HECATE ENERGY COLUMBIA COUNTY 1 LLC

SHEPHERD'S RUN SOLAR PROJECT

Matter No. 24-00103

§ 900-2.8 Exhibit 7

Noise and Vibration

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Acronym List

ANSI	American National Standards Institute
ASA	Acoustical Society of America
ATV	all-terrain vehicle
CCM	Certified Consulting Meteorologist
DOT	Department of Transportation
FHWA	Federal Highway Administration
GIS	geographical information system
HDD	horizontal directional drilling
HFNS	high-frequency natural sound
INCE	Institute of Noise Control Engineering
ISO	International Standards Organization
MVA	mega volt-amp
NED	National Elevation Dataset
NYCRR	New York Codes, Rules, and Regulations
NYS	New York State
NYSEG	New York State Electric and Gas
ORES	New York State Office of Renewable Energy Siting
OSHA	Occupational Safety and Health Administration
RCNM	Roadway Construction Noise Model
ROW	right of way
SAE	Standard Automotive Engineering
WHO	World Health Organization

Glossary of Terms

Applicant — Refers to Hecate Energy Columbia County 1 LLC, the entity seeking a siting permit for the Project from the Office of Renewable Energy Siting (ORES) under Article VIII of the New York State Public Service Law.[1]

Point of Interconnection — Refers to the Craryville 115 kilovolt (kV) substation owned by New York State Electric and Gas (NYSEG) on the Craryville-Klinekill and Churchtown-Craryville 115 kV transmission lines.

Project — Refers to the proposed Shepherd's Run Solar Project, a utility scale solar project that will be comprised of solar arrays, inverters, access driveways, electrical collection lines, collection substation, construction staging areas, fencing and plantings, located on private land in the Town of Copake, Columbia County, New York.

Project Area — Refers to those privately-owned parcels under option to lease, purchase, easement or other real property interests with the Applicant in which all Project components will be sited.

Project Footprint or Limit of Disturbance — Refers to the limit of temporary and permanent disturbance caused by the construction and operation of all components of the Project. This includes all areas to be used for project components, maintained areas and areas outside of the Project fence to be used as landscaping.

Study Area — Refers to the area evaluated for specific resource identification and/or resource impact assessment. The size of this area is appropriate for the target resource and takes into account the project setting, the significance of resource or impact being identified or evaluated, and the specific survey distances included in Title 19 of NYCRR Part 900. As appropriate, the Study Area for each type of survey or resource impact assessment is provided in the respective sections within the Application.

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[1] Any references to Executive Law Section 94-c in this Application refer to former New York State Executive Law Section 94-c, now New York State Public Service Law Article VIII.

Exhibit 7: Noise and Vibration

This Exhibit will track the requirements specified in 19 New York Codes, Rules and Regulations (NYCRR) § 900-2.8.

7(a) Name of Preparer

This Exhibit includes a detailed analysis of the potential sound impacts associated with the construction and operation of the Project. Exhibit 7 was prepared by Mr. Robert O'Neal of Epsilon Associates, Inc. (Epsilon). Mr. O'Neal has over thirty years of experience in the areas of community noise impacts, meteorological data collection, and analyses. He is Board Certified by the Institute of Noise Control Engineering (INCE) in Noise Control Engineering and is a Certified Consulting Meteorologist (CCM) by the American Meteorological Society. The modeling performed by Epsilon for the Project is sufficiently conservative in predicting sound impacts and includes all proposed inverters plus ancillary equipment and the substation operating at their maximum capacities.

7(b) Noise Design Goals for the Project

The design goals for this solar project are described below.

(i) A maximum noise limit of forty-five (45) dBA L_{eq} (8-hour), at the outside of any existing non-participating residence, and fifty-five (55) dBA L_{eq} (8-hour) at the outside of any existing participating residence. The Project meets these limits as discussed in Section 7(l).

(ii) A maximum noise limit of forty (40) dBA L_{eq} (1-hour) at the outside of any existing non-participating residence from the collector substation equipment. The Project meets these limits as discussed in Section 7(l).

(iii) A prohibition on producing any audible prominent tones, as defined by using the constant level differences listed under ANSI S12.9-2005/Part 4 Annex C (sounds with tonal content), at the outside of any existing non-participating residence. Should a prominent tone occur, the broadband overall (dBA) noise level at the evaluated non-participating position shall be increased by 5 dBA for evaluation of compliance with subparagraph (i) and (ii) of this paragraph. The inverter currently under consideration for this project has a tone at 5000 Hz. Therefore, the effective limit for non-participating residents is 40 dBA L_{eq} (8-hour) for evaluation of compliance with subparagraph (i) of this paragraph. The Project meets these limits as discussed in Section 7(e).

(iv) A maximum noise limit of fifty-five (55) dBA L_{eq} (8-hour), short-term equivalent continuous average sound level from the project across any portion of a non-participating property except for portions delineated as NYS-regulated wetlands pursuant to section 900-1.3(e) of this Part and utility ROW to be demonstrated with modeled sound contours drawings and discrete sound levels at worst-case locations. No penalties for prominent tones will be added in this assessment. The Project meets these limits as discussed in Sections 7(k) and 7(l).

