Bullis Savage View Farm, LLC
Grand Isle, VT

Proposed 150 kW Methane Digester Renewable Energy Project

AGRICULTURAL DIGESTERS

Noise Impact Study

.

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Noise Impact Study
for

Proposed 150 kW Methane Digester
Renewable Energy Project

Bullis Savage View Farm
Grand Isle, VT

September 9, 2024

Prepared for:

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I. Introduction & Summary

Bullis Savage View Farm is located at 7 East Shore N in Grand Isle, VT. Bullis Savage View Farm is proposing to construct a 150 kW Methane Digester Renewable Energy Project. The main components of the project consist of:

1. Methane Digester
2. Clark Energy Kohler 185 kW Combined Heat Plant Engine Generator, and
3. Digester gas flare (to control emissions when the engine is not operating).

The purpose of this noise study is to assess the noise impact potential of the operations at the new facility on neighboring properties to satisfy

- the Vermont Public Utility Commission (Act 248) review for noise, and
- the Town of Grand Isle's *Zoning Bylaws & Subdivision Regulations - Section 4.1.2 General Rules Performance Standards – Noise*

The Vermont Public Utility Commission (PUC) Rules do not identify specific noise criteria applicable to agricultural digester energy generation projects. The PUC has adopted noise criteria for other renewables, e.g., wind generation but not methane digesters.

Given the lack of specific PUC criteria, this noise impact analysis will rely on precedent set by Vermont Act 250 maximum allowable noise levels for undue adverse impact at

a. 55 dBA Lmax at any residence or outdoor area of frequent use, and
b. 70 dBA Lmax at the property boundary.

The Town of Grand Isle's *Zoning Bylaws & Subdivision Regulations - Section 4.1.2 General Rules Performance Standards – Noise provides the following standard:*

c. *The following performance standards must be met by all uses in all Districts. The use must not emit any level of sound or noise which is uncharacteristic of the area on a frequent interval (normal agricultural noises will not be considered uncharacteristic of the area.) Examples include operation of motors, saws, machinery, playing of amplified music, discharge of weapons, explosives, etc.* ***Frequent noise levels in excess of sixty-five (65) decibels at the property line are prohibited.*** *{Emphasis added}*

The steps in this study were (1) to establish existing ambient sound levels at the project site through a combination of baseline field measurements and acoustic modeling of existing conditions; (2) perform acoustic modeling of future conditions incorporating the new project; and (3) to compare the projects operational sounds to the limits established.

Results

The study results indicate the proposed project's sound levels meet all of applicable noise standards without needing additional mitigation measures or conditions.

II. Project Description

The proposed project is located on 7 East Shore N in the town of Grand Isle, Vermont. The site is an dairy farm. Savage View is proposing a 150 kW anaerobic digester electric generation project ("the Project").

Existing Conditions:

Bullis Savage View Farm is located at the corner of US Route 2 and East Shore North Road. The location is easterly of the village of Grand Isle.

Lake Champlain is roughly a half-mile east of the site. There are roughly a dozen residence along E Shore N Rd to the south and the Grand Isle

Elementary school directly north of the project site. Immediately north of the school is the Hyde Log Cabin & Schoolhouse which is a State Historic site.

Bullis Savage View Farm is owned by Dwight Bullis, who has been dairy farming at the location his entire life, as have his sons Ryan and Travis. The farm has approximately 875 milking cows at the Project location.

