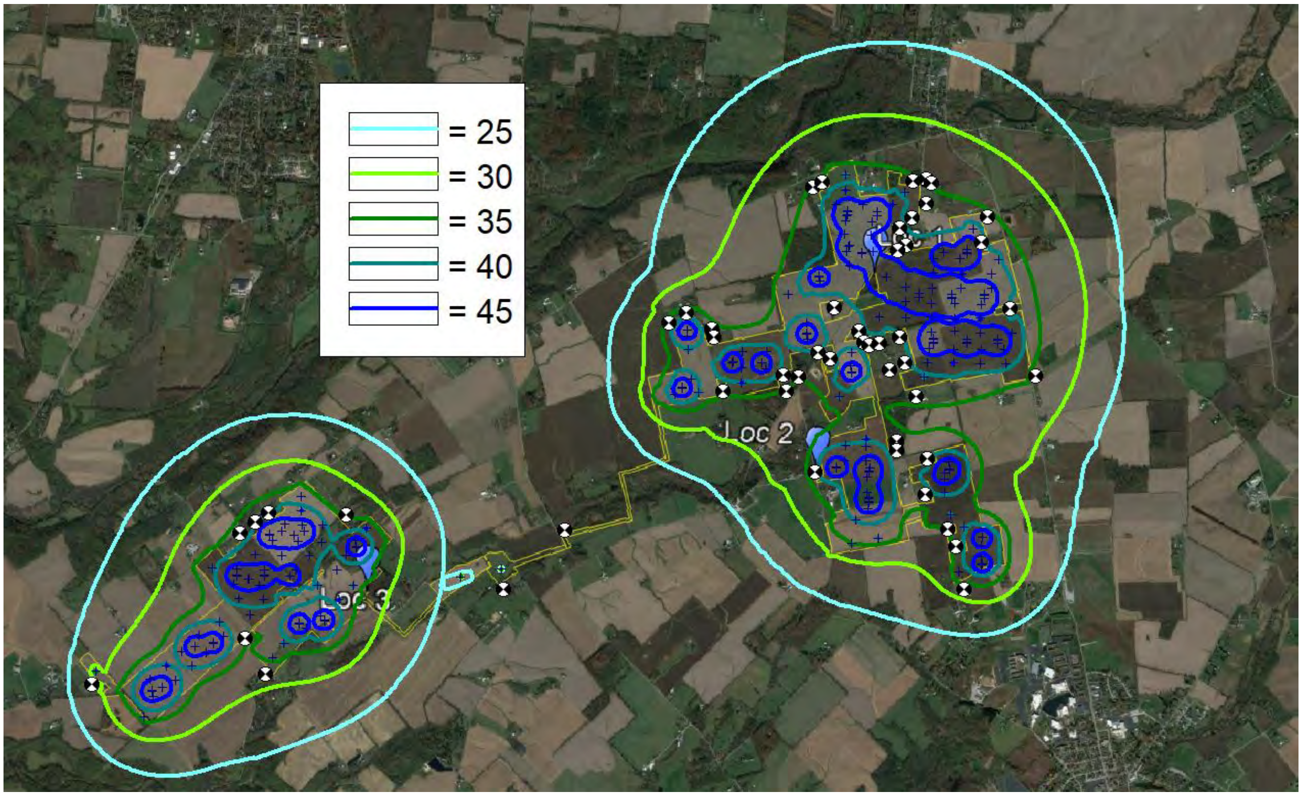
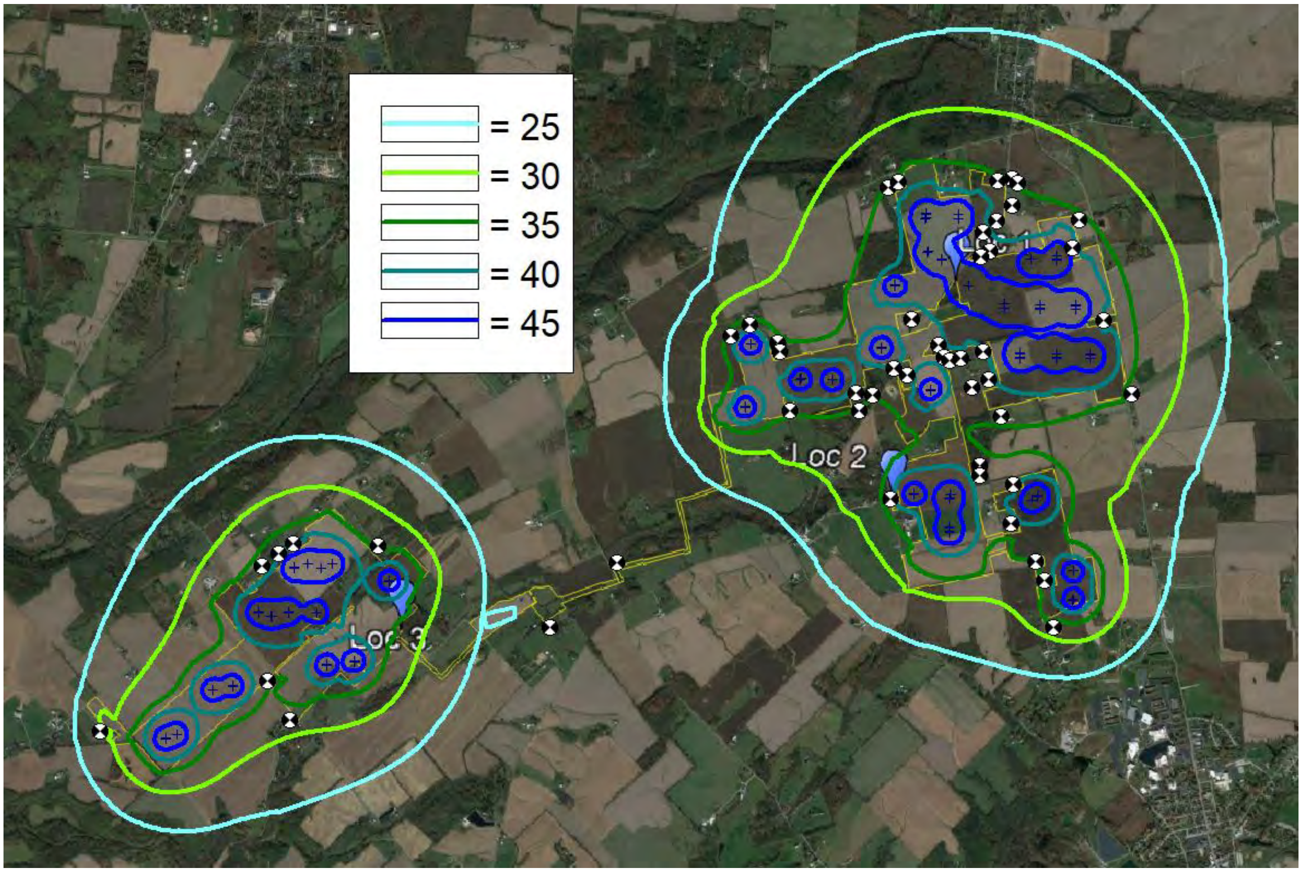
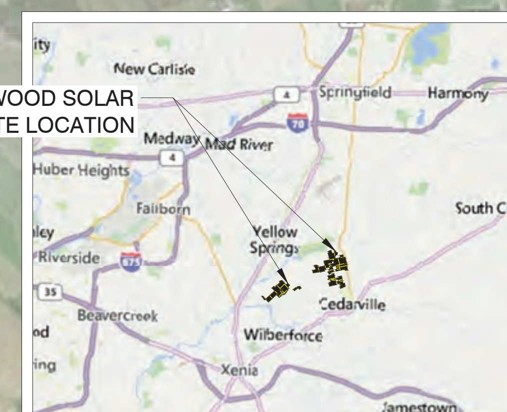


FIGURE 7: Project-Only Nighttime Sound Contours (dBA)



Appendix A – Site Plan

1 SITE PLAN
PV-100 Scale: 1"=1000'



0 SITE LOCATION MAP
PV-100 Scale: NTS

REV	DESCRIPTION	BY	CHK	DATE
0	PRELIMINARY PERMIT LAYOUT	LR	SS	03/25/2021

SHEET TITLE: SITE PLAN

SHEET NO.: PV-100

VE KINGWOOD SOLAR

COUNTY RD 94, CEDERVILLE, OH 45314 LAT: 39.781971° / LON: -83.829896°
PROJECT DETAILS

VESPER ENERGY

SOLVIDA DESIGN • ENGINEERING
1400 Shattuck Avenue, Suite 3
Berkeley, California 94709

DATE:	03/25/2021	DFTR:	LAKIR RAMBHIA
SCALE:	AS SHOWN	CHKD:	STEPHEN SMITH
PAPER SIZE:	24" X 36"	ENGR:	ENGR