There are no applicable sound level requirements in the Town of Copake.

7(c) Radius of Evaluation

All sensitive receptors within at least a 1,500 foot radius from any noise source (e.g., substation transformer(s), medium to low voltage transformers, inverters) proposed for the Project or within the thirty (30) dBA noise contour, whichever is greater, were included in the analysis. These receptors are shown in Figure 7-1.

A cumulative analysis requires noise modeling to include any solar facility and substation existing and proposed by the time of filing the application, and any existing sensitive receptors within a 3,000-foot radius from any noise source proposed for this facility, or within the 30 dBA noise contour, whichever is greater. The existing NYSEG Craryville substation is located immediately adjacent to the Project's proposed collector substation. A review of the sound level data from the existing conditions measurements showed that the substation is a very localized source of sound. A quantitative cumulative assessment has been performed to demonstrate this and is included in Appendix 7-8.

There are no other operating solar facilities within 3,000 feet of a Shepherd's Run Solar noise source or within the 30 dBA noise contour, so a cumulative analysis is not required. There are some solar panels from the bankrupt Monolith Solar project installed at the intersection of Route 23 (Main Street) and Two Town Road. There are no inverters, inverter pads, or collector substation installed, and there was no audible sound from Monolith Solar based on a site visit conducted in February 2022. The Monolith Solar project is not operational and thus does not generate any sound. This is further verified by the existing condition sound level measurement program of July 2020. Existing condition sound level measurements were collected very near the Monolith Solar site (see Location #2 in Figure 1-1 of Appendix 7-3). A review of the sound level data from these measurements (see Figure 2-3 in Appendix 7-3) does not show any daytime steady sound from inverters which would be expected from an operational solar facility.

7(d) Modeling Standards, Input Parameters, and Assumptions

An estimate of the noise level to be produced by the Project was made using the following assumptions.

(1) Future sound levels associated with the Project were predicted using the Cadna/A noise calculation software developed by DataKustik GmbH. This software implements

the ISO 9613-2 international standard for sound propagation (Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation) for full octave bands from 31.5 Hertz (Hz) to 8000 Hz. As per ISO 9613-2, all calculations assumed favorable conditions for sound propagation, corresponding to a moderate, well-developed ground-based temperature inversion, as might occur on a calm, clear night or equivalently downwind propagation. In addition, the ISO 9613-2 standard assumes all receptors are downwind of every sound source simultaneously. No meteorological correction (Cmet) was added to the results, pursuant to 19 NYCRR § 900-2.8(d).

(2) Elevation contours for the modeling domain were directly imported into Cadna/A which allowed for consideration of terrain shielding where appropriate. The terrain height contour elevations were generated from elevation information derived from the National Elevation Dataset (NED) developed by the U.S. Geological Survey.

In addition to modeling at discrete points, sound levels were also modeled throughout a large grid of receptor points, each spaced 10 meters apart to allow for the generation of sound level isopleths. Tabular results and sound level isopleths were calculated and generated for the entire study area.

All sound sources were assumed to be operating simultaneously at maximum sound power levels. The collector substation was also modeled by itself operating at maximum sound power level.

The sound power levels for each source used in the modeling are discussed below.

Inverters

The sound level analysis includes 12 inverters as provided to Epsilon by the Applicant. The source location coordinates, elevations, and heights above ground are summarized in Appendix 7-1. Sungrow inverters were evaluated for this analysis. The inverter manufacturer, power rating, and quantity examined for this assessment are presented below in Table 7-1. The low-voltage transformer associated with each inverter has a sound power level more than 20 dBA quieter than the inverter, so its contribution is negligible, and it was not included in the site-wide sound model.

Table 7-1. Power Inverters Considered for Sound Level Assessment

Manufacturer	Inverter Model	Maximum Electrical Output [kVA]	Quantity
Sungrow	SG4400UD-MV	44,400	12

Broadband and octave band sound power levels for the possible inverter operating under typical (daylight) conditions were provided by the Applicant[2]. The sound power levels are presented in Table 7-2.

Table 7-2. Inverter Octave Band Sound Power Levels

Inverter Type	Broadband Sound Power Level [dBA]	Sound Power Levels [dB] per Octave-Band Center Frequency [Hz]								
		31.5	63	125	250	500	1k	2k	4k	8k
Sungrow SG4400UD	91	89	88	86	82	85	83	86	76	54

Collector Substation

There will be a collector substation located within the Project Area. The modeling inputs of the substation transformer – coordinates, ground elevation, and height above ground – are summarized in Appendix 7-1. One transformer rated at up to 66 MVA is proposed for the collector substation. Epsilon estimated octave band sound level emissions using the techniques in the Electric Power Plant Environmental Noise Guide, Table 4.5 Sound Power Levels of Transformer. Table 7-3 summarizes the transformer sound power level data used in the modeling.