Imagery of Bullis Savage View Farm

Proposed Conditions:

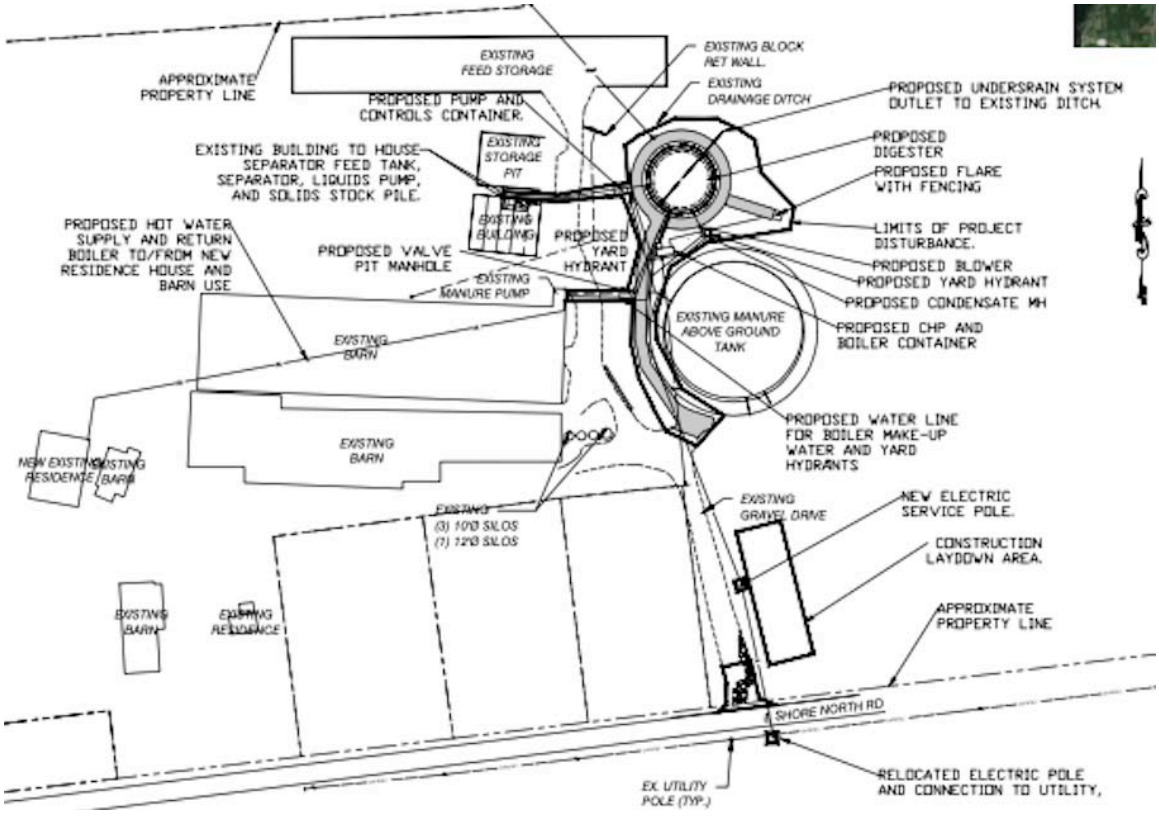
Bullis Savage View Farm is proposing to construct a is proposing a 150 kW anaerobic digester electric generation project. Savage View is working with Agricultural Digesters, LLC to develop the Project.

The Project will consist of a single above-ground digester tank that is fed solely with raw manure from the Farm's milking barn via underground pipe. The digester tank is sealed and operates with mechanical mixers and internal heating coils supplied with waste heat drawn from the electric generator engine, and sized to provide several weeks of manure decomposition residence time. The bacteria formed in the manure in these conditions emits methane which will be used to fuel a combined heat and power (CHP) generator set housed in a Conex container (which will also house controls and other system

mechanical and electric components). A flare will be installed to combust any excess biogas during times when the generator may be out of service.

Photo of a similar project at a different farm showing the digester tank, generator with a flare mounted on the generator's roof.

Th CHP generator set will also distribute heat from the generator to surrounding buildings. Efficiency Vermont will assist Savage View to maximize use of digester heat to eliminate or offset the use of fossil fuel for heating buildings, including residences, on the farm.



Proposed Project Layout

III. General Noise Concepts

Noise is 'unwanted sound'. Sound is what we hear when our ears are exposed to small pressure fluctuations in the air. There are many ways in which pressure fluctuations are generated, but typically they are caused by vibrating movement of a solid object. This report uses the terms 'noise' and 'sound' interchangeably since there is no physical difference between them.

