Report

Noise Assessment
Evergreen Solar, Inc.
New 75 MW PV Mfg Plant
Devens, Massachusetts

Prepared for

Evergreen Solar, Inc.

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CH2MHILL

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Contents

1 Executive Summary

An acoustical evaluation has been conducted to evaluate noise from operation of the Evergreen Solar, Inc. – New 75 MW Photovoltaic Manufacturing Plant (Plant). Current noise levels at the closest noise sensitive receptor have been measured. The applicable noise limits have been identified. The primary Plant noise sources with potential to contribute to measurable noise levels offsite have been identified and their levels quantified. A computer noise model based on standard acoustical estimation methodologies has been used to calculate expected offsite Plant operation noise levels. The model results indicate that, with incorporation of the noise control measures described in this report, compliance with the applicable noise limits should be achieved.

2 Introduction and Background

Evergreen Solar, Inc. will construct and operate a new 75 MW photovoltaic manufacturing plant in Devens, Massachusetts. The construction and operation of the plant will be subject to the State of Massachusetts noise limits and to noise limits established by the Devens Enterprise Commission. This document is an acoustical report that evaluates expected noise from the Plant, determines the types of noise control measures required, and demonstrates compliance with the noise limits.

2.1 Plant Location

The Plant will be located in Devens Massachusetts, in the Devens Regional Enterprise Zone (Devens). The Plant will be built on a currently unoccupied lot. Other land in the immediate area is primarily industrial in the rest of Devens. Land use to the south and east, outside of Devens, is agricultural and residential.

2.2 Fundamentals of Acoustics

Acoustics is the study of sound and noise is defined as unwanted sound. Airborne sound is a rapid fluctuation or oscillation of air pressure above and below atmospheric pressure creating a sound wave. Acoustical terms used in this subsection are summarized in Table 1.

The most common metric for environmental or occupational noise exposure is the overall A-weighted sound level, which has most commonly been adopted by regulatory bodies. The A-weighting network measures sound in a similar fashion to how a person perceives or hears sound. Sound levels at any particular location typically vary over time. The equivalent sound pressure level (L_{eq}), which is defined as the average noise level, on an equal energy basis, for a stated period of time, and statistical methods that capture the dynamics of a changing acoustical environment.

TABLE 1
Definitions of Acoustical Terms

Term	Definitions
Octave Band	A frequency range with an upper limit that is twice the value of the lower limit of the range.
Frequency	The number of times per second at which the sound pressure disturbance oscillates between positive and negative values relative to atmospheric. The frequency is measured in cycles per second, or hertz (hz).
Decibel (dB)	The decibel (dB) is the basic unit used to describe sound levels, including both sound pressure levels and sound power levels. The decibel is defined as 10 times the logarithm (to the base 10) of a ratio of a measured or calculated value to a reference value.
A-Weighted Decibel (dBA)	The sound power level or sound pressure level in decibels, adjusted according to the A-weighting network. The A-weighting adjusts the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. Most environmental and occupational noise standards are stated in terms of A-weighted sound pressure levels.
Equivalent Noise Level (L_{eq})	The average A-weighted sound level, on an equal energy basis, during the measurement period (usually 1-hour).
Sound Power Level (PWL)	A measure of the acoustic power emitted by a sound source. The sound power level (PWL) is defined as $10 \times Log\left(\frac{W}{W_0}\right)$, where W is the sound power emitted by the source (watts) and W_0 is the reference sound power (10^{-12} watt).
Sound Pressure Level (SPL)	A measure of the acoustic pressure at a specific location. The sound pressure level (SPL) is defined as $10 \times Log\left(\frac{p^2}{p_{ref}^2}\right)$, where p is the root mean square (rms) sound pressure being measured and p_{ref} is the reference rms sound pressure (2×10^{-5} newtons per square meter).

