SOUTH RIPLEY SOLAR PROJECT NOISE IMPACT ASSESSMENT

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ConnectGen

Report Title:

South Ripley Solar Project Noise Impact Assessment

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1.0 INTRODUCTION

This report is a Project Noise Impact Assessment ("PNIA") of the proposed South Ripley Solar Energy Center (the "Project") as part of its permit application under Chapter XVIII Title 19 of New York Codes, Rules, and Regulations (NYCRR), Part 900 (also known as Section 94-c).[1]

The project will be located in the town of Ripley in Chautauqua County, New York. The area around the project is primarily farmland with some forested and residential areas. The Project is proposed as a 270 MW solar facility with supporting infrastructure that may include approximately 20 MW of energy storage.

This PNIA evaluates the sound generated by the Project and was conducted as part of the Section 94-c permitting process and in accordance with its regulations.[2]

The PNIA includes:

1. A description of the Project.
2. A discussion of sound level limit standards and guidelines applicable to the Project.
3. Sound level monitoring procedures.
4. Sound monitoring results from monitoring conducted within the Project area.
5. Sound propagation modeling procedures.
6. Sound propagation modeling results.
7. A discussion and analysis of construction noise and its mitigation.
8. Conclusions.

A primer and glossary discussing terms found in this report are in Appendix E and Appendix F, respectively.

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[1] This study was prepared by Mr. Kenneth Kaliski of Resource Systems Group, Inc. (RSG). Mr. Kaliski is Board Certified through the Institute of Noise Control Engineering, a Professional Engineer (licenses in Vermont, New Hampshire, Illinois, Michigan, and Massachusetts) and is a member of the Acoustical Society of America. RSG is a member of the National Council of Acoustical Consultants. Mr. Kaliski has 35 years of experience at RSG. He has substantial experience with noise from renewable energy facilities and is the co-author of "An overview of sound from commercial photovoltaic facilities," Proceedings of Noise-Con 2020, New Orleans, Louisiana.

[2] This report updates the PNIA of August 2021 in response to ORES comments.

2.0 STANDARDS, GUIDELINES, AND PROJECT DESIGN GOALS

This section describes the noise regulations that apply to the Project and any additional sound level design goals. Local standards are discussed first, followed by Section 94-c standards, and international guidelines referenced in Section 94-c.

2.1 TOWN NOISE STANDARD

The Town of Ripley Zoning Document (February 9, 2017) requires a "noise level study" for permit submission but does not provide quantitative noise standards:

> ***Section 620 "Solar and Wind Systems***
> *Solar Panels may be considered accessory "structures" and they do present peculiar safety hazards and challenges (agricultural or otherwise) for First Responders and Fire Departments. They are subject to site plan and other specific review, NYS constitution article XIV and NYS SEQR refer. Minimum requisites for submission and County referral are:*
>
> *1. Draft sketch of installation including boundary lines.*
> *2. Reflectivity and noise level studies.*
> *3. Certification of limitation to allowable 110% farm use*

In September, 2021, the Town Board of Ripley adopted an amendment to the Town of Ripley's Zoning Law which included new noise requirements for solar energy projects at the time of Application submission. The amendment is as follows:

> *"Noise: Once in operation, sound pressure level at the exterior of any residence or non-participating property line, expressed in terms of dBA Leq-8hr, shall not exceed existing background ambient noise, expressed in dBA Leq-8hr as measured by a qualified acoustician, by more than 6dB."*

The Applicant is seeking a waiver to this noise requirement, as discussed in Exhibit 24.

2.2 STATE REGULATIONS

The Project is evaluated by New York State under Chapter XVIII, Title 19 of NYCRR Part 900, and noise is evaluated specifically under the State of New York Office of Renewable Energy Siting, Part 900-2.8, Exhibit 7, also called "Section 94-c".

For solar facilities, the regulation specifies a maximum exterior noise limit of 45 dBA L_{8h} at the outside of any existing non-participating residence and 55 dBA L_{8h} at the outside of any existing participating residence. Noise from collector substation equipment is limited to 40 dBA L_{1h} at existing non-participating residences. Audible prominent tones are given a +5 dBA penalty at residences. The tonal penalty applies only at residences, not at residential property lines. The standards are as measured outside the home or building housing the sensitive land use (residence, seasonal residence, school, hospital, etc.) and would not apply to areas that have transient uses such as camps, driveways, trails, farm fields, and parking areas.[3]

The regulations also specify a standard of 55 dBA L_{8h} at any portion of a non-participating property except NYS-regulated wetlands and utility rights-of-way.

A radius of evaluation, modeling standards, input parameters, and assumptions are also given in the regulations, as well as evaluation procedures for prominent tones, ambient pre-construction baseline conditions, modeling of future noise levels, and reasonable noise abatement measures for operational and construction activities. Relevant excerpts from the regulation can be found in Appendix A.

2.3 WORLD HEALTH ORGANIZATION

The United Nation's World Health Organization (WHO) has published "Guidelines for Community Noise" (1999) which uses research on the health impacts of noise to develop guideline sound levels for communities. The foreword of the report states, "The scope of WHO's effort to derive guidelines for community noise is to consolidate actual scientific knowledge on the health impacts of community noise and to provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in non-industrial environments."

The WHO long-term guideline to protect against hearing impairment is 70 dBA L_{24h} over a lifetime exposure, and higher for occupational or recreational exposure. For short-term protection against hearing impairment due to impulsive sound the guideline is 120 dB-peak for children and 140 dB-peak for adults. Section 94-c requires comparison with these thresholds for construction and blasting.

2.4 SOUND THRESHOLDS FOR SOUTH RIPLEY SOLAR

A summary of the design goals, regulatory limits, and proposed assessment thresholds are shown in Table 1.

[3] Seasonal homes have operating septic systems or running water whereas "camps" do not. Seasonal homes are considered sensitive receptors, but camps are not.

TABLE 1: PROJECT DESIGN GOALS AND REGULATORY LIMITS

To Address	Guideline or Regulation
Section 94-c regulations – residences exterior	Non-participating: 45 dBA L_{8h}
	Participating: 55 dBA L_{8h}
Section 94-c regulations – residential property lines	Non-participating: 55 dBA L_{8h}
Section 94-c regulation – from substation noise	40 dBA L_{1h} for non-participating residences
WHO 1999 hearing impairment guidelines [per Section 94-c, Exhibit 7(m)(1)]	120 dB-peak for children
	140 dB-peak for adults
	70 dBA L_{24h}
ANSI S12.9 Part 4 tonal penalty [per Section 94-c, Exhibit 7(b)(2)(ii)]	5 dB penalty for audible prominent tones at sensitive receptors

3.0 PROJECT DESCRIPTION

3.1 PROJECT AREA

The Project area is immediately to the east of the Pennsylvania and New York border, south of Interstate 90 and north of Interstate 86. State Route 64 and State Route 303 run northwest to southeast through the project. The Project is situated between the towns of North East, PA and Sherman, NY, located about 6 km (3.75 miles) from each town. The major geographical features in the area, which is a mixture of open agricultural land and forests, include Lake Erie (10 km to the north) and the Twentymile Creek valley, which runs to the north side of the Project. A high-voltage power line right-of-way cuts through the western side of the Project from southwest to northeast. A railroad parallels NY-20 about 5 km (3 miles) north of the Project area. A regional map of the Project area is shown in Figure 1.

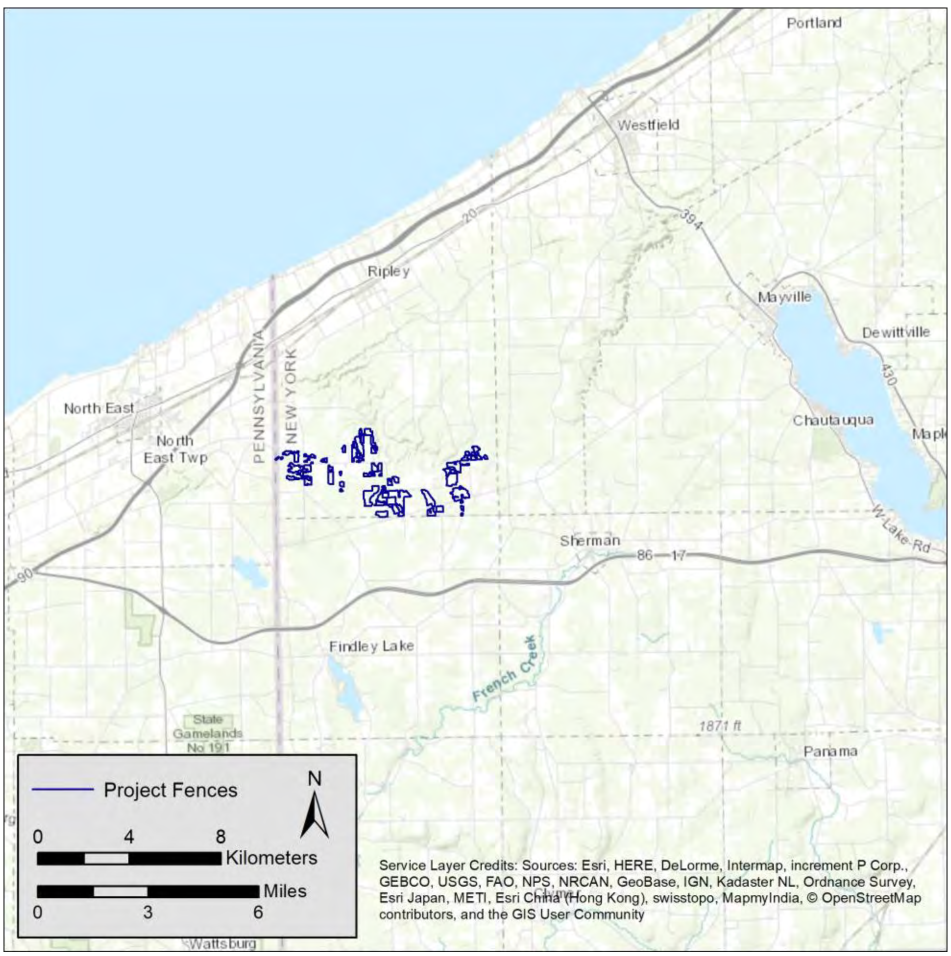


FIGURE 1. REGIONAL MAP

Land within the project boundary is primarily forested and open land. The open areas in the region are dominated by homestead plots and agriculture, including working farms and livestock agriculture. Rural residential homesteads are located throughout the region, mostly occupying cleared land and old farm fields. Seasonal hobby activities such as snowmobiling, operation of off-road ATV's, hunting, fishing, and gardening are widespread. Livestock agriculture is predominant, that is, raising of cattle for milk and beef. Beef and milk operations include cornfields and hayfields for livestock feed, open fields for grazing, milking barns, and the operation of farm equipment on local roads and throughout the fields.

3.2 PROJECT ELEMENTS

The primary operational sound sources include:

- A high-voltage substation transformer rated at 285 MVA, 825 kV BIL, and steps up power to the distribution grid voltage of 230 kV. The transformer will have sound emissions that are guaranteed by the manufacturer to be at least 10 dB below that allowed by the NEMA TR-1 standard.
- 2,232 string inverters rated between 1 and 3 MVA. The inverters will have a temperature-controlled cooling fan that will operate mostly during hotter weather and high loads.
- 136 medium voltage transformers ("MVT"). These transformers will not have cooling fans.
- 20 MW of energy storage. The energy storage facility will include 21 battery energy storage (BESS) units with two HVAC units, each, and seven power conversion system (PCS) units. The energy storage units are typically charged during the day and discharge during the evening. Cooling fans on the battery storage units are temperature controlled and would operate as a function of ambient temperature and charge/discharge loading. The discharge is rated at a four-hour duration.

The project also includes other de-minimis potential sources of sound. These include:

- A small air conditioning unit on the operations building within the substation, and
- Gas-fired breakers that only operate in emergencies.

The solar panels are fixed-tilt. There are no trackers. Thus, outside of the MVTs and inverters, there are no sound generating sources within the arrays.

Daytime operations could include all sources operating – potentially at their maximum capacity simultaneously. The energy storage system typically discharges during the evening (4 pm to 10 pm), but it could discharge at any time of the day or night as conditions dictate. During the night, the inverters may operate for VAR control, the MVTs are energized, and the substation transformer would be energized, but without cooling fans operating.

Electricity from all the solar arrays will come together through underground and overhead collection lines into a proposed substation located on the south side of NE Sherman Rd, adjacent to the Pennsylvania border. The nearest residence to the proposed substation is approximately 90 meters (300 ft) to north, on the opposite side of NE Sherman Rd

A map of the Project area showing modeled receptors, and Project elements is provided in Figure 2.

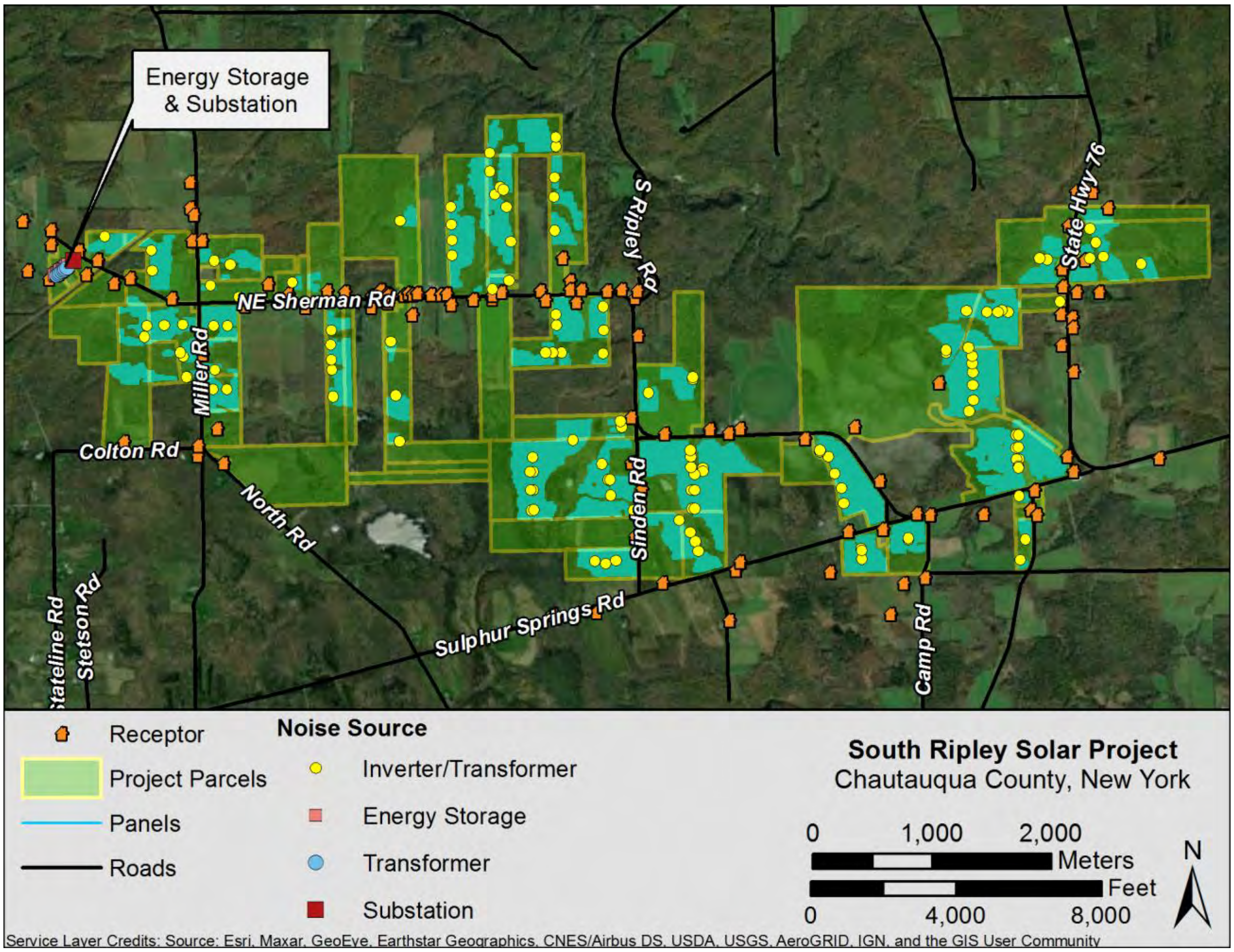


FIGURE 2: PROJECT SITE MAP

4.0 AMBIENT PRE-CONSTRUCTION SOUND LEVEL MONITORING

A detailed monitoring program was developed to assess the ambient pre-construction sound levels for the variety of soundscapes that exist within the Project area. The Project area contains working farms and farmland, rural homesteads, and local roads. Monitoring sites were distributed throughout the Project area to be as representative as possible of the broader local soundscapes that exist in the immediate area.