Table 7-3. Collector Substation Transformer Sound Power Levels

Maximum Rating [MVA]	Broadband Sound Power Level [dBA]	Sound Power Levels [dB] per Octave-Band Center Frequency [Hz]								
		31.5	63	125	250	500	1k	2k	4k	8k
66	95	91	97	99	94	94	88	83	78	71

In addition to the transformer, the substation will have two small HVAC units on the control house, each with a total sound power level of 85 dBA. The coordinates, ground elevation, and height above ground for each unit is shown in Appendix 7-1. The HVAC units have been included in the model as shown in the substation site plan included in Appendix 7-6.

(i) For all modeling scenarios, the ground absorption factor (G) was set to 0.5 for the ground and 0 for water bodies.

[2] Sungrow SG4400UD-MV Noise Test Report

(ii) A temperature of 10 degrees Celsius and 70 percent relative humidity was used to calculate atmospheric absorption for the ISO 9613-2 model. These parameters were selected to minimize atmospheric attenuation in the 500 Hz and 1000 Hz octave bands where the human ear is most sensitive, and thus provide conservative results.

(iii) The maximum A-weighted dBA L_{eq} (1-hour or 8-hour) sound pressure levels, and the maximum linear/unweighted/Z dB (L_{eq} 1-hour) sound pressure levels from the thirty-one and a half (31.5) Hz up to the eight thousand (8,000) Hz full-octave band, at all sensitive sound receptors within the radius of evaluation are discussed and presented in Section 7(l).

(iv) The maximum A-weighted dBA L_{eq} sound pressure levels (L_{eq} (8-hour)) at the most critically impacted external property boundary lines of the facility site (e.g., non-participating boundary lines) are shown in Figure 7-2.

(v) A summary of the number of receptors exposed to sound levels greater than thirty-five (35) dBA are shown in Table 7-4 grouped in one (1)-dBA bins. An "Accessory" structure is a building on a residential parcel which may include a detached garage or some type of similar non-principal structure (boat house, pool house, storage shed, etc.). There are no sound level limits applicable to these structures, but they are provided for informational purposes.

Table 7-4. Receptors Modeled at 35 dBA or Greater – Total Sound L_{eq} (8-hour)

Modeled L_{eq} Sound Level [dBA][1]	# of Receptors					
	Residential		Non-Residential		Accessory	
	Participating	Non-Participating	Participating	Non-Participating	Participating	Non-Participating
45	0	0	0	0	0	0
44	0	0	0	0	0	0
43	0	0	0	0	0	0
42	0	0	0	0	0	0
41	0	0	0	0	0	0
40	0	0	0	0	1	0
39	1	0	0	1	2	1
38	1	0	0	1	2	1
37	1	0	0	1	2	1
36	1	2	0	1	2	2
35	1	3	0	3	2	3

(vi) Sound level contours as specified in 19 NYCRR § 900-2.8(k) are shown in Figure 7-2.

(3) This subsection is applicable to wind projects and the Project is a solar facility.

(4) The Cadna/A model used a one and a half (1.5) meter assessment point above the ground. No uncertainty factor was added to the modeled results.

Panel Tracking System

The small electric motors on the solar panel tracking systems are a negligible source of sound. Manufacturers sound level data for the tracking motors are not available; however, based on Epsilon's experience, the sound power levels of tracking motors for solar arrays are typically in the range of 65 to 70 dBA. Additionally, solar panel tracking motors for the panels only operate for approximately 19 minutes per day. The sound level limits presented in §94-c applicable to operational sound from the facility are based on an 8-hour Leq. Nineteen minutes represents 3.96% of an 8-hour time period. A 3.96% usage factor results in a 14 dBA correction based on the following equation:

$$10 \times \log10\ (0.0396) = -14$$

Therefore, based on a 70 dBA sound power level, the total corrected 8-hour Leq sound power level of a tracking motor accounting for their small amount of operational time is approximately 56 dBA. (70 dBA – 14 dBA = 56 dBA). This is substantially quieter than all other project components including the inverters (91 dBA), the substation transformer (95 dBA), and the substation HVAC units (85 dBA). The shortest distance from a non-participating receptor to a project component is 164 feet (50 meters). Based on the corrected sound power level and this distance, the highest 8-hour Leq sound pressure level due to a tracking motor is 23 dBA at the closest receptor. Daytime ANS-weighted ambient sound levels in the Project area range from 38 dBA to 59 dBA Leq as shown in Table 3-2 of the Ambient Pre-Construction Sound Level Measurement Program report include in Appendix 7-3. For these reasons, the tracking motors are a negligible sound source and they have not been included in the acoustic modeling of the Project.

Existing NYSEG Craryville Substation

The existing NYSEG Craryville substation is located immediately adjacent to the project's proposed collector substation. A review of the sound level data from the existing conditions measurements showed that the substation is a very localized source of sound. A quantitative cumulative assessment has been performed to demonstrate this.