3 Existing Noise Levels

Existing noise levels in the area were measured at two locations. Location M1 is near the east property line of the Plant site. Location M2 is the noise sensitive location which will be the closest to the area of the plant where most of the noise generating equipment will be located. This location is 62 Old Mill Road in Harvard and is labeled as M2. Both locations are shown in Figure 1. The noise measurement results are shown in Table 2.

TABLE 2
Summary of Continuous Noise Measurements at Noise Monitoring Site M1, Plant Site East Property Line

Date	Start Time	L_{eq}	L_{50}	L_{90}	Date	Time	L_{eq}	L_{50}	L_{90}
7/11/07	12:00	45	43	41	7/12/07	1:00	43	42	40
7/11/07	13:00	46	44	42	7/12/07	2:00	46	44	42
7/11/07	14:00	45	44	41	7/12/07	3:00	47	46	43
7/11/07	15:00	45	42	39	7/12/07	4:00	44	43	41
7/11/07	16:00	41	41	38	7/12/07	5:00	46	45	43
7/11/07	17.00	42	39	36	7/12/07	6:00	46	45	43
7/11/07	18:00	40	38	35	7/12/07	7:00	46	45	41
7/11/07	19:00	39	36	34	7/12/07	8:00	48	48	45
7/11/07	20:00	40	37	34	7/12/07	9:00	49	48	44
7/11/07	21:00	39	37	34	7/12/07	10:00	49	47	43
7/11/07	22:00	53	45	36	7/12/07	11:00	48	46	42
7/12/07	23:00	42	40	39	7/12/07	12:00	47	46	41
7/12/07	0:00	42	40	39					

TABLE 3
Summary of Continuous Noise Measurements at Noise Monitoring Site M2, 62 Old Mill Road

Date	Start Time	L_{eq}	L_{50}	L_{90}	Date	Time	L_{eq}	L_{50}	L_{90}
7/11/07	13:00	47	44	41	7/12/07	2:00	45	43	40
7/11/07	14:00	55	44	41	7/12/07	3:00	44	43	40
7/11/07	15:00	45	46	41	7/12/07	4:00	46	42	40
7/11/07	16:00	43	42	39	7/12/07	5:00	47	43	41
7/11/07	17.00	42	41	38	7/12/07	6:00	45	45	43
7/11/07	18:00	39	39	35	7/12/07	7:00	49	45	42
7/11/07	19:00	38	36	33	7/12/07	8:00	49	46	43
7/11/07	20:00	51	35	33	7/12/07	9:00	46	43	41
7/11/07	21:00	40	44	34	7/12/07	10:00	44	43	40
7/11/07	22:00	39	38	35	7/12/07	11:00	48	43	41
7/11/07	23:00	39	37	35	7/12/07	12:00	49	45	42
7/12/07	0:00	41	38	36	7/12/07	13:00	52	44	42
7/12/07	1:00	45	39	37					

4 Approach

The approach used in this evaluation consists of the following:

- Summarize the applicable noise limits and define the controlling (most restrictive) noise limits.
- Measure the current offsite noise levels at the most restrictive offsite noise sensitive receptor.
- Identify the primary sources of operational noise and quantify their expected octave band sound power levels.
- Model the Plant operational noise levels at noise sensitive. Determine the locations of the Plant operational noise sources onsite. Include parameters that will affect the transmission of source noise to offsite locations. These parameters will include the noise reduction effects of structures (complete buildings or partial enclosures) or terrain, barriers, silencers, ground effects, atmospheric absorption, foliage, and the noise blocking effects of the ground and onsite buildings. Parameters that will tend to increase noise at certain offsite locations, such as reflection off of building surfaces, will also be included. If the controlling noise limit is exceeded at any sensitive receptor, evaluate noise mitigation measures in a step-by-step manner, controlling noise sources until compliance is achieved.

5 Applicable Noise Limits

Specific noise limits that apply to the operation of the Plant have been established by both the State of Massachusetts and the Devens Enterprise Commission.