4.1 REPRESENTATIVE MONITOR LOCATIONS

Six monitoring locations, distributed within the Project boundary, were selected as representative of the different ambient soundscapes in the area. The representative areas included rural residential, farming, low and high traffic roads, and remote areas.

The six selected monitoring locations that represent these areas are referred to by the nearest road or feature: “CR 64,” “Miller Road,” “Substation,” “CR 303,” “Sulphur Springs Road,” and “Meeder Road.” The monitoring locations are listed in Table 2, which indicates the defining characteristics of each location. The geographical distribution of the sites is shown on the map in the next section in Figure 3. Each of the sites are discussed further below.

TABLE 2: MONITORING LOCATION CHARACTERISTICS

Monitor Label	Site Name	Rural Residential	Active Farm	Low Traffic	Truck Traffic	High Traffic	Remote Area
A	CR 64	X	X		X	X	
B	Miller Road			X			
C	Substation	X			X	X	
D	CR 303			X			X
E	Sulphur Springs Road			X			X
F	Meeder Road	X	X		X	X	

4.2 SCOPE OF MONITORING

Long-term sound level monitoring was carried out at the six sites in the winter, from March 4 to 12, 2020, and the summer, from July 9 to July 16, 2020. Monitoring locations, distributed throughout the project area, are shown in Figure 3.

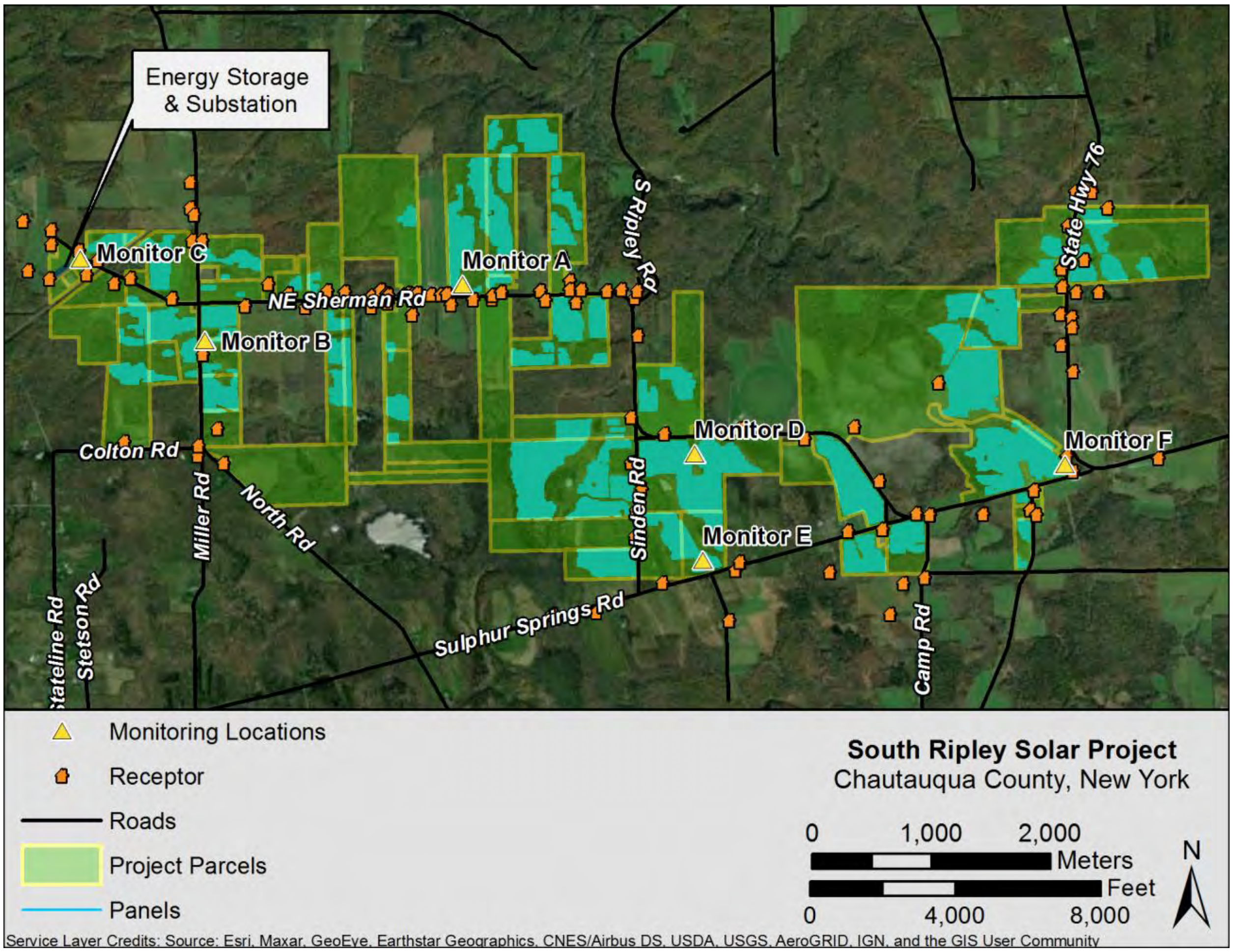


FIGURE 3: OVERVIEW OF MONITORING LOCATIONS

4.3 METHODOLOGY

Sound level data were collected with ANSI/IEC Class 1 sound level meters that continuously logged overall and 1/3-octave band sound levels once each second. Three models of sound level meters were utilized, as shown in Table 3.

Each sound level meter microphone was mounted on a wooden stake at a height of approximately 1.2 m (4 ft.) and protected by an ACO-Pacific hydrophobic windscreen (170 mm (7 in.) diameter). Audio signals from each microphone were recorded continuously throughout the monitoring period to allow for sound source identification. The Svantek meter was set to record digital audio internally, and the Cesva meters were connected to Roland R-05 or R-09HR digital sound recorders for source identification by audio. All sound level meters were calibrated before and after monitoring periods, with either a Cesva CB-5, Larson Davis CAL200, or Brüel and Kjær 4231 calibrator, emitting a 94 dB tone at 1 kHz.

Wind speeds were logged at each monitoring site. Precipitation and air temperature were logged at Meeder Road. Although the ASOS station at Erie International Airport (ERI) is physically closer, the overall meteorology from the ASOS station at the Chautauqua County-Jamestown Airport was found to have a more accurate representation of the site.

TABLE 3: SOUND LEVEL METERS AT EACH SITE

Monitor Location	Summer	Winter	Coordinates UTM NAD83 Z18N	
			X (m)	Y (m)
CR 64	Cesva SC-310	Cesva SC-310	605,687	4,672,311
Miller Road	Cesva SC-310	Svantek SV979	603,529	4,671,838
Substation	Svantek SV979	Svantek SV979	602,484	4,672,527
CR 303	Cesva SC-310	Cirrus CR:171	607,637	4,670,893
Sulphur Springs Road	Cesva SC-310	Cirrus CR:171	607,702	4,669,999
Meeder Road	Svantek SV979	Svantek SV979	610,740	4,670,800

4.4 DATA ANALYSIS

One-second sound level data from each monitor were averaged into 10-minute periods and summarized over the entire monitoring period. Data were excluded from the averaging under the following conditions:

- Wind gust speeds above 5 m/s (11 mph)
- Temperatures below -18° C (0° F)
- Extreme values of relative humidity (equipment specification dependent)
- Precipitation in the form of rain, sleet, or ice
- Thunder
- Anomalous sounds that were out of character for the area being monitored, including nearby chainsaws, lawn equipment, and nearby farm equipment
- Seasonal sound sources such as harvesting equipment, lawn mowers, and snow removal equipment, and
- During microphone calibration.

Particularly during summer monitoring, biogenic sounds including insects, amphibians, and birds were present. These seasonal sounds were filtered out of the reported sound levels using the “ANS” frequency-weighting network when tonal bird and insect sound was found.[4] This effectively removes the high-frequency portion of biogenic sound.

4.5 FORMAT OF MONITORING RESULTS

Over 4,000 hours of sound level data were collected for this project. This section describes how the background sound level results are presented for each monitor over both seasons of monitoring. Following the site descriptions, the actual results are presented.

For each monitoring location, results are presented as graphs of sound level and maximum wind gust speed as a function of time throughout the monitoring period in Section 5. For each monitor site, results are presented as graphs of sound level, temperature, and gust wind speed

[4] Sounds considered tonal that get the ANS weight applied are those for which a prominent discrete high frequency (>1.25 kHz) tone is found using either of the two methods:

1. If a 1/3 octave band exceeds the neighboring 1/3 octave band on either side by more than 5 dB (as in ANSI S12.9 Part 4 Annex C), or
2. If a 1/3 octave band exceeds the average of the two neighboring lower and two neighboring upper 1/3 octave bands on each side by more than 5 dB.

The latter method is used to capture complex bird harmonic sounds that would not be considered tonal under the first method.

as a function of time throughout the monitoring period. Each plot runs from Monday through Sunday.

Each point on the graph represents data summarized for a single 10-minute interval. Equivalent continuous sound levels (L_{eq}) are the energy-average sound level over 10 minutes. The tenth-percentile sound level (L_{90}) is the sound level that is exceeded 90% of the time during each 10-minute period. Sound level data for the winter is presented as overall A-weighted data sound levels, while summer sound levels are provided with ANS-weighting that removes tonal biogenic noise.

Processed data represent sound levels for those periods for which data have been excluded, as explained in Section 4.3. The reason for exclusion of data at a particular 10-minute interval (i.e., low temperature, wind gusts, relative humidity, or anomalous activity) is indicated in the lower portion of each figure. Sound level data during the excluded periods are shown in lighter shade for the L_{eq} and L_{90}. Note that daylight savings occurred during the monitoring period and thus there is no data between 2 AM and 3 AM on Sunday, March 8th.

Wind data from each site are presented as average wind speed and gust wind speed. The 10-minute average wind speed data are averaged for all observations in the 10-minute interval. The gust speed is the maximum gust occurring at any time during the 10-minute interval; these are not averaged. All data provided in this report is reported in local time, which observes daylight savings time. Winter monitoring was in EST (GMT+5) while summer monitoring occurred in observance of Daylight Savings Time - EDT (GMT +4).

5.0 SOUND LEVEL MONITORING RESULTS

Sound level monitoring at each site is detailed in this section. The location of each site is described, followed by sound level results from the winter and summer monitoring periods.

5.1 MONITOR A: COUNTY ROAD 64

The “CR 64” monitor was located at along an access road to upland fields along County Road 64 (also referred to as NE Sherman Road) in Ripley, New York. The parcel is surrounded by rural residential plots, farm fields, forest, an active beef operation (250 meters (820 feet) to the west), and a winery (500 meters (1,640 feet) to the southwest). A stream runs about 65 meters to the southeast of the monitor location. The site is located on the map in Figure 4. Figure 5 shows the installed monitor adjacent to a telephone pole alongside the parcel’s access road in winter and summer conditions, respectively.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 4: COUNTY ROAD 64 MONITOR LOCATION MAP

FIGURE 5: PHOTOGRAPH OF THE CR 64 MONITOR SITE IN WINTER, LOOKING EAST AND IN SUMMER, LOOKING SOUTHWEST

Monitoring Results Description

Winter

Long-term winter sound level results are plotted as time history plots in Figure 6 alongside the average and gust wind speed measured adjacent to the microphone, period exclusions, and regional humidity. Sound levels at the monitor generally fluctuated diurnally, with higher sound levels during the day that were mostly caused by intermittent high-speed traffic on CR 64. Trains were present throughout day and night with clearly audible train horns. A stationary siren from the firehouse sounded daily at 5pm (except on Sundays). Sirens found at other times were removed from the averaging as anomalous events. Other contributing sources of sound were aircraft overflights (at least one per hour during the day and about one every two hours at night), dogs barking, nighttime mammal activity (including domestic dogs), birds (including crows), tractors and small equipment operating in the distance, truck passbys, and intermittent distant gunfire. An unidentified mammal interacting with the monitor necessitated exclusion on one occasion. The elevated L_{90} sound levels in the afternoons (on 3/5, 3/11, and 3/12) were a result of tractors or 4-wheelers operating on nearby parcels. Plowing activity (both municipal and resident) was removed, as the National Operational Hydrologic Remote Sensing Center recorded snow on the evening of the March 6th. The lowest sound levels at the site were driven by the nearby creek, as nighttime levels on nights following precipitation events were slightly higher than other nights (precipitation occurred earlier in the day prior to monitor deployment).

Summer

Long term time history results from the summer monitoring period are provided in Figure 7. Similar to the winter monitoring, the sound levels showed a diurnal pattern that was driven by traffic and human activity during the day. Nighttime L_{90} responded diurnally along with the L_{eq} due to the lack of water running in the nearby creek. A substantial portion of the monitoring period (mostly at night) was excluded due to exceedance of the sound level meter's relative humidity specification. Thunderstorm events were recorded on the first three days of monitoring (July 10th through July 12th). Traffic, intermittent farm and outdoor equipment, biogenic noise, and distant trains were the signature sources during the summer.