The dominant noise source at the Craryville Substation is a 25 MVA transformer. Future Leq (8-hour) sound levels during worst-case cumulative operation of the Craryville transformer combined with the Project's inverters and collector substation have been calculated using the methodology described in Section 7(j) of Exhibit 7. Appendix 7-8 provides the predicted A-weighted (dBA) and full octave band frequency (31.5 Hz to 8,000 Hz) sound pressure levels at all receptors. The results are sorted by receptor ID and sorted by A-weighted sound level high to low, and are broken down by receptor type (Residential, Non-Residential and Accessory) and participation (Non-Participating and Participating). In total, there are ten tables from Table 7-8.1a to Table 7-8.1j in Appendix 7-8.

The highest sound levels at residential receptors, under this scenario are:

- Non-participating receptor = 37 dBA
- Participating receptor = 40 dBA

These sound levels are below the design goals of 45 dBA for a non-participating residence and 55 dBA for a participating residence, and also meet the adjusted design goal at the non-participating residences of 40 dBA due to the observed prominent tone and subsequent 5 dBA penalty. Thus, the project complies with these design goals.

7(e) Prominent Tones

ANSI/ASA S12.9-2013 Part 3, Annex B, section B.1 (informative) presents a procedure for testing for the presence of a prominent discrete tone. According to the standard, a prominent discrete tone is identified as present if the time-average sound pressure level in the one-third octave band of interest exceed the arithmetic average of the time-average sound pressure level for the two adjacent one-third octave bands by any of the following constant level differences:

- 15 dB in low-frequency one-third-octave bands (from 25 up to 125 Hz);
- 8 dB in middle-frequency one-third-octave bands (from 160 up to 400 Hz); or,
- 5 dB in high-frequency one-third-octave bands (from 500 up to 10,000 Hz).

(1) The available inverter sound data is limited to octave band sound levels; therefore, a quantitative evaluation of one-third octave band sound levels was not possible. For this reason, the inverters were assumed to be tonal and prominent by default. Due to this assumption, a 5 dBA penalty is being applied on a short-term broadband basis to non-participating residential receptors (40 dBA as per Section 900-2.8(b)(2)(iii)). Despite the assumption of tonality and subsequent broadband penalty, short term broadband sound pressure levels do not exceed 40 dBA at any non-participating residences without any mitigation measures.

(2) One-third octave band sound power levels for the collector substation transformer were not supplied by the vendor for the substation equipment; therefore, a quantitative evaluation of one-third octave band sound using the spreadsheet modeling approach was not possible. For this reason, the substation transformer was also assumed to be tonal and prominent by default.

7(f) Low Frequency Noise for Wind Facilities

This subsection is not applicable to this project.

7(g) Infrasound for Wind Facilities

This subsection is not applicable to this project.

7(h) Sound Study Area

Figure 7-1 is a map of the sound study area showing the location of sensitive sound receptors in relation to the Project (including the collector substation and the point of interconnect).

(1) In total, 392 discrete receptors were analyzed for the Project. These include 247 residential receptors, 131 accessory receptors, and 14 non-residential receptors. Of the 392 receptors, 11 were participating, and 381 were non-participating, as defined in Section 7(h)(3) below. Of the 131 accessory receptors, 8 were participating and 123 were non-participating. Of the 14 non-residential receptors, all 14 were non-participating. The receptor initially designated receptor 291 was determined to be a shed that will be removed as part of construction, so it has been excluded from analysis. A detailed listing of all receptors including receptor ID, latitude/longitude, elevation, participation status, and receptor category is included as Appendix 7-2.

(2) All residences were included as sensitive sound receptors regardless of participation in the facility (e.g., participating, potentially participating, and non-participating residences) or occupancy (e.g., year-round, seasonal use).

(3) Only properties that have a signed contract with the Applicant prior to the date of filing the application were identified as “participating.” Other properties were designated as “non-participating.”

7(i) Evaluation of Ambient Pre-Construction Baseline Noise Conditions

An evaluation of ambient pre-construction baseline noise conditions was conducted for eight (8) days by using the L_{90} statistical and the L_{eq} energy-based noise descriptors, and by following the recommendations included in ANSI/ASA S3/SC 1.100 -2014-ANSI/ASA S12.100-2014 American National Standard entitled Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas. The full details of the ambient pre-construction sound level measurement program are found in Appendix 7-3.

7(j) Evaluation of Future Noise Levels during Construction

(1) Future construction noise modeling was performed for the main phases of construction and from activities at the proposed laydown area using the ISO 9613-2:1996 sound propagation standard as implemented in the Cadna/A software package. Reference sound source information was obtained from either Epsilon's consulting files or the FHWA's Roadway Construction Noise Model (RCNM). No concrete batch plant is proposed for the Project. Therefore, no modeling for this activity is included.