5.1 State of Massachusetts Noise Regulations

The State of Massachusetts has established noise regulations in the Code of Massachusetts Regulations (CMR) Chapter 310, Section 7.10 (310 CMR 7.10), as follows:

7.10: U Noise

(1) No person owning, leasing, or controlling a source of sound shall willfully, negligently, or through failure to provide necessary equipment, service, or maintenance or to take necessary precautions cause, suffer, allow, or permit unnecessary emissions from said source of sound that may cause noise.

(2) 310 CMR 7.10(1) shall pertain to, but shall not be limited to, prolonged unattended sounding of burglar alarms, construction and demolition equipment which characteristically emit sound but which may be fitted and accommodated with equipment such as enclosures to suppress sound or may be operated in a manner so as to suppress sound, suppressible and preventable industrial and commercial sources of sound, and other man-made sounds that cause noise.

(3) 310 CMR 7.10(1) shall not apply to sounds emitted during and associated with:
(a) parades, public gatherings, or sporting events, for which permits have been issued provided that said parades, public gatherings, or sporting events in one city or town do not cause noise in another city or town;
(b) emergency police, fire, and ambulance vehicles;
(c) police, fire, and civil and national defense activities;
(d) domestic equipment such as lawn mowers and power saws between the hours of 7:00 A.M. and 9:00 P.M.

(4) 310 CMR 7.10(1) is subject to the enforcement provisions specified in 310 CMR 7.52.

The regulations are enforced by the Department of Environmental Protection (DEP). There are no specific numerical limits on noise in the regulations. However, the DEP has also issued a noise policy, as follows:

Policy

A noise source will be considered to be violating the Department's noise regulation (310 CMR 7.10) if the source:

1. Increases the broadband sound level by more than 10 dB(A) above ambient, or
2. Produce a "pure tone" condition – when any octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more.

These criteria are measured both at the property line and at the nearest inhabited residence. "Ambient" is defined as the background A-weighted sound level that is exceeded 90% of the time, measured during equipment operating hours. "Ambient" may also be established by other means with consent of the Department.

Motor vehicle noise, including that from vehicles accessing the plant site, is not regulated by the DEP. Similarly, backup alarms operated by trucks or onsite mobile equipment, are regulated by OSHA and are not subject to the DEP regulations.

5.2 Devens Enterprise Commission

The Devens Enterprise Commission has established noise regulations in 974 CMR 4.05. These include limits as follows:

No party owning, leasing, or otherwise controlling a facility within Devens shall be allowed to:

(a) Produce a broadband sound pressure level which exceeds an existing background sound pressure level by the following margins:

1. 5 dBA as measured at any residential property line or receptor within Devens;
2. 10 dBA as measured at any commercial or industrial property line or receptor within Devens.
3. 5 dBA as measured at any Devens perimeter boundary abutting a residential External Receptor
4. 10 dBA as measured at any Devens perimeter boundary abutting a commercial or industrial External Receptor.

(b) Produce a broadband sound pressure level which exceeds the following levels:

1. 45 dBA nighttime / 55 dBA daytime, as measured at any residential property line or receptor within Devens
2. 60 dBA as measured at a commercial or industrial property line or receptor within Devens
3. 45 dBA nighttime / 55 dBA daytime as measured at any Devens perimeter boundary abutting a residential External Receptor
4. 60 dBA as measured at any Devens perimeter boundary abutting a commercial or industrial External Receptor.

There are also limits on pure tones. The background sound pressure level is defined as the L90 during the quietest one-hour time interval during equipment operating hours. Daytime hours are defined as 7:00 am to 6:00 pm.

6 Primary Sources of Plant Operational Noise

The primary Plant operational noise sources that will contribute to offsite noise will consist of the cooling towers, scrubbers, VOC controls devices, and emergency diesel engine generator sets. This equipment is all located in the same general location at the southeast corner of the plant. The noise from the cooling towers, scrubbers, and VOC control devices will be primarily from the fans and motors. The noise from the diesel engine generators will be from the exhaust and from mechanical noise from the engine.