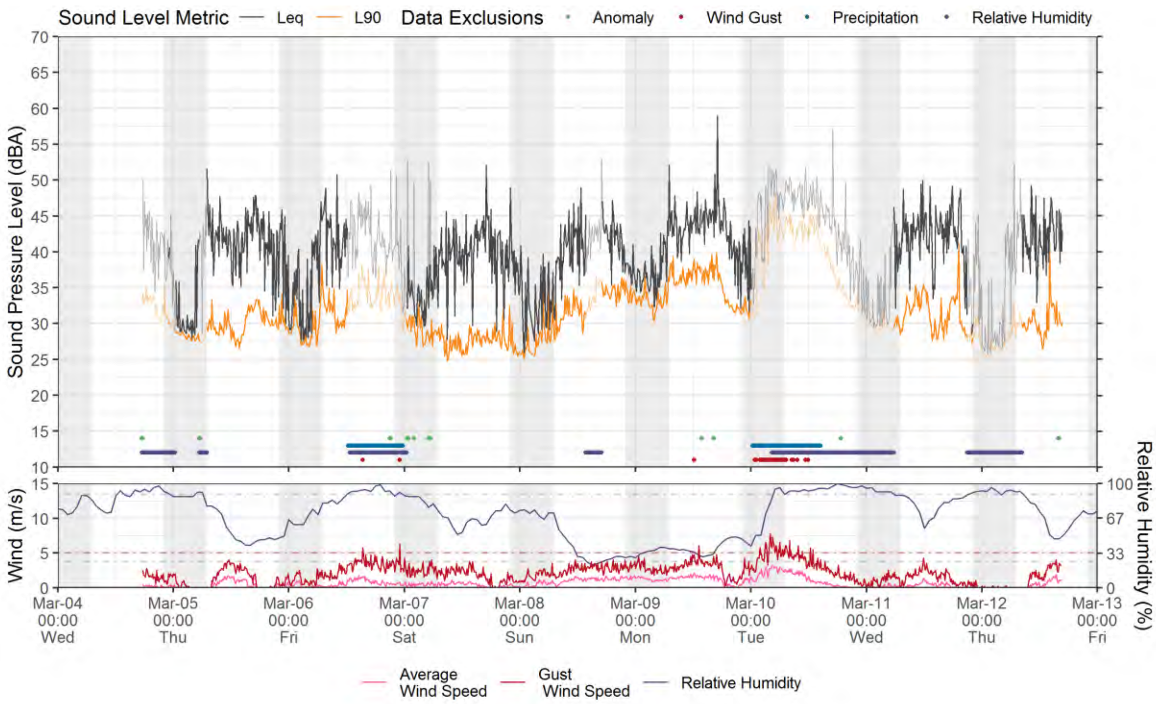


FIGURE 6: CR 64 MONITOR TIME HISTORY—WINTER—MARCH 4 TO MARCH 13, 2020

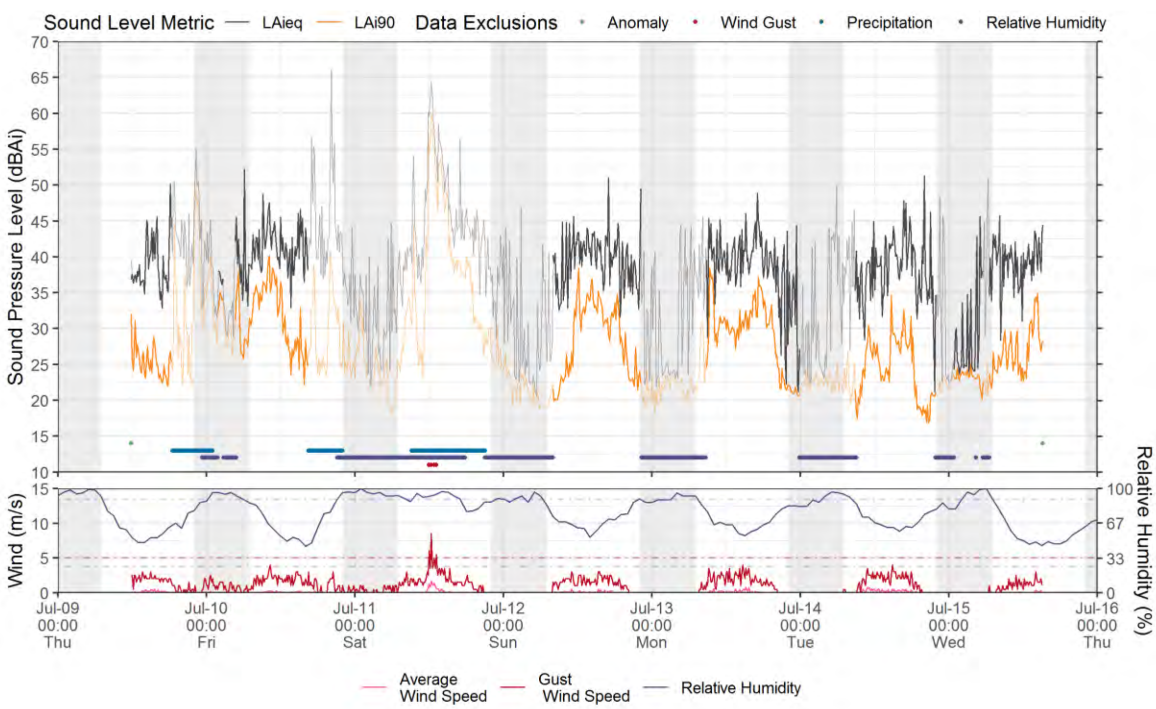


FIGURE 7: CR 64 MONITOR TIME HISTORY—SUMMER —JULY 9 TO JULY 16, 2020

5.2 MONITOR B: MILLER ROAD

The “Miller Road” monitor was located to the north of a homestead in Ripley, New York in what appeared to be an old vineyard and has since grown back to sparse trees and grass. The monitor was approximately 45 meters (150 feet) east of Miller Road and 100 meters (330 feet) north of the residence. The parcel is surrounded by forests and hayfields. A residential wind turbine was located 110 meters (360 feet) southeast of the monitor.

An aerial view of the monitoring site is shown in Figure 8. Pictures of the monitor installed in winter and summer monitor are provided in Figure 9.

FIGURE 8: MILLER ROAD MONITOR LOCATION MAP

FIGURE 9: PHOTOGRAPHS OF THE MILLER ROAD MONITOR IN WINTER, LOOKING SOUTHEAST, AND IN SUMMER, LOOKING NORTHEAST

Winter Monitoring

Long-term winter sound level results are plotted as time history graphs in Figure 10 along with the average and gust wind speed. Sound levels generally followed a diurnal pattern with sound levels higher during the day and lower at night due mostly to anthropogenic activity. Sound levels during the day on weekdays were higher than the weekend due to lighter traffic on the weekdays. The daily fluctuations in sound level were often interrupted during windy periods due to the operation of the nearby residential wind turbine. The lowest sound levels on nights with continuous wind was notably higher than on less windy nights, as a result of the small wind turbine operating nearby. When nights were calm, the fully diurnal pattern due to anthropogenic activity was clear.

Other sounds included the daily stationary siren form the firehouse, a tractor operating at a distance on the property, residents coming and going from the property, distant car and truck passbys on CR 64, infrequent truck and car passbys on Miller Road, commercial aircraft overflights and low-flying small aircraft. Distant trains and train whistles were audible throughout the early mornings and nighttime periods with typically more than ten distant train passbys each day. As alluded to above, the wind turbine generator on the property was often audible during quiet periods when the wind was blowing aloft.

The two spikes on the last day of monitoring were from a small low flying aircraft, which also occurred on the afternoon of March 8th and the morning of March 9th.

Summer Monitoring

The time history results from the summer monitoring in July 2020 at the Miller Road monitor are presented in Figure 11. Sound levels were typically diurnal in response to vehicular traffic and outdoor equipment, though the pattern was interrupted on some occasions with higher apparent sound emissions from a nearby residential turbine. Periods in which the L_{90} and L_{eq} tracked together were indicative of sound emissions from the nearby residential turbine, such as on the overnight from July 10th to 11th and at the beginning of July 15th.

Daytime anthropogenic noise was dominated by vehicle passbys on Miller Road with spikes intermittent 10-1minute L_{eq} between 40 and 50 dBA. Several truck passbys in the morning of July 14th caused the highest nighttime sound levels of the period. Distant trains were evident throughout the day and night.

Bird sounds were prevalent surrounding dawn and dusk each day; the contribution of this biogenic noise is mostly removed by the smart-ANS weighting. The 10-minute A-weighted sound level dipped below 20 dBA in the evening on July 14th due to low windspeeds, minimal anthropogenic activity, and no wind turbine operation.

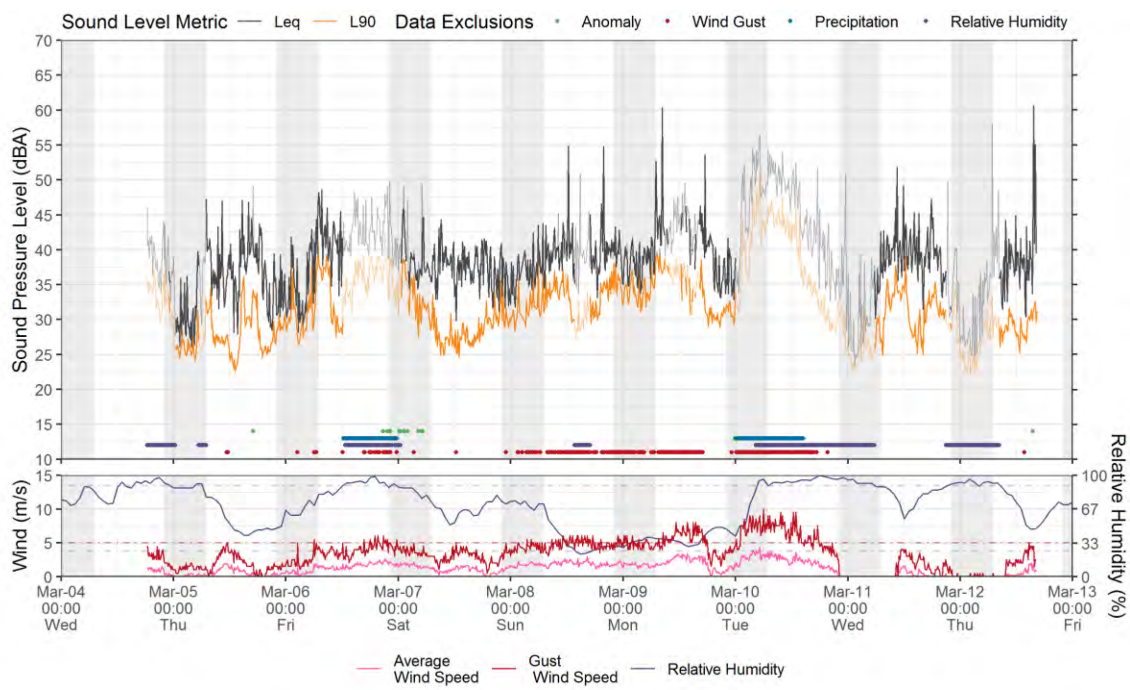


FIGURE 10: MILLER ROAD MONITOR TIME HISTORY—WINTER —MARCH 4 TO MARCH 13, 2020

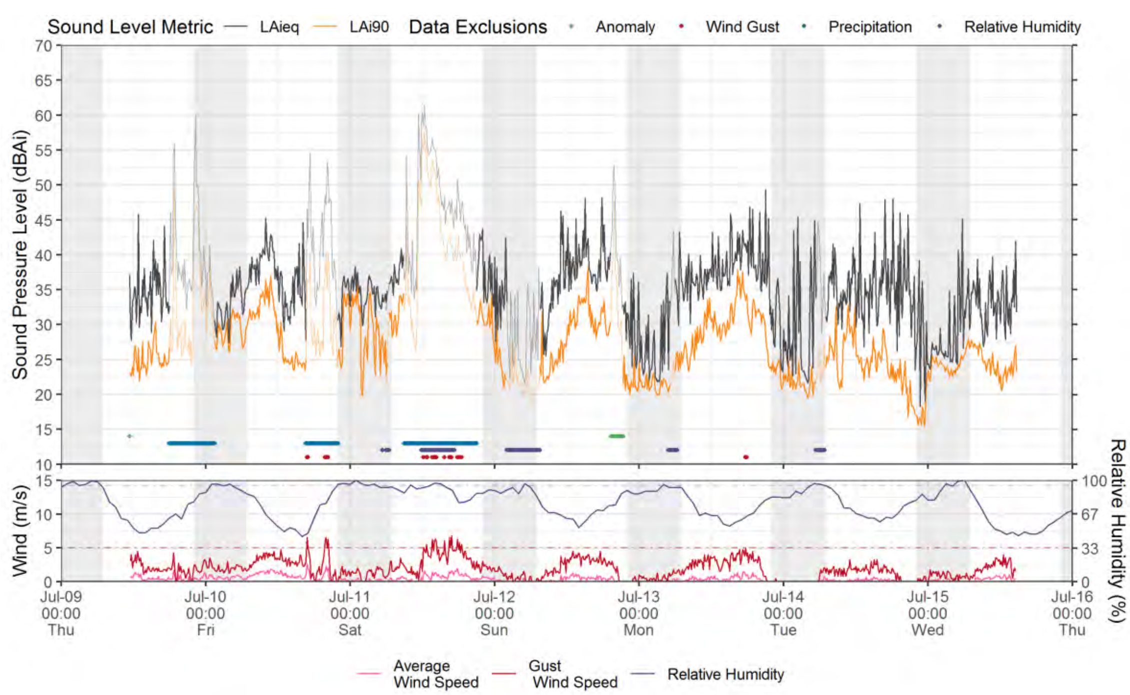


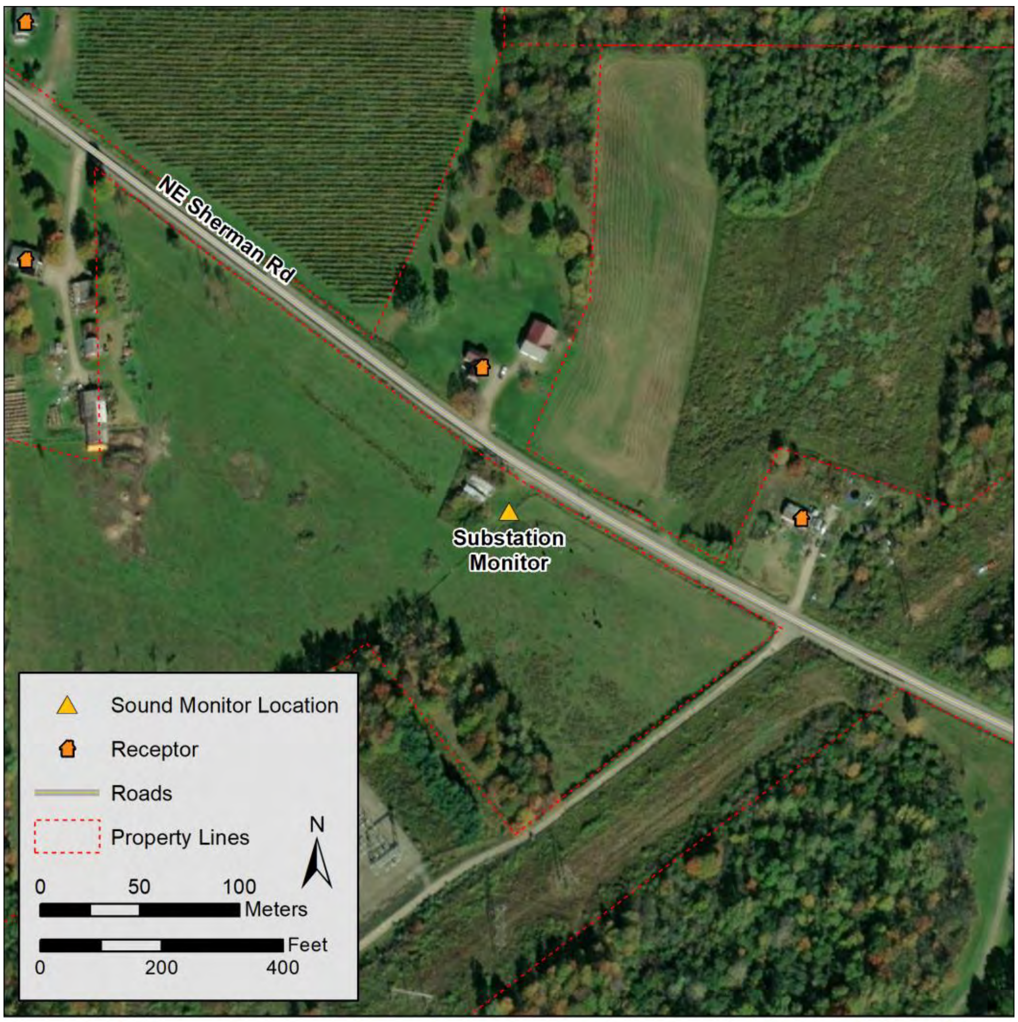
FIGURE 11: MILLER ROAD MONITOR TIME HISTORY—SUMMER— JULY 9 TO JULY 16, 2020

5.3 MONITOR C: SUBSTATION

The “Substation” monitor was located on an uninhabited parcel 265 meters (870 feet) east of the Pennsylvania state line in Ripley, New York. The monitor was approximately 19 meters (62 feet) from the road and 150 meters (490 feet) northeast of the existing area substation.