(2) The majority of the construction activity will occur around each of the inverter locations, at the location of the collector substation, at each of the solar arrays, and at the locations where HDD (Horizontal Directional Drilling) will occur. By its very nature, construction activity moves around the Project Area. Full construction activity will generally occur at one location at a time, although there will be some overlap at adjacent construction locations for maximum efficiency. For modeling conservatism, it was assumed that full activity was occurring at the closest locations to their surrounding receptors. There are generally five phases of construction for a solar energy project – site preparation and grading, trenching and road construction, HDD, equipment installation, and commissioning. Table 7-5 presents the equipment sound levels for the louder pieces of typical construction equipment expected to be used at this site along with their phase of construction.

Table 7-5. Sound Levels for Noise Sources Included in Construction Modeling

Phase	Equipment	Sound Level at 50 feet [dBA]
Site Preparation & Grading	Grader (174 hp)	85
Site Preparation & Grading	Rubber Tired Loader (164 hp)	85
Site Preparation & Grading	Scraper (313 hp)	89
Site Preparation & Grading	Water Truck (189 hp)	80
Site Preparation & Grading	Generator Set	81
Trenching & Road Construction	(2) Excavator (168 hp)	85
Trenching & Road Construction	Bar Trencher (600 hp)	89
Trenching & Road Construction	Grader (174 hp)	85
Trenching & Road Construction	Water Truck (189 hp)	80
Trenching & Road Construction	Trencher (63 hp)	83
Trenching & Road Construction	Rubber Tired Loader (164 hp)	85
Trenching & Road Construction	Generator Set	81

Phase	Equipment	Sound Level at 50 feet [dBA]
Equipment Installation	Crane (399 hp)	83
Equipment Installation	Crane (165 hp)	83
Equipment Installation	(2) Forklift (145 hp)	85
Equipment Installation	(2) Vermeer PD10 Pile Driver	84
Equipment Installation	(6) Pickup Truck/ATV	55
Equipment Installation	(2) Water Truck (189 hp)	80
Equipment Installation	(2) Generator Set	81
HDD Entry	Excavator (168 hp)	85
HDD Entry	Auger Drill Rig	85
HDD Entry	Pickup Truck/ATV	55
Commissioning	(2) Pickup Truck/ATV	55

(3) The operational modeling requirements included Sections 7(d)(1)(i) through 7(d)(1)(iii), and 7(d)(3) of this Exhibit were also used for modeling of construction noise.

(4) Worst-case sound levels from construction activity are shown using sound level contours in Figure 7-3 and sound levels at the most critically impacted receptors are shown in Tables 7-6 and 7-7.

Two areas within the Project Area were chosen to calculate worst case construction sound levels. The areas and assumed locations of simultaneous construction are:

- Area 1 – This area includes the closest receptors to a solar array panel. Modeling assumed simultaneous construction activity at this solar array panel. Site preparation and grading work, trenching and road construction work, equipment installation work, and commissioning work was modeled at this location.

- Area 2 – This area includes all receptors in the vicinity of the closest HDD entry point to a receptor. Modeling assumed simultaneous construction activity at this HDD entry point. HDD work and commissioning work was modeled at this HDD entry point.

For each of the areas, construction sound levels at the ten closest receptors have been calculated. These receptors included both non-participants and participants. The results are shown as maximum 1-second L_{eq} sound levels with all pieces of equipment for each phase operating at the locations. These results overstate expected real-world results, because under actual construction conditions, not all pieces of equipment will be operating at the same exact time, and the highest sound levels from every piece of equipment will not tend to occur at the same time as was assumed in the modeling. At other areas of construction (i.e., substation, laydown yards, inverter pads), sound levels due to construction would be lower, as those locations are further from receptors than the two areas that were analyzed.

Area 1 Modeling Results

The cumulative impacts from site preparation and grading work, trenching and road construction work, equipment installation work, and commissioning work was calculated with the Cadna/A model for the ten closest receptors to construction activity within Area 1. The loudest phase of construction within this area will be trenching and road construction work. A sound contour figure of trenching and road construction work occurring at the solar array is presented in Figure 7-3.

The highest sound level at a non-participating receptor within this area is 75 dBA during site preparation and grading (Receptor #300), 77 dBA during trenching and road construction (Receptor #300), 77 dBA during equipment installation (Receptor #300), and 41 dBA during commissioning (Receptor #300). Modeling results of construction sound levels within this area are summarized in Table 7-6.