The human sense of hearing is subjective and highly variable between individuals. Noise regulations and guidelines set quantitative limits to the sound pressure level (measured with sound analyzers and predicted with computer models) in order to protect people from sound exposures that most would judge to be annoying or disruptive.

The sensitivity of the human ear to sounds of different frequencies is measured by the A-weighted decibel scale (dBA). A 10-dBA change in noise levels is judged by most people as a doubling of sound level. The smallest change in noise level that a human ear can perceive is about 3-dBA. Increases of 5-dBA or more are clearly noticeable.

The following figure shows sound levels for some common noise sources to give the reader perspective:

Table 1
Sound Levels and Relative Loudness of Typical Noise Sources

Noise Source or Activity	Sound Level (dBA)	Subjective Impression	Relative Loudness (human judgment of different sound levels)
Jet aircraft takeoff from carrier (50 ft)	140	Threshold of pain	64 times as loud
50-hp siren (100 ft)	130		32 times as loud
Loud rock concert near stage, Jet takeoff (200 ft)	120	Uncomfortably loud	16 times as loud
Float plane takeoff (100 ft)	110		8 times as loud
Jet takeoff (2,000 ft)	100	Very loud	4 times as loud
Heavy truck or motorcycle (25 ft)	90		2 times as loud
Garbage disposal, food blender (2 ft), Pneumatic drill (50 ft)	80	Moderately loud	Reference loudness
Vacuum cleaner (10 ft), Passenger car at 65 mph (25 ft)	70		1/2 as loud
Large store air-conditioning unit (20 ft)	60		1/4 as loud
Light auto traffic (100 ft)	50	Quiet	1/8 as loud
Bedroom or quiet living room, Bird calls	40		1/16 as loud
Quiet library, soft whisper (15 ft)	30	Very quiet	
High quality recording studio	20		
Acoustic Test Chamber	10	Just audible	
	0	Threshold of hearing	

Sources: Beranek (1988) and EPA (1971)

Noise levels during the day in a noisy urban area frequently range from 70 to 80 dBA. Noise levels above 110 dBA become intolerable and then painful; levels higher than 80 dBA over continuous periods can result in hearing loss. Constant noises tend to be less noticeable than irregular or periodic noises.

IV. Measuring Sound

Sound is typically measured with an instrument that provides an instantaneous measurement that gives the sound pressure level at an exact moment in time. However, sound pressure levels are constantly changing so it makes sense to describe noise and sound in terms of time.

Instantaneous measurements are logged occur over time and described as, “levels.” Levels of interest in noise studies generally include the maximum level (Lmax), the minimum level (Lmin), etc.

Statistical sound levels, such as the L10, L50, and L90 give us information about the distribution of sound levels over time. For example, the L10 is the sound level that is exceeded 10 percent of the time, while the L90 is the sound level exceeded 90% of the time. The L50 is exceeded half the time.