The monitor was near a small pond at the low point of a cow pasture and adjacent to three storage containers. Two residences are located across CR 64 (NE Sherman Road), at 85 meters (280 feet) to the north and 140 meters (460 feet) to the east from the monitor.

An aerial view of the site is provided in the map in Figure 12. Figure 13 shows photographs of the monitor installed in winter and summer conditions.



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 12: SUBSTATION MONITOR LOCATION MAP

FIGURE 13: PHOTOGRAPH OF THE SUBSTATION MONITOR SITE IN WINTER, LOOKING EAST AND IN SUMMER, LOOKING SOUTH

Winter Monitoring

Long-term winter sound level results are plotted as time history graphs in Figure 14. CR 64 was the main source of sound throughout the monitoring period; sound levels generally tracked with traffic volumes with a clear diurnal pattern, leading to higher sound levels during the day and lower sound levels at night. Typical sounds observed at the site included high-speed car, truck, and motorcycle passbys on CR 64, distant trains, and train whistles, aircraft overflights (commercial and recreational), trickling water, and local sounds.

The spikes around 5 PM on March 8th and in the early afternoon on the last two days of monitoring were caused by motorcycle passbys and idling.

Summer Monitoring

Figure 15 provides the time history results of the summer monitoring period at the CR 64 monitor. The consistent ~10 dB difference between the L_{90} and L_{eq} at the monitor indicates that short duration events dominate the soundscape. For the first couple of days, the short duration events were mostly limited to daytime due to high-speed vehicular traffic on CR 64; ten-minute nighttime L_{eq} were generally below 35 dBA.

After the precipitation during the first three days of monitoring, increased amphibian activity was notable, as the nearby wetland area had been refreshed. After the beginning of the heightened amphibian activity on the morning of July 12th, amphibian sound dominated the nighttime soundscape between midnight and noon. The sounds produced by the frogs were broadband from about 300 Hz to 3 kHz and thus the Smart ANS weighting did not completely remove the frog sound. Ten-minute equivalent sound levels at night with the frogs active were around 50 dBA,NS, which was slightly elevated above daytime levels in their absence.

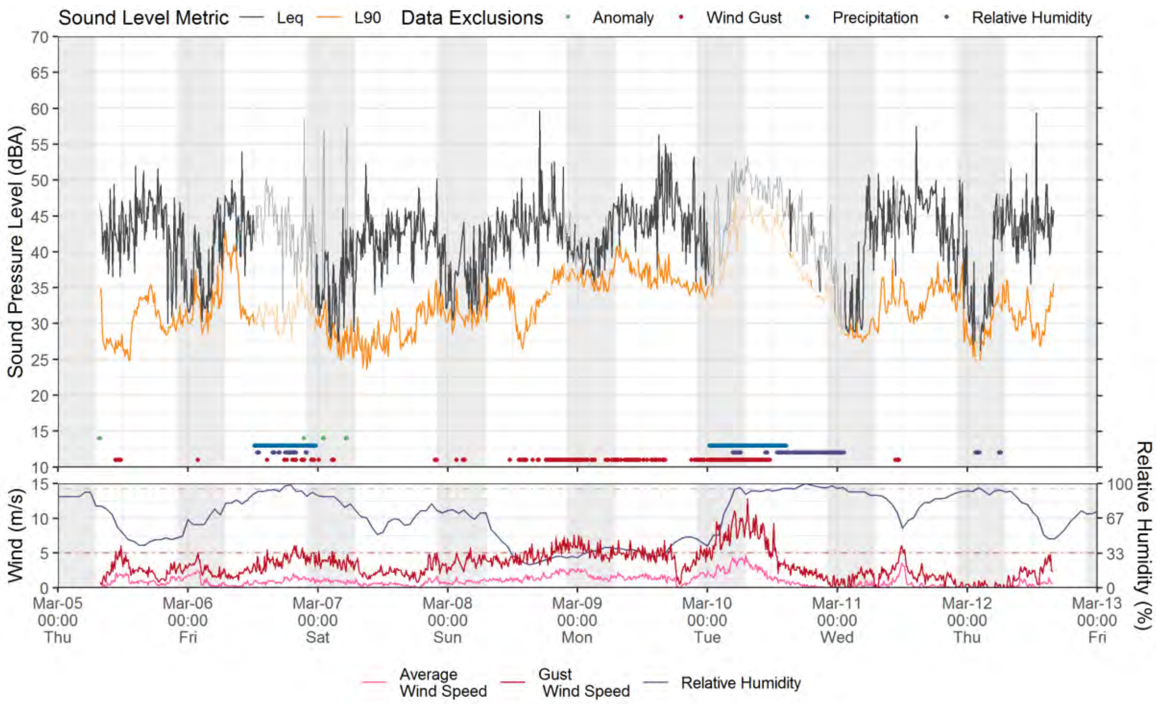


FIGURE 14: SUBSTATION MONITOR TIME HISTORY—WINTER—MARCH 5 TO MARCH 13, 2020

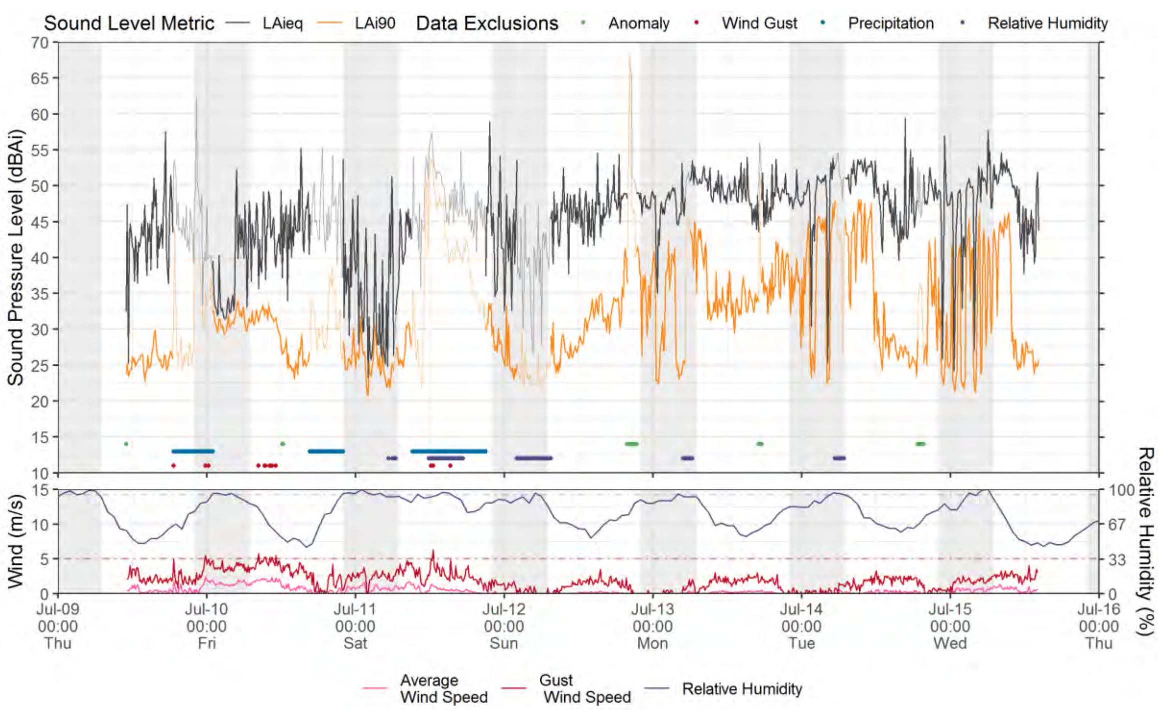


FIGURE 15: SUBSTATION MONITOR TIME HISTORY—SUMMER—JULY 9 TO JULY 16, 2020

5.4 MONITOR D: CR 303

The “CR 303” monitor was located on an uninhabited parcel in Ripley, New York. The monitor location was 145 meters south of CR 303 (NE Sherman Road) and approximately 490 meters (1,610 feet) east across the adjacent agricultural field from Sinden Road. This location is along a private access road in a buffer zone of spruces and grass between agricultural fields and forest. An aerial view of the site is provided in the map in Figure 16. Figure 17 shows the monitor installed in winter and summer conditions.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 16: CR 303 MONITOR LOCATION MAP

FIGURE 17: PHOTOGRAPH OF THE CR 303 MONITOR SITE IN WINTER AND IN SUMMER

Winter Monitoring

Time history results from long-term winter sound level monitoring are plotted in Figure 18. The monitoring location was relatively remote in that it was removed from anthropogenic activity. Distant transportation noise sources (e.g., vehicular traffic, trains, and aircraft) and wind through the trees were the main contributors to sound levels. Although bird activity was prevalent, they were mostly absent from the area immediately adjacent to monitor in the sparse spruce edge habitat.

Summer Monitoring

The time history results from summertime monitoring at the CR 303 monitor are provided in Figure 19. A diurnal pattern is evident that corresponds to daytime human activity. The smart-ANS weight mostly removed biogenic sound levels in the morning as a result of the avian dawn chorus. Nighttime sound levels were generally below 30 dBA $L_{eq10min}$. The ANS-weighted L_{90} at night often dropped below 25 dBA. Sound level spikes at night during the last three days of monitoring were related to heavy truck passbys on CR 303.

The highest sound levels on July 12th were a result of agricultural equipment operating nearby for most of the afternoon. After this date, the daytime sound levels generally decreased from typical levels above 40 dBA to an L_{eq} typically below 35 dBA. Similar agricultural equipment was measured each day, starting on July 12th, and may have been working further away from the monitor each day.

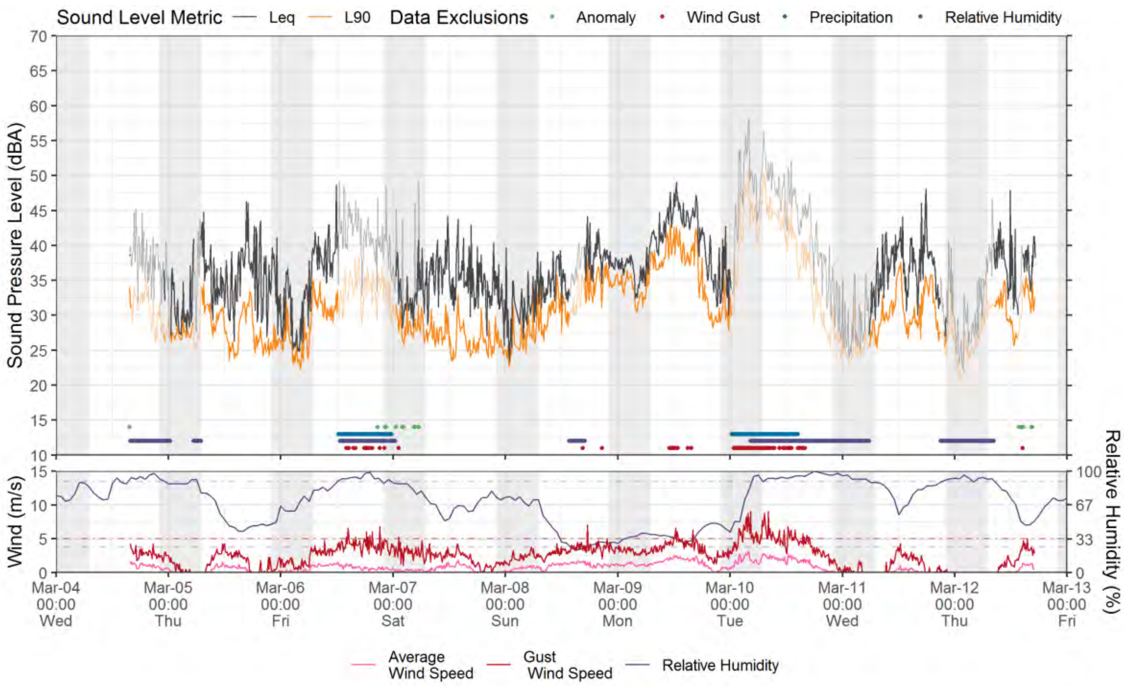


FIGURE 18: CR 303 MONITOR TIME HISTORY—WINTER—MARCH 4 TO MARCH 13, 2020

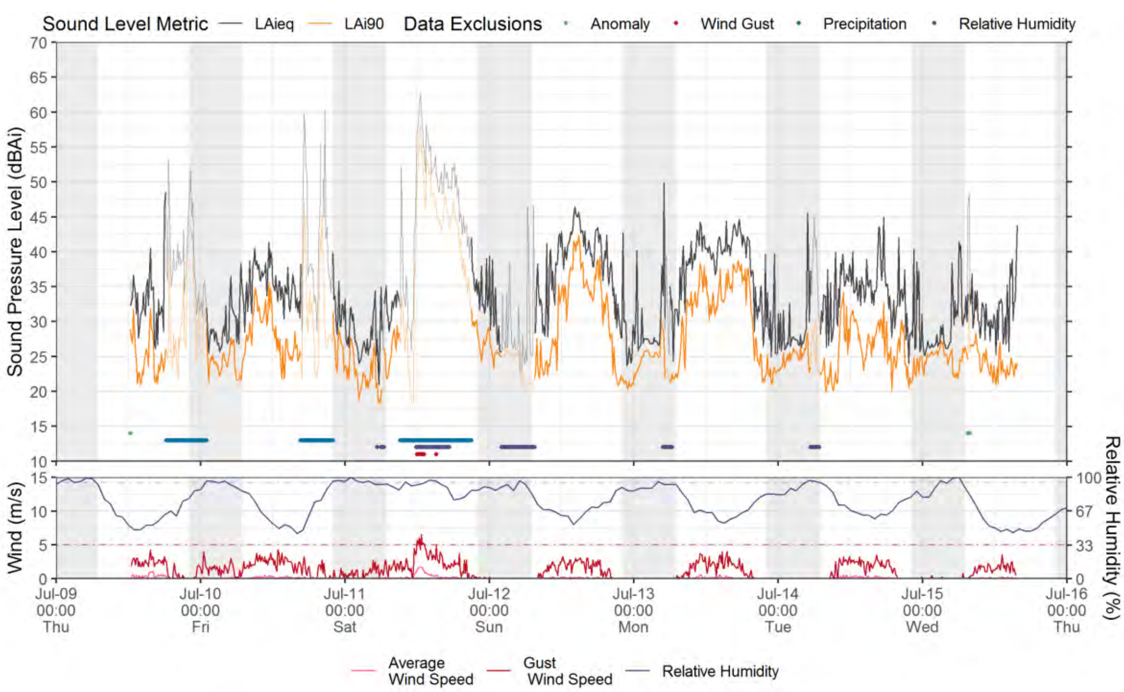


FIGURE 19: CR 303 MONITOR TIME HISTORY—SUMMER—JULY 9 TO JULY 16, 2020

5.5 MONITOR E: SULPHUR SPRINGS ROAD

The “Sulphur Springs Road” monitor was located along the edge of a remote agricultural field north of Sulphur Springs Road in Ripley, New York. The monitoring location was approximately 125 meters (410 ft) northwest of the intersection of Sulphur Springs Road / Post Road and Kopta Road. The monitor was placed on the edge of a remote field landlocked by forest. The monitor did not have line of sight to any roads and was surrounded by slightly higher terrain.