Table 7-6. Construction Sound Modeling Results – Area 1 Construction [dBA]

Receptor ID	Distance [m]	Participation Status	Site Preparation & Grading	Trenching & Road Construction	Equipment Installation	Commissioning	Worse Case Total (All Phases)
300	50	Non-Participating	75	77	77	41	81
134	116	Non-Participating	67	69	69	33	73
257	121	Non-Participating	67	69	69	33	73
71	131	Non-Participating	66	68	68	32	72
349	144	Non-Participating	65	67	67	31	71
70	184	Non-Participating	63	65	65	29	69
336	202	Non-Participating	62	64	64	28	68
142	257	Non-Participating	60	62	62	26	66

Receptor ID	Distance [m]	Participation Status	Site Preparation & Grading	Trenching & Road Construction	Equipment Installation	Commissioning	Worse Case Total (All Phases)
39	261	Non-Participating	60	62	62	26	66
353	265	Non-Participating	60	62	62	26	66

Area 2 Modeling Results

The cumulative impacts from HDD work and commissioning work was calculated with the Cadna model for the ten closest receptors to construction activity within Area 2. The loudest phase of construction within this area will be HDD work. A sound contour figure of HDD work occurring at the HDD entry point is presented in Figure 7-3.

The highest sound level at a non-participating receptor within this area is 68 dBA during HDD (Receptor #39) and 33 dBA during commissioning (Receptor #39). Modeling results of construction sound levels within this area are summarized in Table 7-7, and a sound contour figure of results is shown in Figure 7-3.

Table 7-7. Construction Sound Modeling Results – Area 2 Construction [dBA]

Receptor ID	Distance [m]	Participation Status	HDD	Commissioning	Worst Case Total (All Phases)
39	68	Non-Participating	68	33	68
40	168	Participating	60	44	60
49	227	Participating	57	34	57
300	249	Non-Participating	57	25	57
257	259	Non-Participating	56	23	56
134	278	Non-Participating	56	23	56
336	288	Non-Participating	55	22	55
139	289	Non-Participating	55	22	55
82	296	Participating	55	21	55
71	335	Non-Participating	54	23	54

Cumulative Construction Sound Levels

The Applicant expects that Project construction will occur in phases and does not currently anticipate simultaneous construction activities in the same area. However, the Applicant's consultant calculated the logistically improbable "Worst Case Total, All Phases" sound level for the ten closest receptors. These values are presented in the last column of Tables 7-6 and 7-7 above. These values represent the improbable worst-case construction sound levels from all pieces of equipment assuming all phases of construction are occurring simultaneously at the closest locations to a receptor. These results overstate expected real-world results, because under actual construction conditions, not all pieces of equipment will be operating at the same exact time, and the highest sound levels from every piece of equipment will not tend to occur at the same time, as the modeling assumes. At all other construction areas, sound levels due to construction will be lower, as those locations are farther from receptors.

To account for the possible cumulative effect of all construction activities, additional modeling scenarios were performed assuming simultaneous construction activity at seven sites throughout the Project Area. In addition, a sound contour figure of the loudest phase assuming cumulative activity (trenching and road construction) was prepared. Tabular modeling results of cumulative construction sound levels at the are summarized in Table 7-8, and a sound contour figure of cumulative trenching results is shown in Figure 7-5. Additionally, cumulative modeling results for all receptors are shown in Appendix 7-9.

Table 7-8. Cumulative Construction Sound Modeling Results [dBA]

Receptor ID	Participation Status	Site Preparation & Grading	Trenching & Road Construction	Equipment Installation	Commissioning
300	Non-Participating	75	77	62	26
134	Non-Participating	68	69	61	25
257	Non-Participating	67	69	61	25
71	Non-Participating	66	68	60	24
349	Non-Participating	65	67	60	24
339	Non-Participating	65	66	66	29
70	Non-Participating	64	65	59	23
336	Non-Participating	63	65	60	24
107	Non-Participating	63	64	65	28
79	Non-Participating	62	64	64	28

These results similarly overstate expected real-world results, because under actual construction conditions, not all pieces of equipment will be operating at the same exact time, and the highest sound levels from every piece of equipment will not tend to occur at the same time, as assumed for modeling.

Construction Noise Conclusions

Noise is an unavoidable outcome of construction. The five major construction phases are: site preparation and grading, trenching and road construction, HDD, equipment installation, and commissioning. Most of the construction will occur at significant distances to sensitive receptors, and therefore noise from most phases of construction is not expected to result in impacts to sensitive receptors. There are a few instances where construction will be fairly close to residences (receptor IDs 300, 39, and 49) and coordination with these neighbors may be warranted. Construction noise will be minimized through the use of best management practices.

7(k) Sound Levels in Graphical Format

(1) Figure 7-2 presents future L_{eq} (8-hour) sound contour lines showing expected sound levels during worst-case operation of the Project's inverters plus the collector substation using the methodology described above. Figure 7-4 presents future L_{eq} (1-hour) sound contour drawings showing expected sound levels during worst-case operation of the Project's collector substation-only using the methodology described above.

(2) The sound contour maps include all sensitive sound receptors, boundary lines (differentiating participating and non-participating), and all Project noise sources.

(3) Sound contours are rendered until the thirty (30) dBA noise contour is reached, in one (1)-dBA steps, with sound contour multiples of five (5) dBA differentiated.

(4) Full-size hard copy maps (22" x 34") of these figures in 1:12,000 scale will be submitted to the Office.