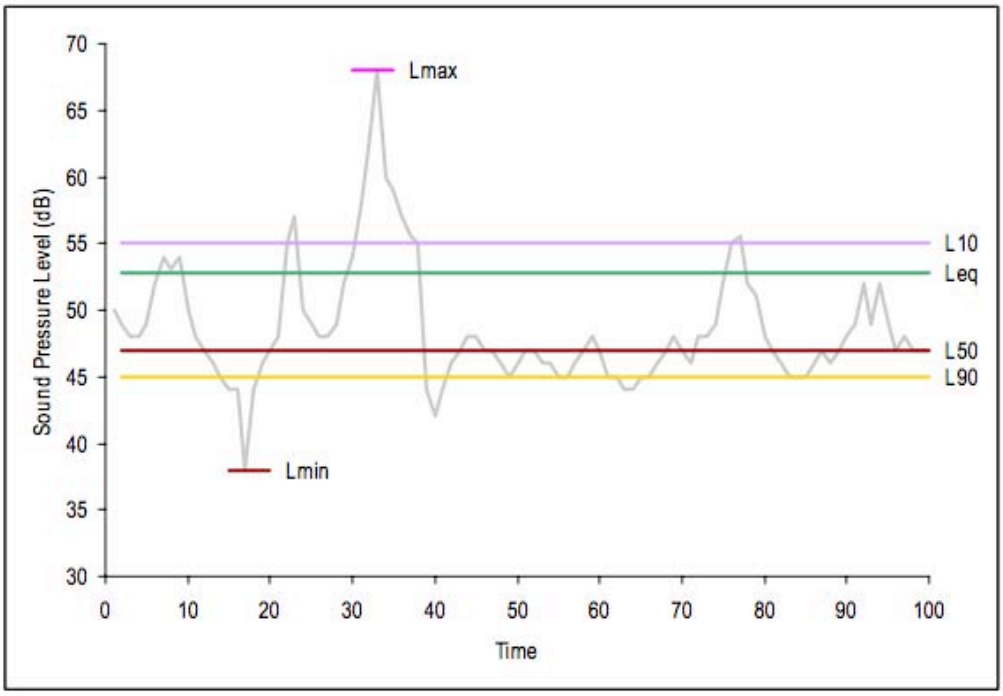


Illustration of Sound Pressure Statistics

A useful metric to describe noise levels is in terms of the “continuous equivalent sound level” (Leq). The Leq is an average of the sound pressure over an entire monitoring period. The monitoring period could be for any amount of time. It could be one second (Leq 1-sec), one hour (Leq (1)), or 24 hours (Leq (24)). When we say average, this is not a simple arithmetic average because we are measuring in decibels that are logarithmic values. To measure Leq, the sound meter converts the dB values to 'real numbers', adds them all up then divides by the number of samples and finally converts this true energy average back to decibels. Because it is not a simple average, loud and infrequent noises have a greater effect on the resulting average level than quieter and more frequent noises. For example, the median sound level be calculated to be 47 dBA, but the equivalent average sound level (Leq) is 53 dBA because it tends to weight the higher sound levels and is representative of sound that takes place over time. The Leq is the most commonly used descriptor in noise standards and regulations.

V. Noise Criteria & Standards

There are several jurisdictions that could regulate noise or provide evaluation criteria.

Local Ordinance

Grand Isle Zoning Bylaws & Subdivision Regulations

Section 4.1.2 General Rules Performance Standards – Noise

The following performance standards must be met by all uses in all Districts. The use must not:

Emit any level of sound or noise which is uncharacteristic of the area on a frequent interval (normal agricultural noises will not be considered uncharacteristic of the area.) Examples include operation of motors, saws, machinery, playing of amplified music, discharge of weapons, explosives, etc. **Frequent noise levels in excess of sixty-five (65) decibels at the property line are prohibited.** *{Emphasis added}*

Act 250 - Vermont Land Use Environmental Commissions (Act 250)

Act 250 has no written guidelines, however, relies on precedent setting case work of *McLean Enterprises Corporation Land Use Permit #2S1147-1-EB to* evaluate “undue noise pollution” under Criteria 1A and Aesthetics Criteria 8. Noise criteria established under McLean as precedent include:

b. Use of the maximum instantaneous sound level measured Lmax.

c. The Board set a maximum allowable noise level for when noise is unduly adverse at

    i. 55 dBA Lmax at any residence or outdoor area of frequent use, and
    ii. 70 dBA Lmax at the property boundary.

These precedents are referenced herein as the compliance criteria.

VI. Assessing Noise Impacts

Sound is caused by variations in air pressure at a range of frequencies. Sound power is a measure of the acoustic power emitted or radiated by a source. Sound pressure is observed at a specific location and is related to the difference in air pressure above or below atmospheric pressure. The fluctuation in air pressure is a result of the sound power of a source, the distance at which the sound pressure level is being observed, and the characteristics of the path and environment around the source and receiver. When one refers to sound level, they are generally speaking of the sound pressure level.