An aerial view of the site is provided in the map in Figure 20. Figure 21 shows photographs of the monitor installed in winter and summer conditions.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 20: SULPHUR SPRINGS ROAD MONITOR LOCATION MAP

FIGURE 21: PHOTOGRAPH OF THE SULPHUR SPRINGS ROAD MONITOR SITE IN WINTER, LOOKING EAST AND SUMMER, LOOKING SOUTH

Winter Monitoring

Time history results from long-term winter sound level monitoring at the Sulphur Springs Road monitor location are plotted in Figure 22. The Sulphur Springs Road monitor was located at the most remote site, as it was separated from anthropogenic activity more than the other monitors. In the distance, trucks, trains, and commercial aircraft overflights were the main anthropogenic noise sources. A diurnal pattern was often observed Monday through Friday in which sound levels were a function of anthropogenic activity. The diurnal pattern recorded at the Sulphur Springs Road monitor often consisted of a quieter period between early afternoon and early evening during the week. Otherwise, bird activity was common and dominated by crows.

Around noon on March 6th, a three-minute engine brake event raised the sound level at the monitor. The spikes during the day on March 7th and March 11th were aircraft overflights.

Summer Monitoring

The time history results from the summer monitoring period at the Sulphur Springs Road monitor are plotted in Figure 22. The diurnal pattern from anthropogenic activities was pronounced for both the L_{eq} and L_{90}. The similarity of the traces of each metric in the plot signifies that the soundscape was comprised of a wide range of distant sounds, such as trains, aircraft overflights, and vehicles on area roads. A distant tractor was measured during the day on July 13th. The spikes in 10-minute L_{eq} on the mornings of July 13th and July 14th (at about 5 AM) were two truck passbys on nearby roads.

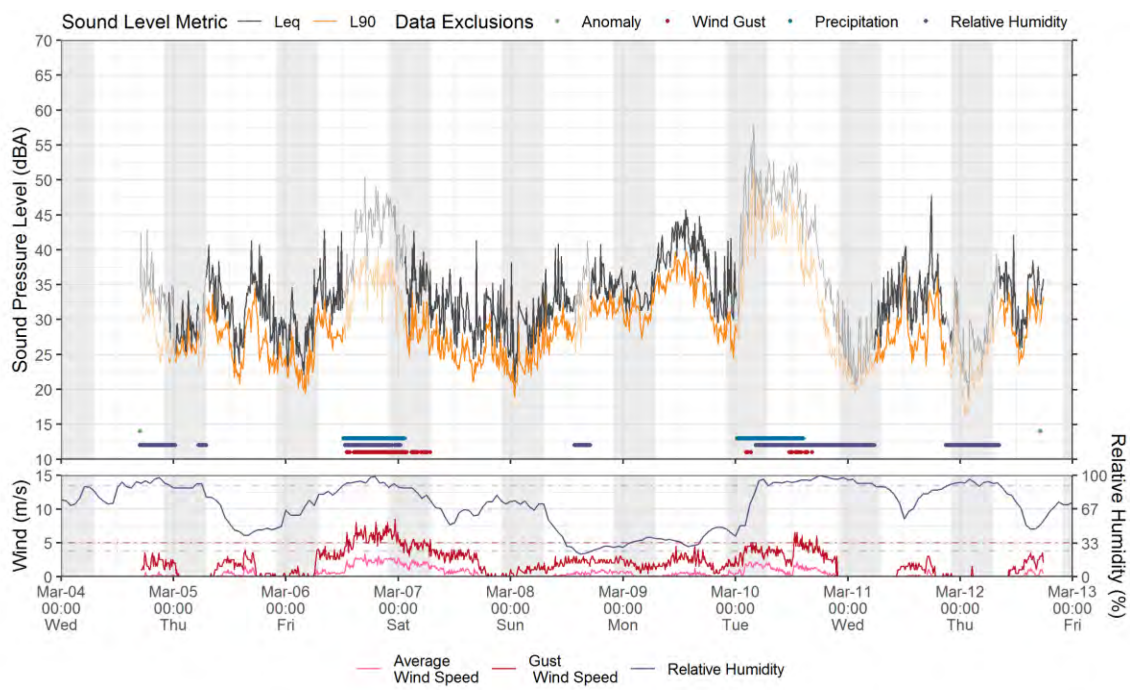


FIGURE 22: SULPHUR SPRINGS ROAD MONITOR TIME HISTORY—WINTER—MARCH 4 TO MARCH 13, 2020

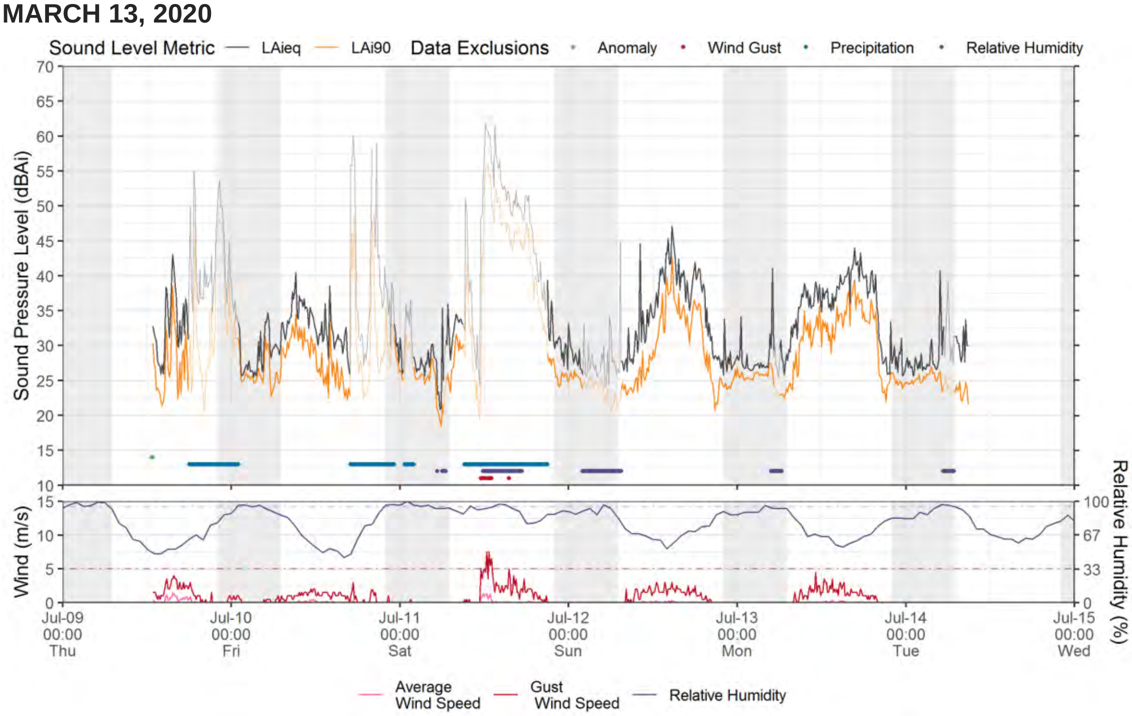


FIGURE 23: SULPHUR SPRINGS ROAD MONITOR TIME HISTORY—SUMMER—JULY 9 TO JULY 15, 2020

5.6 MONITOR F: MEEDER ROAD

The “Meeder Road” monitor was attached to a telephone pole in an agricultural field near the intersection of State Highway 76, CR 64 (NE Sherman Road), and Meeder Road in Ripley, New York. The monitor was located about 50 meters (165 feet) west of Meeder Road and 100 meters north of NE Sherman Road. The monitoring location is in a large field with a long line of sight to the west, including the approach of CR 303 and its intersection with CR 622 and Mina Road, which is approximately 340 meters (1,115 feet) to the southwest. One residence is 60 meters (195 feet) to the north of the monitor, and another is 80 meters (260 feet) to the southeast. A large barn is located about 125 meters (410 feet) to the southeast.

An aerial view of the site is provided in the map in Figure 24. Figure 25 shows photographs of the monitor installed in winter and summer conditions.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 24: MEEDER ROAD MONITOR LOCATION MAP

FIGURE 25: PHOTOGRAPH OF THE MEEDER ROAD MONITOR SITE IN WINTER, LOOKING WEST, AND SUMMER, LOOKING NORTH

Winter Monitoring

Time history results from winter sound level monitoring at the Meeder Road monitor location are plotted in Figure 26. Vehicular noise was the dominant feature of the soundscape measured, due to the monitor's clear line-of-sight to a long stretch of road and intersection. Vehicles traveling south on NY-76, a high-speed north/south thoroughfare east of the project, utilize Meeder Road to turn onto CR 303 (NE Sherman Road). As such, trucks and vehicles decelerate on Meeder Road, stop at the intersection, and then turn and accelerate, thus prolonging the passby and elevating sound levels.

The soundscape also contained general activities from the surrounding farm buildings and residences, such as sounds from workshops, heating systems, tractors, chainsaws, residents coming and going from their homes nearby, and 20-minute periods of diesel trucks idling. Other sounds included distant train passbys, commercial and recreational aircraft, and birds.

Summer Monitoring

Sound level results from the summer monitoring period at the Meeder Road monitoring location are plotted in Figure 27. The influence of vehicular noise on the soundscape is evident with the difference between the L_{eq} and L_{90}, particularly during the day. Spikes in the 10-minute L_{eq} sound levels at night were related to truck traffic. The Meeder Road monitor location was exposed to the highest winds compared to the other locations. Average wind speed was generally correlated with the L_{90}.

The lowest 10-minute L_{90} measured at the site was about 21 dBA on the morning of July 11th. The highest nighttime L_{90} (about 34 dBA) was recorded near midnight of July 12th, after the largest precipitation event of the period. The highest sound level was a result of running water from the pond on the opposite side of Meeder Road.

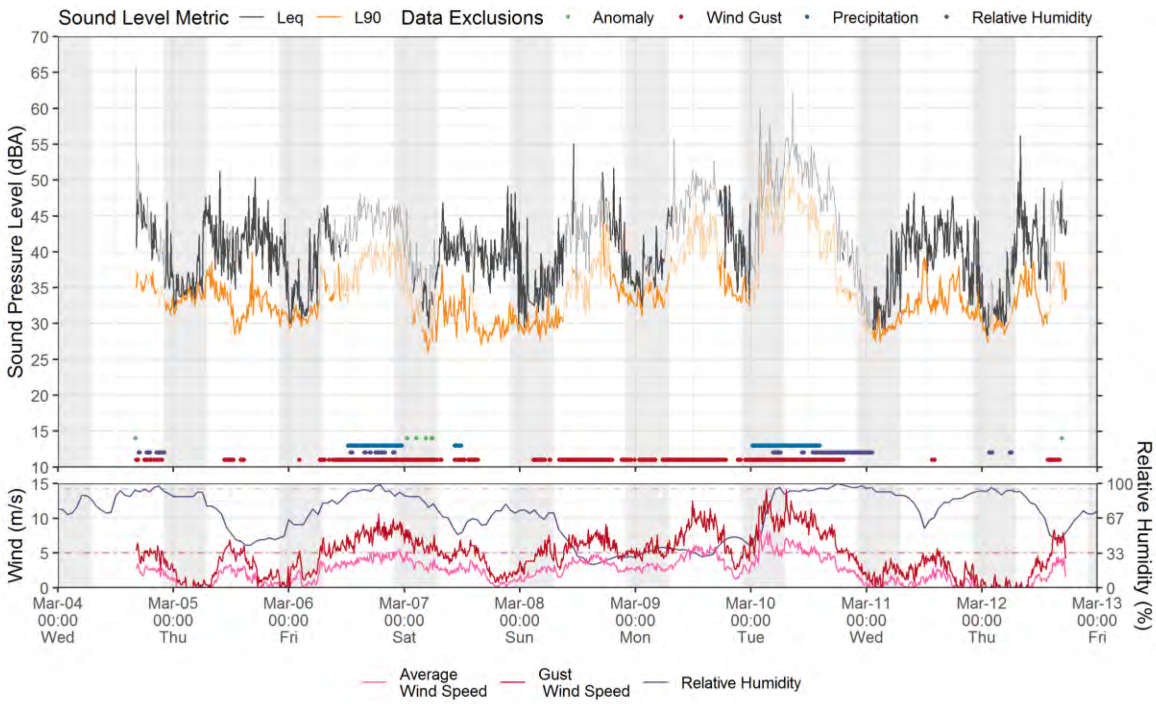


FIGURE 26: MEEDER ROAD MONITOR TIME HISTORY—WINTER—MARCH 4 TO MARCH 13, 2020

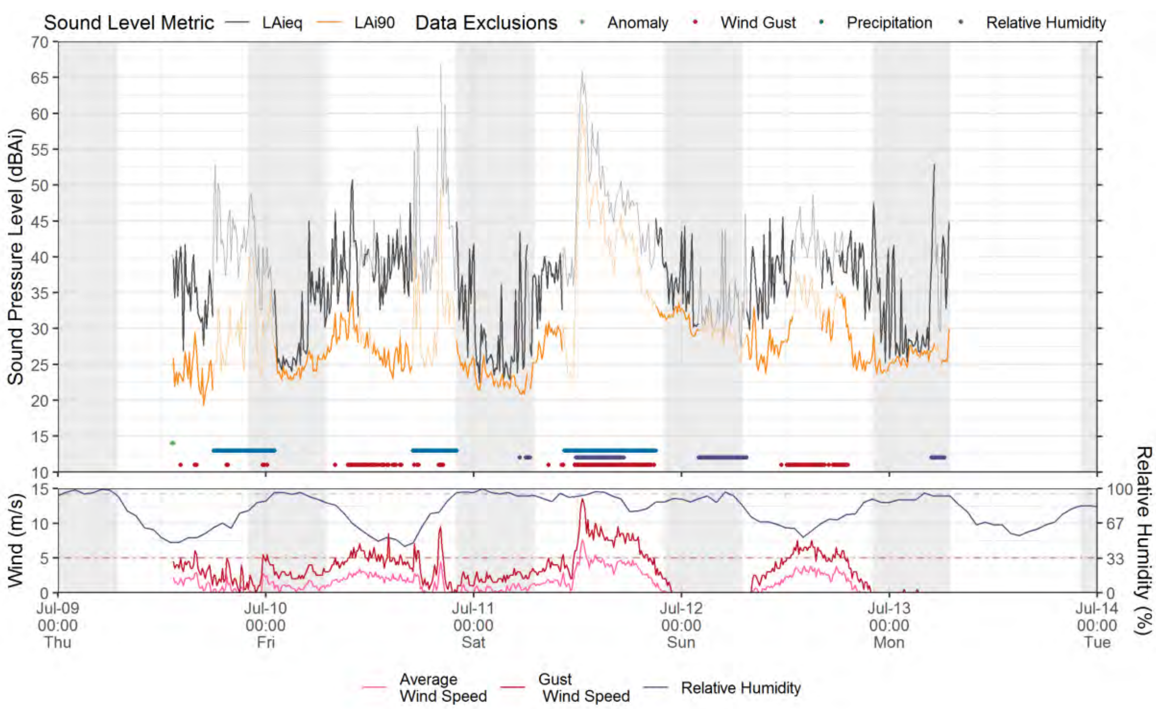


FIGURE 27: MEEDER ROAD MONITOR TIME HISTORY—SUMMER—JULY 9 TO JULY 14

6.0 OVERALL MONITORING RESULTS

The sound levels over the entire monitoring period are summarized in Tables 4 through 6. The aggregated levels for each period were determined by averaging all valid 1-second periods for the given season; the combined period considered both seasons in the analysis.