7(l) Sound Levels in Tabular Format

A tabular comparison between the maximum sound impacts and any design goals, noise limits, and local requirements for the facility, and the degree of compliance at all sensitive sound receptors and at the most impacted non-participating boundary lines within the Study Area is presented below.

All Sources Running – Inverters Plus the Collector Substation

Future L_{eq} (8-hour) sound levels during worst-case operation of the Project's inverters plus the collector substation have been calculated using the methodology described above. Appendix 7-4 provides the predicted A-weighted (dBA) and full octave band frequency (31.5 Hz to 8,000 Hz) sound pressure levels at all sensitive receptors. The results are sorted by receptor ID and sorted by A-weighted sound level high to low, and are broken down by receptor type (Residential, Non-Residential and Accessory) and participation (Non-Participating and Participating). In total, there are ten tables from Table 7-4.1a to Table 7-4.1j found in Appendix 7-4.

The highest sound levels at residential receptors, under this scenario are:

- Non-participating receptor = 37 dBA
- Participating receptor = 39 dBA

These sound levels are below the design goals of 45 dBA for a non-participating residence and 55 dBA for a participating residence, and also meet the adjusted design goal at the non-participating residences of 40 dBA due to the observed prominent tone and subsequent 5 dBA penalty. Thus, the Project complies with these design goals.

Sound level contours generated from the modeling grid are presented in an overview figure, (Figure 7-2), accompanied by a series of inset maps that provide a higher level of detail at all modeled receptors. As these figures show, sound levels will be below the design goal of 55 dBA at all non-participating property lines. The highest sound level due to the Project at a non-participating property line is 54 dBA on Parcel ID: 144.-1-7, near the collector substation.

Collector Substation Only

Future L_{eq} (1-hour) sound levels during worst-case operation of the Project's collector substation only have been calculated using the methodology described above. Appendix 7-5 provides the predicted A-weighted (dBA) and full octave band frequency (31.5 Hz to 8,000 Hz) sound pressure levels at all residences. The results are sorted by receptor ID and sorted by A-weighted sound level from high to low for all non-participating residences. Tables 7-5.1a (by receptor ID) and Table 7-5.1.b (by sound level) are found in Appendix 7-5.

The highest sound level for the collector substation only is 35 dBA at a non-participating residence. These sound levels meet the design goal of 35 dBA, assuming the 5 dBA tonal penalty, which is likely for a substation transformer.

Local Requirements

There are no applicable quantitative sound level requirements in the Town of Copake.

7(m) Community Noise Impacts

(1) *Hearing Loss for the Public*

The Project's potential to result in hearing loss to the public was evaluated against the 1999 "Guidelines for Community Noise" published by the World Health Organization (WHO). According to the WHO Guidelines, the threshold for hearing impairment is 70 dBA Leq (24-hour), 110 dBA (Lmax, fast) or 120/140 dBA (peak at the ear) for children/adults. Operational noise will always be less than 55 dBA Leq (8-hour) at any residence. This is well below the 70 dBA limit. The only construction noise source for this Project capable of exceeding the WHO hearing impairment threshold is blasting, but no blasting is anticipated for this Project. All other construction activities will produce noise below the WHO hearing impairment threshold. Therefore, no Project activities have the potential to cause hearing loss to the public.

(2) *Potential for Structural Damage*

At this time, blasting is not planned as part of construction for the Project. If blasting becomes necessary, a detailed discussion of the potential to produce structural damage on any existing proximal buildings is found in Exhibit 10 Geology, Seismology and Soils.

7(n) Noise Abatement Measures for Construction Activities

(1) *Noise Abatement Measures*

Noise is an unavoidable outcome of construction. The Applicant will communicate with the public to notify them of the beginning of construction of the Project. Most of the construction will occur at significant distances to sensitive receptors, and therefore noise from most phases of construction is not expected to result in impacts to sensitive receptors. Nonetheless construction noise will be minimized through the use of best management practices such as those listed below.

- Blasting is not anticipated at this site. However, if necessary, blasting will be limited to daytime hours and conducted in accordance with an approved Blasting Plan.
- Post installation and horizontal direction drilling (HDD) will be limited to daytime hours.
- Pursuant to 19 NYCRR § 900-6.4(k)(1), utilizing construction equipment fitted with exhaust systems and mufflers that have the lowest associated noise whenever those features are available and maintaining functioning mufflers on all transportation and construction machinery.

- Maintaining equipment and surface irregularities on construction sites to prevent unnecessary noise.
- Configuring, to the extent feasible, the construction in a manner that keeps loud equipment and activities as far as possible from noise-sensitive locations.
- Using back-up alarms with a minimum increment above the background noise level to satisfy the performance requirements of the current revisions of Standard Automotive Engineering (SAE) J994 and OSHA requirements.
- Developing a staging plan that establishes equipment and material staging areas away from sensitive receptors when feasible.
- Contractors shall use approved haul routes to minimize noise at residential and other sensitive noise receptors.