Several factors determine how sound levels decrease over distance. Under ideal conditions, a line noise source (such as constant flowing traffic on a busy highway) decreases at a rate of approximately 3 dB each time the distance doubles.

Under real-life conditions, however, interactions of the sound waves with the ground often results in attenuation that is slightly greater than the ideal reduction factors given above. Other factors that affect the attenuation of sound with distance include existing structures, topography, foliage, ground cover, and atmospheric conditions such as wind, temperature, and relative humidity. Noise in terms of these factors can be assessed using a worksheet format or acoustical modeling software.

The International Standards Organization (ISO) prepared a comprehensive list of factors and methodology to calculate noise in its *ISO 9613-2 Standard, Acoustics- Attenuation of sound during propagation outdoors and Part 2: General Method of Calculation."* The standard states,

> *"ISO 9613 specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level…under meteorological conditions favorable to propagation from sources of known sound emissions. These conditions are for downwind propagation…. propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night."*

The acoustical modeling software package Cadna-A by Datakustik GmbH is an internationally accepted acoustical model to implement ISO 9613. Cadna-A has a high level of reliability and takes into account source power levels, surface reflection and absorption, atmospheric absorption, geometric divergence, meteorological conditions, structures, walls, berms, topography, foliage and other conditions.

Cadna-A also includes Federal Highway Administration methodology TNM to evaluate automotive and truck vehicle noise emissions from roads and highways.

VII. Existing Conditions Field Measurements:

The first step in the noise assessment for this project was to measure actual background sound levels. Field measurements were taken on May 16, 2024 from the morning through the afternoon to observe typical farm operations and measure typical noise conditions. Ambient conditions were considered typical during the noise field measuring.

Sound level measurements were first taken with no vehicle (mobil) operations conducted at Bullis Savage View Farm. This scenario provided the “background” sound levels. There were fans operating in the dairy barn to circulate air amongst the cows. The fans were measured at 60-dB.

The background sound levels were dominated by traffic and truck traffic on US Route 2.

Sound power was measured through a range of Lmin 35-dB to Lmax of 70-dB. Lmax occurred when trucks drove on US Route 2.

VIII. Existing Conditions Cadna-A Acoustical Modeling:

The second step in the noise assessment for this project was to model the existing conditions and background sound levels.

This was not a necessary step but it does provide a check on the model when compared to the measured sound levels at the site. The acoustical modeling software package Cadna-A by Datakustik GmbH is an internationally accepted acoustical model to implement ISO 9613.

The existing buildings, lidar topography, and residences were used to develop a base map for input into the model. Hillside Shading imagery was used to evaluate trees and vegetation. Field survey measurements were taken of buildings, barns, silos, manure tanks, nearby structures and residences including the school and State Historic Site.

Hillside Shading imagery of the site. Source State of Vermont-USGS

The only on-farm noise source input was the dairy barn fans. Mobil farm tractor and other vehicles were not included in the model.

Road noise was modeled. VTrans 2023 Traffic Count data along US 2 (AADT = 2860 trips) and local roads (AADT = 300) were input into the model.

The existing condition model results are shown on the following graphic.