The three tables provide results for the winter monitoring period (Table 4), the summer monitoring period (Table 5), and the combined period (Table 6). As noted above, the sound levels were weighted using a “Smart-ANS” filter, which removed high-frequency tonal sound from amphibians, birds, and insects. Differences in the A-weighted and ANS-weighted sound levels in winter were minimal (generally less than 1 dB) but were more significant in summer due to biogenic sound.

Sites along roadways resulted in a larger difference between the L_{eq} and L_{90}. This is because the soundscapes at these sites include more transient or intermittent sounds, such as aircraft overflights or passing automobiles, that elevate the L_{eq} relative to the L_{90}.

During the winter (Table 4), the equivalent continuous levels (L_{eq}) at night were generally about 4 or 5 dB less than daytime levels at all sites. The winter nighttime equivalent continuous level (L_{eq}) averaged over all six sites is 40 dBA. The lowest winter overall L_{eq} (35 dBA) was measured at the Sulphur Springs monitor. The nighttime winter L_{90} ranged from 24 to 30 dBA between sites; this level was often limited by consistent wind and/or running water.

Overall sound levels for the summertime are shown in Table 5. Most overall equivalent sound levels were around 40 dBA, with the exception of the Substation monitor that was dominated by frog sounds in the second half of the period. Otherwise, the largest consistent difference between daytime and nighttime L_{eq} in the summer was evident at CR 303 and Sulphur Springs Road, as they were the farthest removed from sources of nighttime sound (such as intermittent vehicular traffic). The nighttime L_{90} at each site was under 25 dBA or below. The nighttime levels during the summer were less than winter due to less water running (snow melt began in March and by July the region was encroaching on drought status).

The overall sound levels for the combined period comprising both seasons is provided in Table 6. The overall nighttime L_{eq} was 40 dBA averaged over all six sites for the combined monitoring periods, which is in line with both seasons. With the exception of the Substation monitor, most levels were similar between seasons.

TABLE 4: AMBIENT PRECONSTRUCTION SOUND MONITORING WINTER SUMMARY

	Monitoring Location	Sound Level (dBA)											
		Overall				Day				Night			
		Leq	L10	L50	L90	Leq	L10	L50	L90	Leq	L10	L50	L90
Winter	CR 64	42	41	33	28	43	43	34	28	38	38	32	28
	Miller Road	41	41	34	28	42	41	33	27	38	40	34	28
	Substation	44	42	35	29	46	43	35	29	41	40	34	29
	CR 303	38	41	33	27	39	42	33	27	35	38	31	26
	Sulphur Springs Road	35	38	31	25	36	39	32	26	33	36	30	24
	Meeder Road	41	42	35	30	43	44	36	31	38	38	33	30

TABLE 5: AMBIENT PRECONSTRUCTION SOUND MONITORING SUMMER SUMMARY

	Monitoring Location	Sound Level (dBA)											
		Overall				Day				Night			
		Leq	L10	L50	L90	Leq	L10	L50	L90	Leq	L10	L50	L90
Summer	CR 64	41	41	32	24	41	42	33	25	39	38	26	22
	Miller Road	38	39	30	23	39	41	32	25	35	36	27	22
	Substation	48	52	39	26	49	52	39	27	48	51	37	25
	CR 303	38	41	29	24	40	43	33	25	33	32	27	23
	Sulphur Springs Road	37	40	30	25	39	42	34	26	29	31	27	25
	Meeder Road	39	39	29	24	40	41	32	26	37	34	27	24

TABLE 6: AMBIENT PRECONSTRUCTION SOUND MONITORING COMBINED SEASONS SUMMARY

	Monitoring Location	Sound Level (dBA)											
		Overall				Day				Night			
		Leq	L10	L50	L90	Leq	L10	L50	L90	Leq	L10	L50	L90
Combined	CR 64	42	41	33	26	42	42	33	27	38	38	31	26
	Miller Road	39	40	32	25	41	41	33	26	36	39	32	24
	Substation	47	49	35	28	47	49	36	28	46	50	34	27
	CR 303	37	40	31	25	39	42	33	26	34	36	28	24
	Sulphur Springs Road	35	38	31	25	36	40	32	26	32	35	28	24
	Meeder Road	41	42	34	27	42	44	35	29	38	37	32	25

7.0 SOUND PROPAGATION MODELING

7.1 PROCEDURES

ISO 9613-2 & CadnaA

Future Project sound levels during construction and operation of the facility were modeled in accordance with the standard ISO 9613-2, “Acoustics – Attenuation of sound during propagation outdoors, Part 2: General Method of Calculation,” as required under 94-c, 900-2.8(d). The ISO standard states,

> This part of 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 … or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night.

The model takes into account source sound power levels, surface reflection and absorption, atmospheric absorption, geometric divergence, meteorological conditions, walls, barriers, berms, and terrain. The acoustical modeling software used here was CadnaA, from Datakustik GmbH. CadnaA is a widely accepted acoustical propagation modeling tool, used by many noise control professionals in the United States and internationally.

ISO 9613-2 assumes downwind sound propagation between every source and every receptor, consequently, all wind directions, including the prevailing wind directions, are taken into account.

For solar facilities, the ISO 9613-2 model is more likely to overestimate sound levels. First, the barrier-effect of the solar panels in blocking sound from interior sources, especially inverters and medium-voltage transformers, is not taken into account in the modeling done for this Project. Second, sound emissions of solar equipment tend to be highest during sunny days. Under these conditions, the sound is refracted upwards, lowering the sound levels measured near the ground. Under the modeling assumptions used in this report, the meteorological conditions are always downward refracting, such as occurs during cloudy days with moderate downwind conditions or a well-developed moderate nighttime temperature inversion.

The project area was primarily modeled with half porous and half hard ground (G=0.5), which is a conservative assumption given that most of the ground is porous (G=1.0). The substation was modeled as G=0.5, where the ground is made up of loose gravel[5], and the energy storage facility was modeled at G=0.0, where the ground is assumed to be concrete. No attenuation due to foliage was included.

In the model, a 1.5-meter (5 foot) receptor height was used for modeling discrete receptors (like homes and worst-case property line points) and contour mapping. The discrete receptors were included if they were, at a minimum, within 1,500 feet of any project noise-generating component, or within the 30 dBA contour line.

Other model input parameters are listed in Appendix B.

Consistent with Section 94-c regulations for the modeling of solar facilities, no additional uncertainty was added to the modeling results.

Results calculated with these parameters are used to model the eight-hour equivalent average sound level during the day, with all equipment operating at maximum capacity. This also represents a worst-case nighttime condition if the inverters are used for VAR support. The one-hour equivalent average sound level for the substation during the day, with fans operating, was also calculated.

Source Assumptions

All equipment was modeled at the manufacturer's published maximum sound power levels. If only the overall A-weighted sound levels were provided by the manufacturer, or a particular equipment model has not yet been selected, octave bands were estimated based on RSG measurements of similar equipment or published spectra. More information on the modeled equipment is as follows:

Array Inverter Skids

The 2,244 string inverters are scattered throughout the Project. There are six , 13, or 20 inverters grouped in a location and are collocated with a single 1, 2, or 3 MVA, respectively, medium voltage transformer (MVT) in each group. The inverters convert the DC electricity generated by the solar panels to low-voltage AC power and the transformers then increase the voltage to medium-voltage AC power for transmission to the substation.

Each inverter is modeled with a sound power level of 78 dBA, which is based on the manufacturer specification (See Appendix 5 of the Application and Appendix H of this report). In the model, clumps of inverters are modeled as a single point with a correction for the number of inverters. The correction is equal to K=10log(n), where n is the number of inverters. Since the

[5] The loose gravel in a substation is highly porous and is intended to drain well. RSG has conducted calibration studies on substation gravel and found that the appropriate ground factor for accurate modeling is 0.6. However, Section 94-c requires the ground factor to be 0.5, which is used in the PNIA model.

clumps are either composed of six, 13, or 20 inverters, the corrections are +8, +11, and +13 dB, respectively (K = 10log(n)). Thus, total sound level for the clump is 78 dBA + K.

These inverters have fans whose speed is a function of temperature and load. For the modeling in this report, the fans are assumed to operate at 100 percent.

As noted above, each group of inverters are collocated with a single MVT. Each MVT is modeled at a sound power level of 74 to 79 dBA, corresponding with the maximum NEMA TR-1 sound levels for 1, 2, and 3 MVA.[6]

Substation Transformer

The maximum sound level is determined in reference to the National Electrical Manufacturer's Association standard NEMA TR-1-2013, Transformers, Step Voltage Regulators and Reactors. In this case, the transformer is rated at 171/228/285 MVA and 825 kV BIL. Based on Table 1 of the standard, this transformer has a maximum sound pressure level of 86 dBA with fan cooling (ONAF) and 83 dBA without fan cooling (ONAN). Based on the size of the transformer (approx. LxWxH = 4.6 m X 5.5 m X 4.0 m), this results in a sound power level of 107 dBA with cooling fans on.[7]

The substation transformer is modeled with a sound power of 97 dBA with cooling fans on, which includes 10 dB of attenuation relative to the NEMA TR1 standard. The 10 dB reduction will be specified as part of the bid package for the transformer.

To include an octave band spectrum for sound modeling, we measured the average normalized spectrum from a similarly sized distribution transformer RSG measured (see Appendix H for test report) and normalized the sound power to this spectrum. The normalization is as follows:

TABLE 7: NORMALIZATION OF OVERALL A-WEIGHTED SOUND LEVELS TO A-WEIGHTED OCTAVES FOR THE SUBSTATION TRANSFORMER

	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
No Fans	-59	-45	-4	-9	-4	-21	-28	-30	-36
With Fans	-53	-37	-8	-10	-4	-5	-8	-14	-24

The transformer will be energized 24 hours/day. The fans typically will operate only during daylight above a load of about 171 MVA.

[6] NEMA TR-1 sound pressure level ratings for 1, 2, and 3 MVA are 58 dBA, 61 dBA, and 63 dBA, respectively. Prescribed area using actual dimensions (8' X 5' X 5') S=38 m^2, $L_w - L_p = 10\log(S/S_0) = 16$ dB.

[7] ONAF prescribed area S=187m^2, $L_w - L_p = 10\log(S/S_0) = 23$ dB

The substation will also have an operations building to the west of the transformer. This building is included in the model. It will have a small air conditioning unit on the north side of the building. As no air conditioner has been selected, we assumed a 1.5-ton unit similar to the Baird W18A. This has a rated sound pressure level of 62.8 dBA at 10 feet, which converts to a sound power level of 78 dBA. As the sound power of this unit is almost 20 dB below the substation transformer, the source sound will not have any impact on increasing the sound level at any receiver and is thus de minimis. However, for completeness, we have included the air conditioning unit as a source in the model.

Spectral data is not available for this source, and therefore it must be assumed tonal under the Section 94-c regulations.

Battery Energy Storage System (BESS)

The primary source of sound from the BESS is from the cooling units on the BESS battery containers. Each of the 21 containers has two HVAC units. Each unit is estimated to generate 70 dBA at 1 meter (See Appendix H), for a total sound power of 78 dBA. Spectral data is not available for this source, and therefore it must be assumed tonal under the Section 94-c regulations.

The BESS will also utilize inverters/transformers (PCS system). The sound power for these is based on Sungrow SG3600UD. The test report for this unit is found in Appendix H. This unit is potentially tonal at the 5,000 Hz 1/3 octave band.

Cumulative modeling

There are no other solar or wind projects within 3,000 feet of the Project. Thus, cumulative impacts from other nearby projects were not included in the model.

7.2 MITIGATION OF OPERATIONAL SOURCES

Mitigation has been incorporated into the model to meet applicable Section 94-c noise standards. The mitigation in the model includes the selection of energy storage equipment with low noise cooling equipment and a specification on the substation transformer sound pressure level of NEMA TR-1 minus 10 dB, and a noise barrier in and around the substation. The noise barrier is shown in Figure 28.

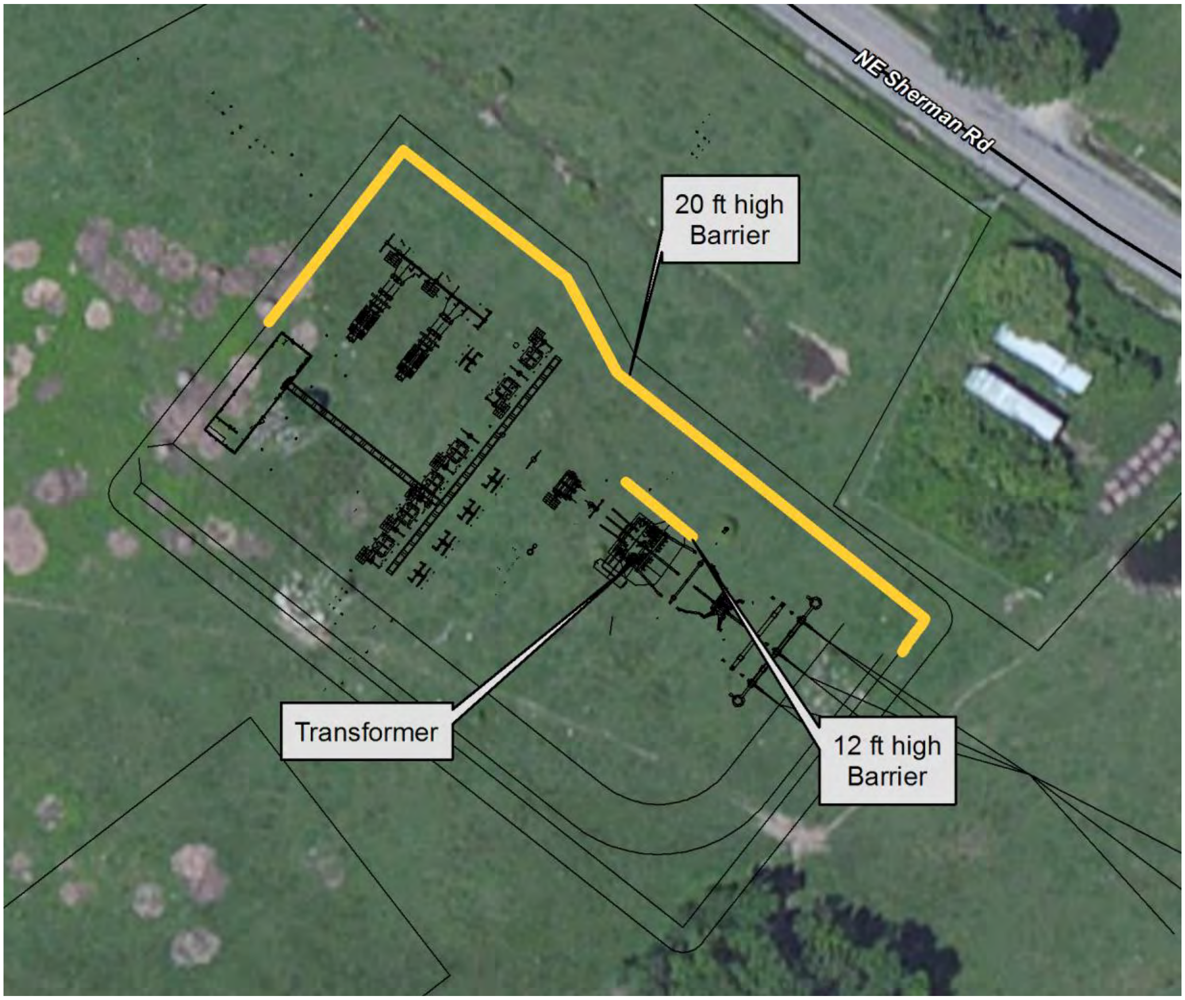


FIGURE 28: PROPOSED SUBSTATION NOISE BARRIERS

7.3 TONALITY

An assessment for tonal prominence of the inverters and transformers was not conducted because 1/3 octave band data is not currently available from the manufacturers.