The cooling towers, scrubbers, and VOC control devices will generally run continuously (24 hours/day) although not all units will always be online. For example, the number of cooling towers in operation will depend on the cooling load at any particular time.

The engine generator sets will usually not be in operation. Each engine generator will typically only be exercised for 1-2 hours per month. Only one engine generator will be exercised at a time and this operation will always occur during daylight hours (8:00 am to 5:00 pm).

Cooling tower octave band noise levels were provided by a manufacturer. Also provided were levels of noise reduction that can be achieved for various noise reduction techniques.

Engine generator set noise levels were also provided by a manufacturer. Additional levels of noise reduction that can be achieved were derived from manufacturers published technical data.

Fan and motor noise from the scrubbers and VOC control devices were derived from manufacturer's data and computer programs based on the expected air flow rates and static pressures for each of the systems.

7 Model Evaluation of Plant Operation Noise Levels

An evaluation of Plant operation noise was conducted using the Cadna/A noise model. This model implements the methodologies in ISO 9613-2 *Acoustics - Sound Attenuation During Propagation Outdoors*. Octave band sound power levels or sound pressure levels at a reference distance, as described above, are the basic input to the model. Other input includes base maps locating the noise sources relative to the Plant property line, aerial photograph, building data, assumed atmospheric conditions, and details on techniques used for noise control. The model divides the Plant into individual point, area, and vertical area noise sources representing each piece of equipment or structure that produces a significant amount of noise. Using these power levels as a basis, the model calculates the sound pressure level that would occur at a grid of receptor locations from each source after losses due to distance, air absorption, ground effects, and the barrier effects of buildings and terrain. The noise contributions from all of the Plant sources are logarithmically added for each receptor grid location to determine the total Plant noise. Noise level contours are generated by the model based on the grid noise levels.

The noise contours from the Plant have been calculated by the model and mapped over the site and the surrounding areas as shown in Figures 2 and 3 for noise with and without an engine generator set in operation, respectively. The noise levels presented represent the anticipated steady-state level from the plant with normal operation of plant equipment. These noise level contours show compliance with both the nighttime and daytime noise limits for noise from the Plant alone. The contours show only the noise levels from the Plant. They do not represent the total noise from the Plant combined with the existing ambient noise.

The noise levels were estimated assuming additional noise control where necessary. For example, the fans are assumed to have silencers on their discharges. A noise wall was assumed to be in place near the equipment along the east property line.

Summaries of the noise impacts at the noise sensitive receptors are in Tables 4 and 5.

TABLE 4
Evaluation of Plant Compliance During Daytime with Engine Generator in Operation

	R1	**R2**	**R3**
Current L90 for Quietest Hour in 8:00 am to 5:00 pm period	39	39	39
Plant Contribution	31	31	29
Total with Plant	40	40	39
Increase	1	1	0
Comply with Limit on Increase?	Yes	Yes	Yes
Daytime Absolute Limit	55	55	55
Comply with Limit on Absolute Noise Level?	Yes	Yes	Yes

TABLE 5
Evaluation of Plant Compliance During Nighttime with Engine Generator not in Operation

	R1	**R2**	**R3**
Current L90 for Quietest Hour in 8:00 am to 5:00 pm period	33	33	33
Plant Contribution	27	29	28
Total with Plant	34	34	34
Increase	1	1	1
Comply with Limit on Increase?	Yes	Yes	Yes
Daytime Absolute Limit	45	45	45
Comply with Limit on Absolute Noise Level?	Yes	Yes	Yes

Figure 1-Noise Monitoring Locations (M1 & M2)