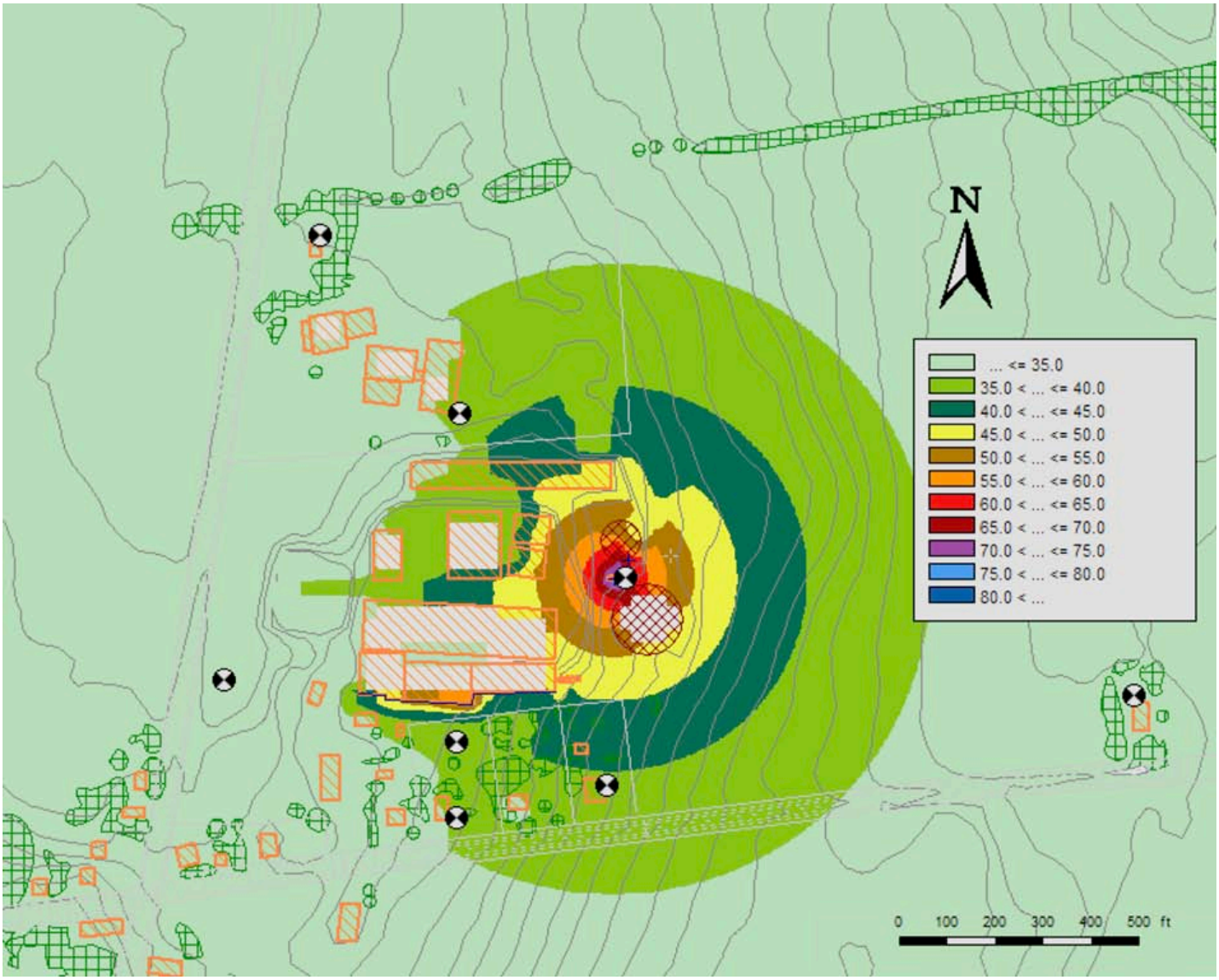
Existing Conditions Model Results

As expected , the existing conditions model identified the roadway traffic noise from US 2 as the prime noise generator. Background noise at the project site was quiet (<35-dB).

IX._Proposed Condition Cadna-A Acoustical Modeling:

The third step in the noise assessment for this project was to model the proposed conditions with the CHP engine operating. The Proposed Condition CHP in Conex (75-dB @10m H = 1m) was input into the model with the existing dairy barn fans.