Project equipment such as transformers are often tonal at integer multiples of the line frequency (60 Hz). Transformers are usually tonal in the 125 Hz, 250 Hz, 315 Hz, 500 Hz, or 630 Hz 1/3 octave bands during the ONAN condition, but not the ONAF condition due to masking from the cooling fans, though some tonal prominence often remains. Inverters sometimes also have tonal prominence at higher frequencies due to fans or filters.

The application of a 5 dB penalty to all equipment is a conservative assumption as even if the equipment generates tonal sound, the level of tonality is generally reduced at the receiver due to the attenuation of the sound over distance and masking by broadband background sound.

Tonal penalties were not included in the modeled sound power or modeling isolines but are included in later tables where the modeled sound levels are compared to noise standards, where appropriate.

7.4 MODEL RESULTS OF OPERATIONAL SOUND

Mitigated short-term sound propagation modeling results are shown in Figures 29 through 35 for the worst-case configuration. Note that the figures do not include the 5 dB tonal penalty. The penalty is applied to the appropriate standards of the numerical table of the results in Table 8.

The number of non-participating sensitive receptors at each sound level above 35 dBA is provided in Table 9. All residences in the model are conservatively considered non-participating residences, except for one participating seasonal structure that will be moved or removed as part of the Project (Receptor 103).

Modeling results for the substation only is shown in Figure 36. The highest sound level due to the substation is 35 dBA at Receptor 5. With a 5 dB tonal penalty, this is 40 dBA and meets the Section 94-c limits.

TABLE 8: SUMMARY OF L_{8H} SOUND MODELING RESULTS FOR EACH OPERATING SCENARIO (IN dBA)

Receptor Type	Project Sound Level – Maximum L_{8h} (dBA)			Plus 5 dB tonal penalty Maximum L_{8h} (dBA)		
	Min.	Max.	Avg.	Min.	Max.	Avg.
Residential[8]	20	40	31	25	45	36
Residential due to substation transformer[9]		35			40	
Participating Seasonal[10]		48			53	
Property Line[11]		53			n/a	

[8] Includes all residences except the participating seasonal structure shown below. The worst-case locations are Receptors 47, 20, 5, 49, 23, and 77.
[9] Only the worst-case location is shown. The worst-case sound level is at Receptors 5 and 6.
[10] This is a structure on a participating parcel located relatively close to inverters that will be moved or removed as part of the Project (Receptor 103).
[11] The worst-case property line sound level is at Receptor 63.

TABLE 9: SENSITIVE RECEPTORS AT SOUND LEVELS ABOVE 35 dBA[12]

Sound Pressure Level - Maximum L_{8h} (dBA)	Number of Sensitive Receptors	
	All Sources Operating	+5 dB Tonal Penalty
35	7	5
36	8	6
37	3	8
38	5	4
39	4	7
40	1	7
41	0	8
42	0	3
43	0	5
44	0	4
45	0	1

Results show sound levels are at or below 45 dBA L_{8h} at all receptors, meeting the applicable Section 94-c limits for participating and non-participating residential receptors.

In addition, the substation transformers are at or below 40 dBA L_{1h} at all homes with a tonal penalty applied in the model. All property line sound levels are at or below the applicable 55 dBA L_{8h} limit. The highest modeled property line sound level of 45 dBA is adjacent to the substation, about 135 meters (443 ft) southeast of the transformer.

The results summarized above indicate compliance with all applicable Section 94-c sound level limits.

See Table 23 in Appendix C for A-weighted modeling results for each receptor, and Table 26 in Appendix D for 1/1 octave band modeling results.

[12] This table does not include the one participating seasonal structure that will be moved or removed, modeled at 47 dBA without a tonal penalty and 52 dBA with a tonal penalty.

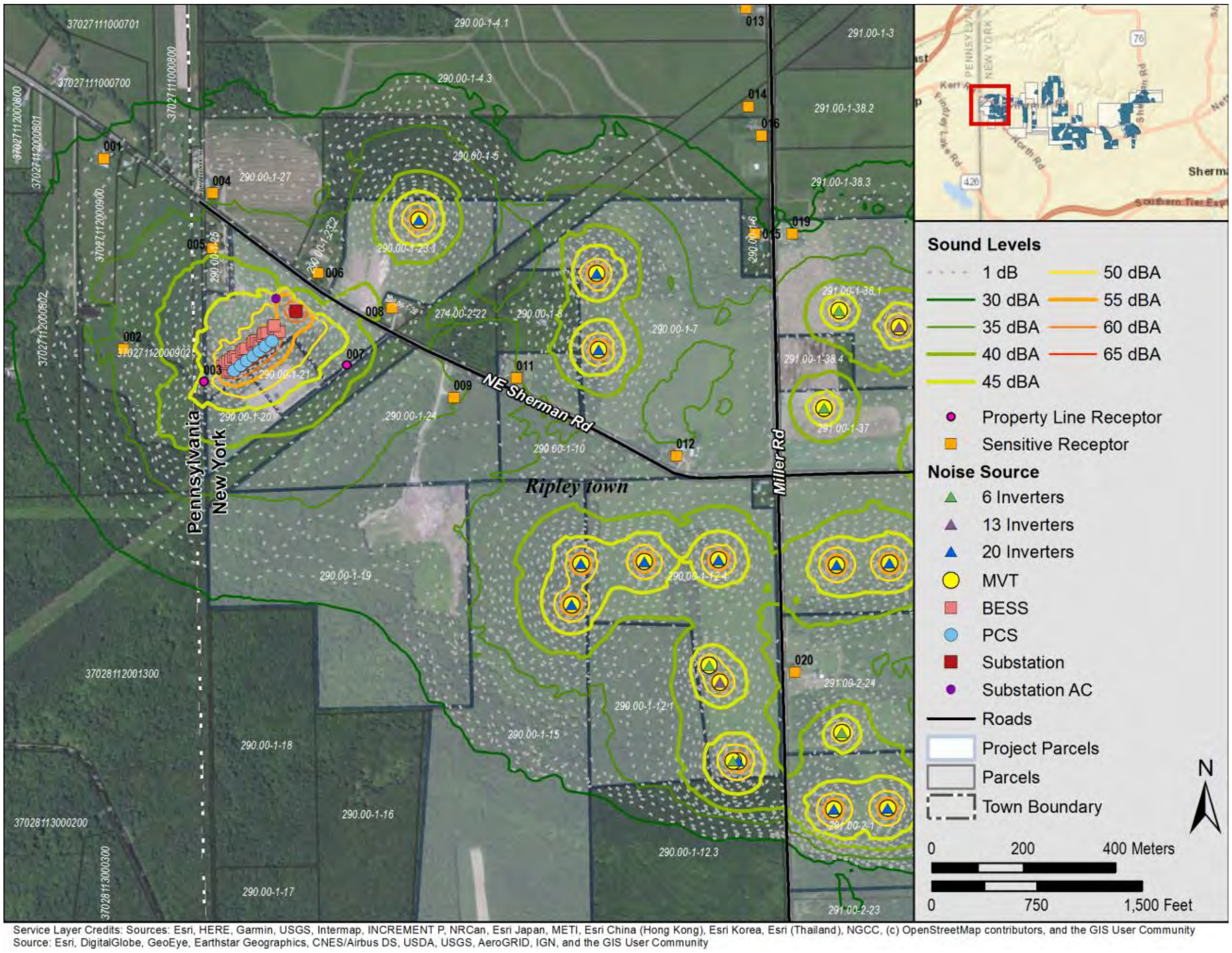


FIGURE 29: MITIGATED MAXIMUM L_{8H} SOUND PROPAGATION MODEL RESULTS – MAP 1

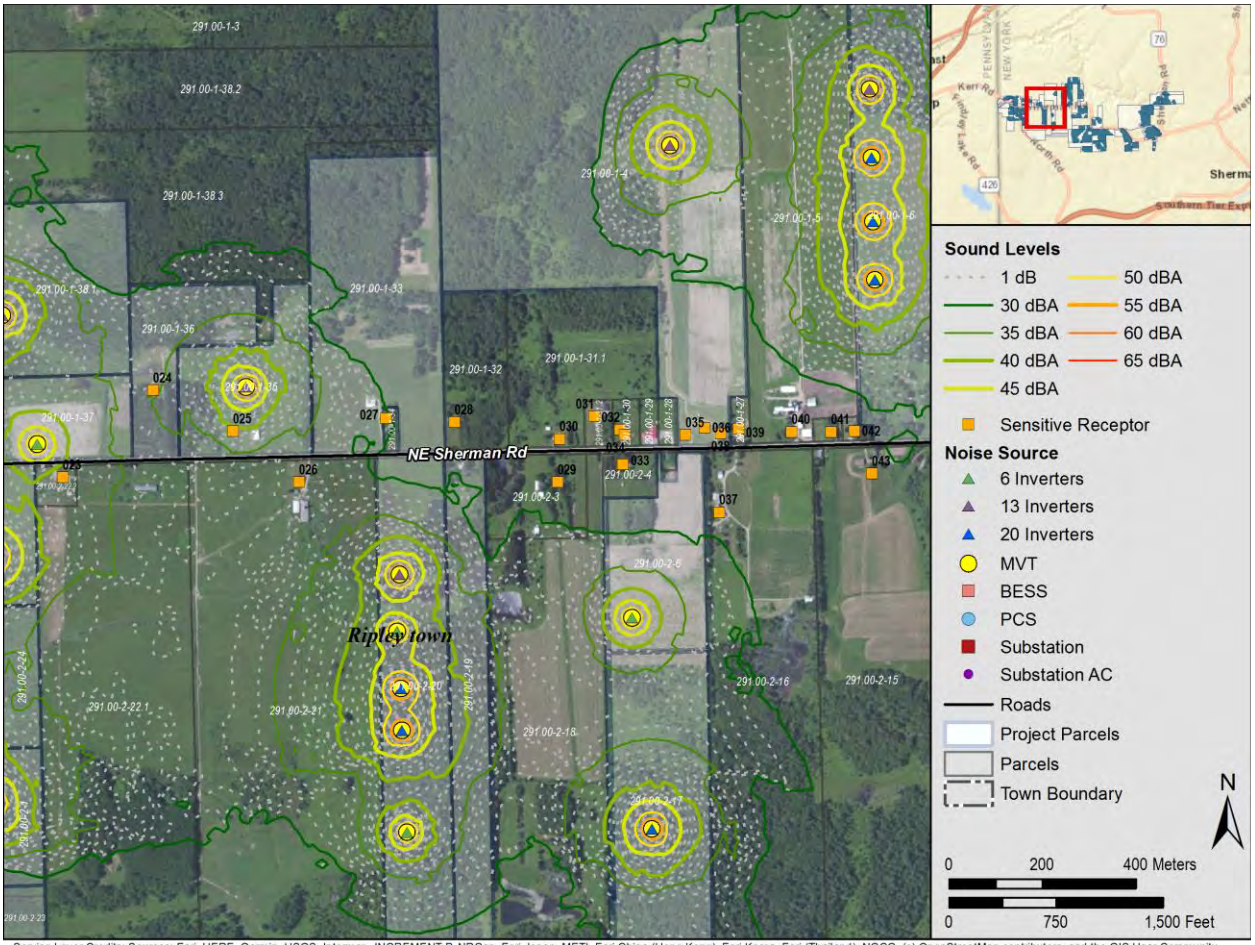
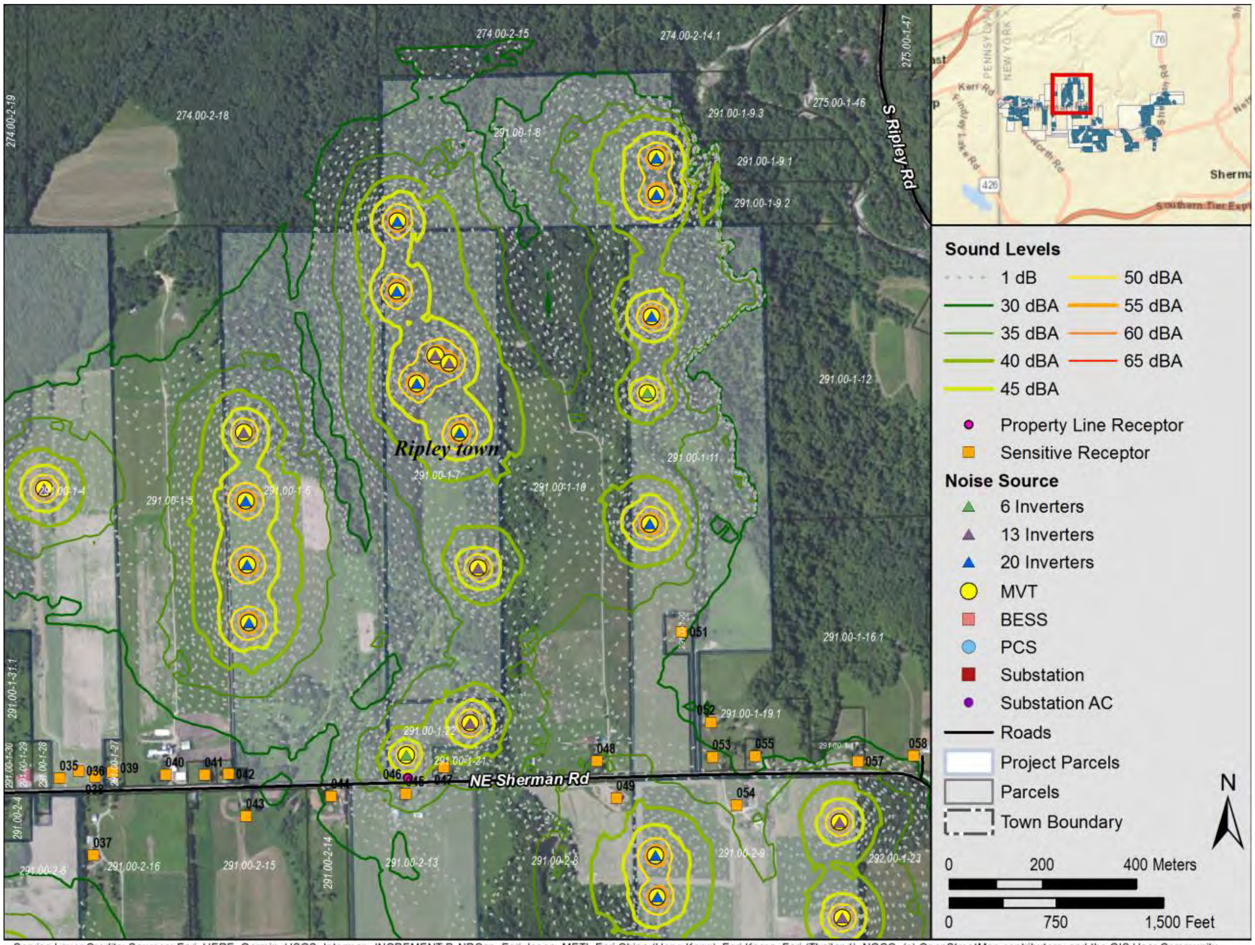
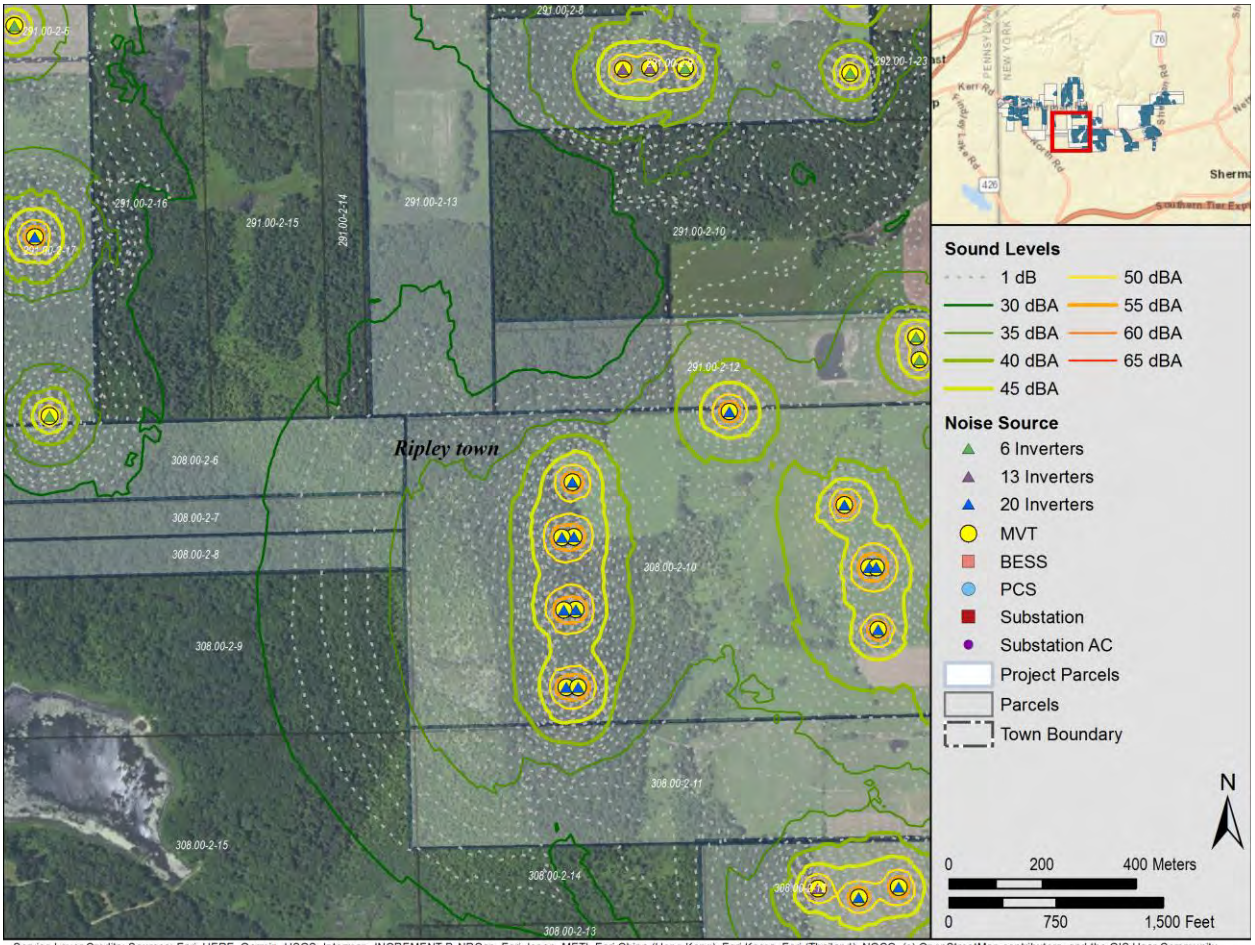