(2) *Complaint Management Plan*

Complaints due to construction or operation of the Project have the potential to occur. If complaints do arise, the Complaint Management Plan provides information on how and when the public may file a complaint, as well as an identification of any procedures or protocols that may be unique to each phase of the Project or complaint type. In accordance with 19 NYCRR § 900-6.2(a), (c) and (d), the Applicant will provide notice of commencement of construction and completion of construction. The notice will include the procedure and contact information for registering a complaint. To minimize noise impacts during construction, the Applicant will comply with 19 NYCRR § 900-6.4(k)(2), which includes responding to noise and vibration complaints according to the complaint resolution protocol approved by the Office.

(3) *Compliance with Local Laws*

There are no applicable sound level requirements in the Town of Copake.

7(o) Noise Abatement Measures for Project Design and Operation

(1) *Wind Facilities*

This subsection is not applicable to the Project.

(2) *Solar Facilities*

Adverse noise impacts will be avoided or minimized through careful siting of Project components. The noise emitted by a solar project is limited to daytime periods only for the majority of the components. No mitigation is required at any of the central inverters or the collector substation under the current design.

7(p) Software Input Parameters, Assumptions, and Associated Data for Computer Noise Modeling

(1) GIS files used for the computer noise modeling, including noise source and receptor locations and heights, topography, final grading, boundary lines, and participating status have been submitted to the Office by digital means.

(2) The Cadna/A computer noise modeling files have been submitted to the Office by digital/electronic means.

(3) Site plan and elevation details of the substation, as related to the location of all relevant noise sources, are presented in Appendix 7-6.

(4) This subsection is not applicable to the Project.

(5) (i) The locations of all noise sources identified with GIS coordinates are presented in Appendix 7-1. The digital GIS files with that information have been submitted to the Office.

(ii) Sound information from the manufacturers for all noise sources included in this analysis are presented in Appendix 7-7.

7(q) Miscellaneous

(1) A glossary of terminology, definitions, and abbreviations used throughout this Exhibit is included as Appendix 7-10. The references mentioned in the application are found in the References section below.

(2) All information has been reported in tabular, spreadsheet compatible or graphical format as follows:

(i) All data reported in tabular format has been clearly identified to include headers and summary footer rows. Headers include identification of the information contained in each column, such as noise descriptors; weighting; duration of evaluation; time of the day; whether the value is a maximum or average value and the corresponding time frame of evaluation.

(ii) Table titles identify whether the tabular or graphical information correspond to the "unmitigated" or "mitigated" results, if any mitigation measures are evaluated (not applicable to this project), and “cumulative” or “non-cumulative” for cumulative noise assessments.

(iii) Columns or rows with results related to a specific design goal, noise limit or local requirement, identify the requirement to which the information relates.

(iv) Tables include rows at the bottom summarizing the results to report maximum and minimum values of the information contained in the columns. Sound receptors are separated in different tables according to their use (e.g., participating residences, non-participating residences, schools, parks, cemeteries, historic places, etc.).

(v) This Exhibit reports estimates of the absolute number of sensitive sound receptors that will be exposed to noise levels that exceed any design goal or noise limit (in total as well as grouped in one (1)-dBA bins). There are no receptors that exceed a design goal or noise limit for this project.

References

American National Standard ANSI/ASA S1.4-1983 (R2006). 1983. *Specification for Sound Level Meters.*

American National Standard ANSI/ASA S1.11-2004 (R2009). 2004. *Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters.*

American National Standard ANSI/ASA S1.40-2006 (R2020). 2006. *Specifications and Verification Procedures for Sound Calibrators.*

American National Standard ANSI/ASA S1.43-1997 (R2007). 1997. *Specification for Integrating-Averaging Sound Level Meters.*

American National Standard ANSI S12.9-1992/Part 2 (R2018). 1992. *Quantities and Procedures for Description and Measurement of Environmental Sound. Part 2: Measurement of long-term, wide-area sound.*

American National Standard ANSI S12.9-2013/Part 3 (R2018). 2013. *Quantities and Procedures for Description and Measurement of Environmental Sound. Part 3: Short-term Measurement with an Observer Present.*

American National Standard ANSI S12.9-2005/Part 4 (R2020). 2005. *Quantities and Procedures for Description and Measurement of Environmental Sound. Part 4: Noise Assessment and Prediction of Long-term Community Response.*

American National Standard ANSI S12.18-1994 (R2019). 1994. *Procedures for Outdoor Measurement of Sound Pressure Level.*

American National Standard ANSI/ASA S3/SC1.100-2014 & ANSI/ASA S12.100-2014. 2014. *Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas.*

Edison Electric Institute. 1984. *Electric Power Plant Environmental Noise Guide, 2nd Edition.*

International Standard ISO 9613-2. 1996. *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation.*

U.S. DOT, Federal Highway Administration (FHWA). 2006. *FHWA Roadway Construction Noise Model User's Guide.*

World Health Organization (WHO). 1999. *Guidelines for Community Noise.*