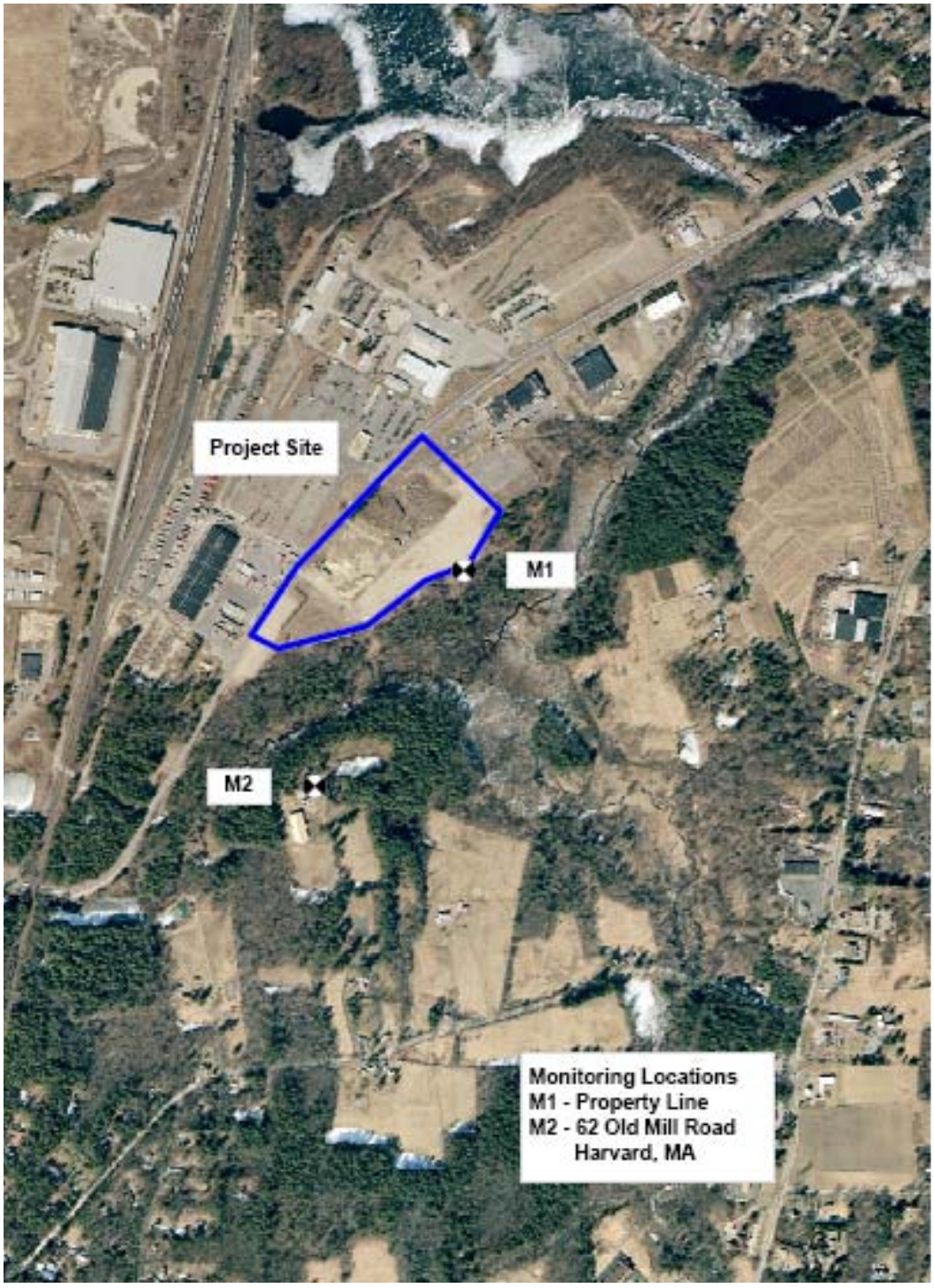

Figure 2-Estimated Plant Noise Levels with Diesel Engine Generator in Operation, dBA