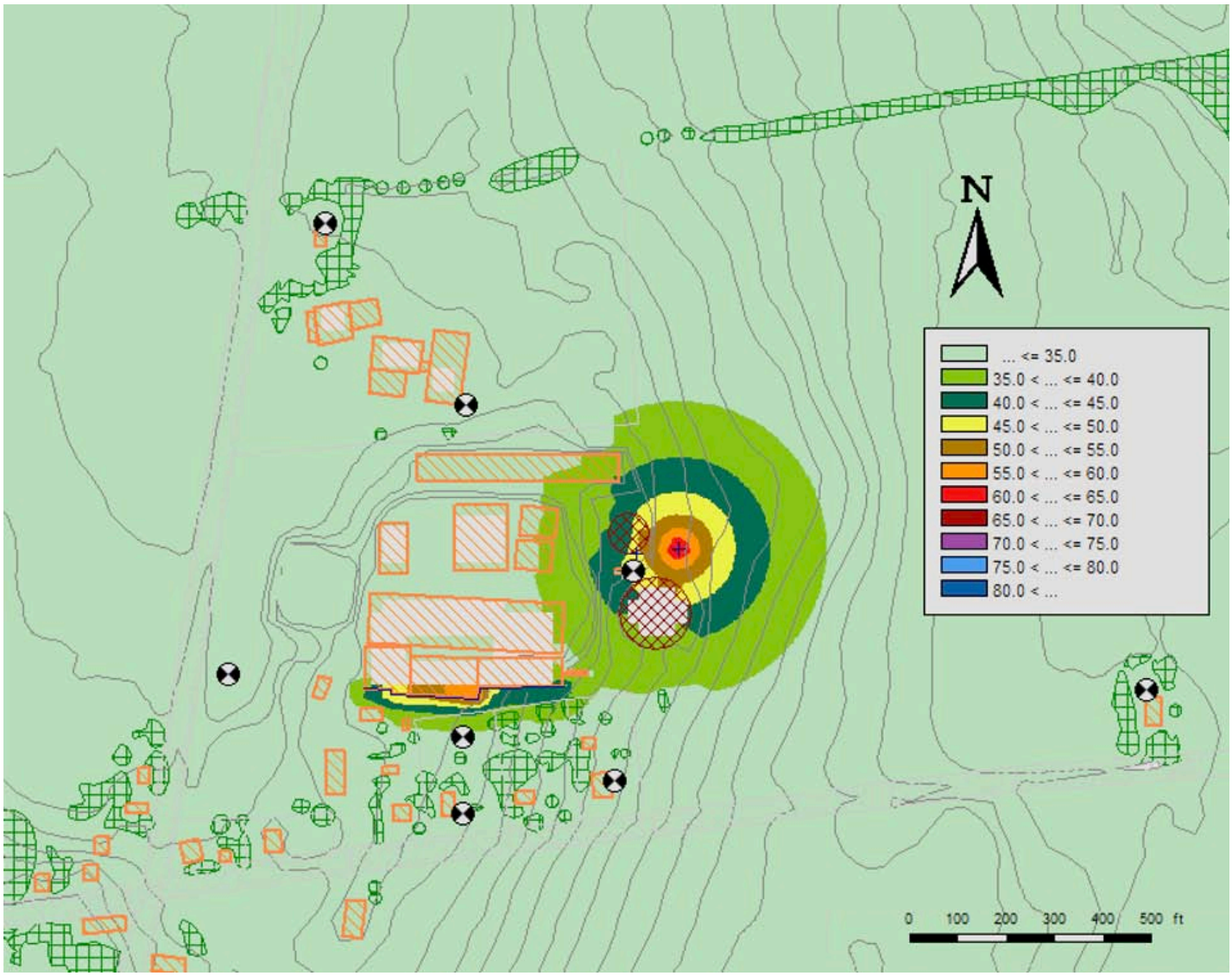
The results of the Proposed Condition with the CHP operating are shown below.



Proposed Condition CHP Operating Model Results

The proposed condition with the CHP operation predict the noise to be less than 50-dB at the property lines, less than 45-dB at the school and nearest residence, and no impact on the State Historic site.

The results of the Proposed Condition with the CHP off and the flare operating are shown below.



The Proposed Condition with the CHP off and the flare operating predict no impact on the school, residences, and State Historic site.

X. Summary of Results

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