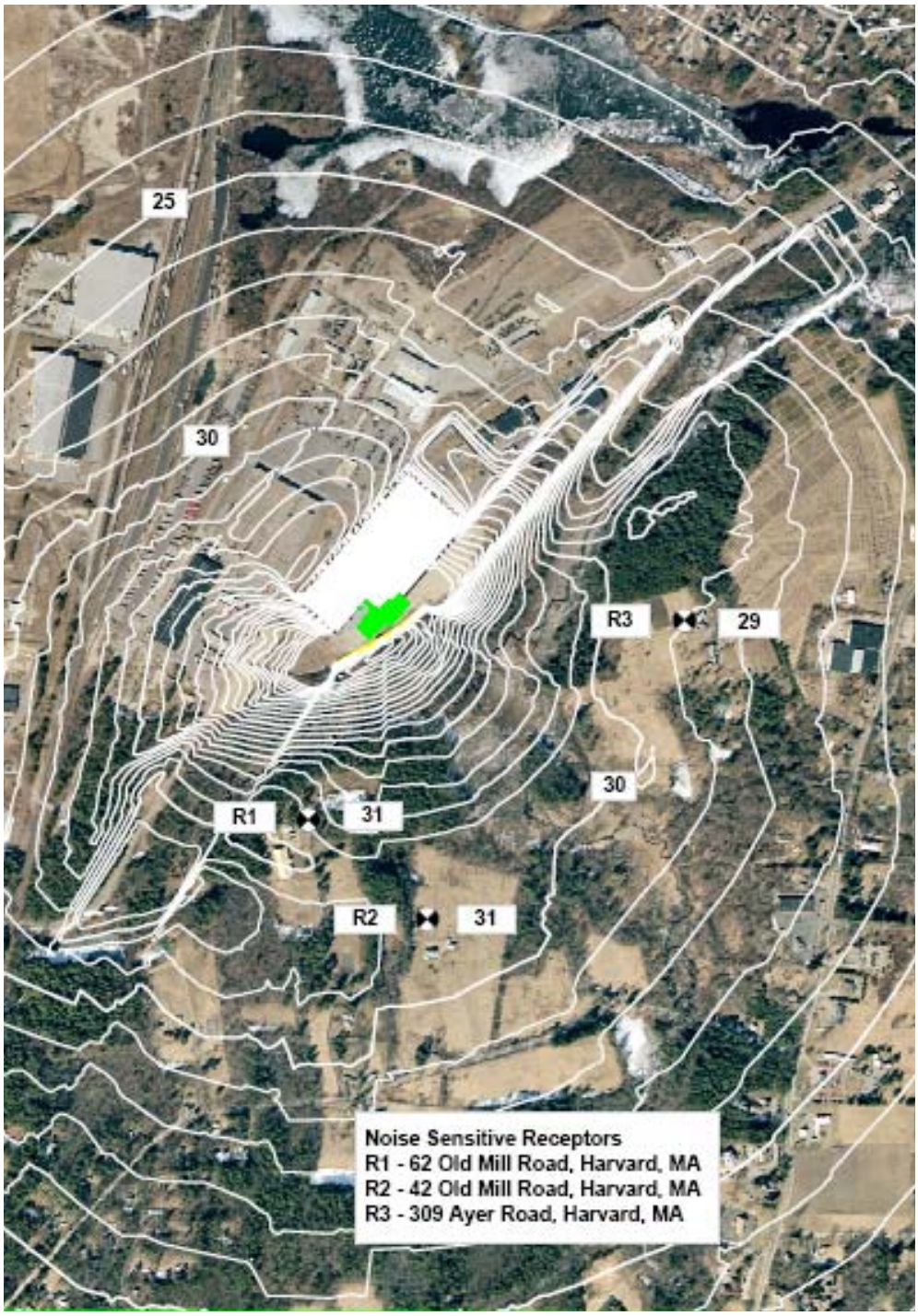

Figure 3-Estimated Plant Noise Levels without Diesel Engine Generator in Operation, dBA