FIGURE 30: MITIGATED MAXIMUM L_{8H} SOUND PROPAGATION MODEL RESULTS – MAP 2



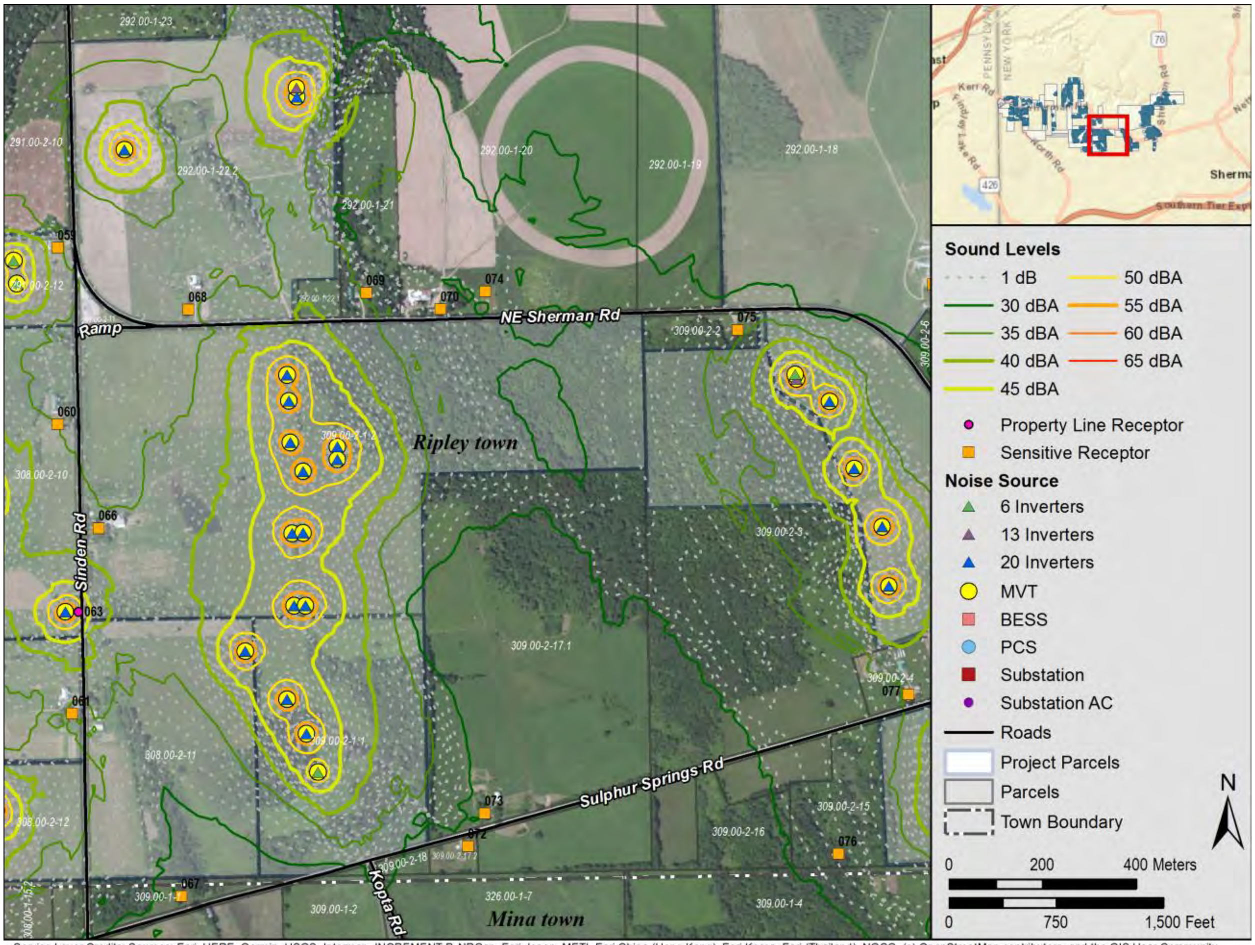
Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 31: MITIGATED MAXIMUM L_{8H} SOUND PROPAGATION MODEL RESULTS – MAP 3



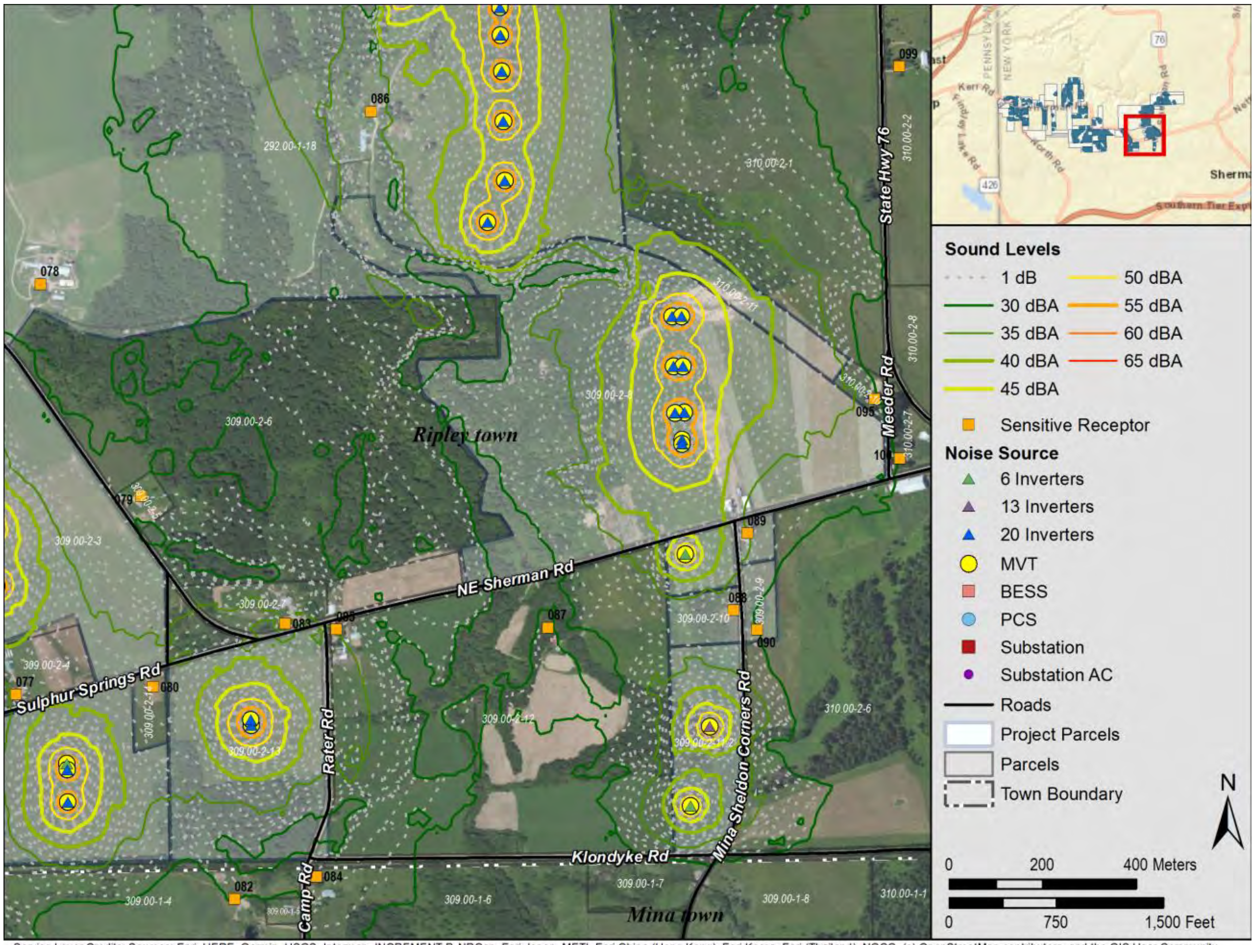
Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 32: MITIGATED MAXIMUM L8H SOUND PROPAGATION MODEL RESULTS – MAP 4



Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 33: MITIGATED MAXIMUM L_{8H} SOUND PROPAGATION MODEL RESULTS – MAP 5



Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 34: MITIGATED MAXIMUM L_{8H} SOUND PROPAGATION MODEL RESULTS – MAP 6

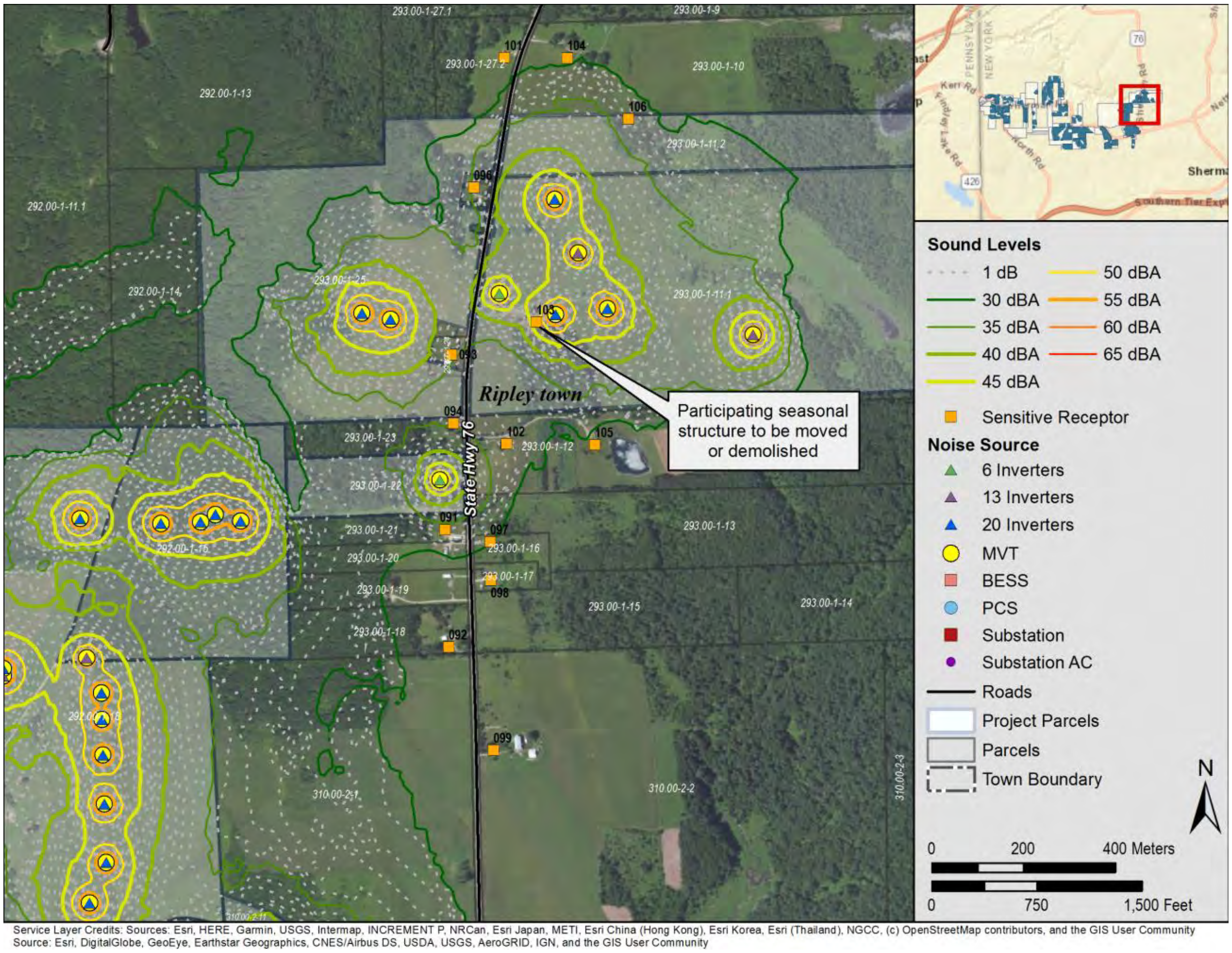
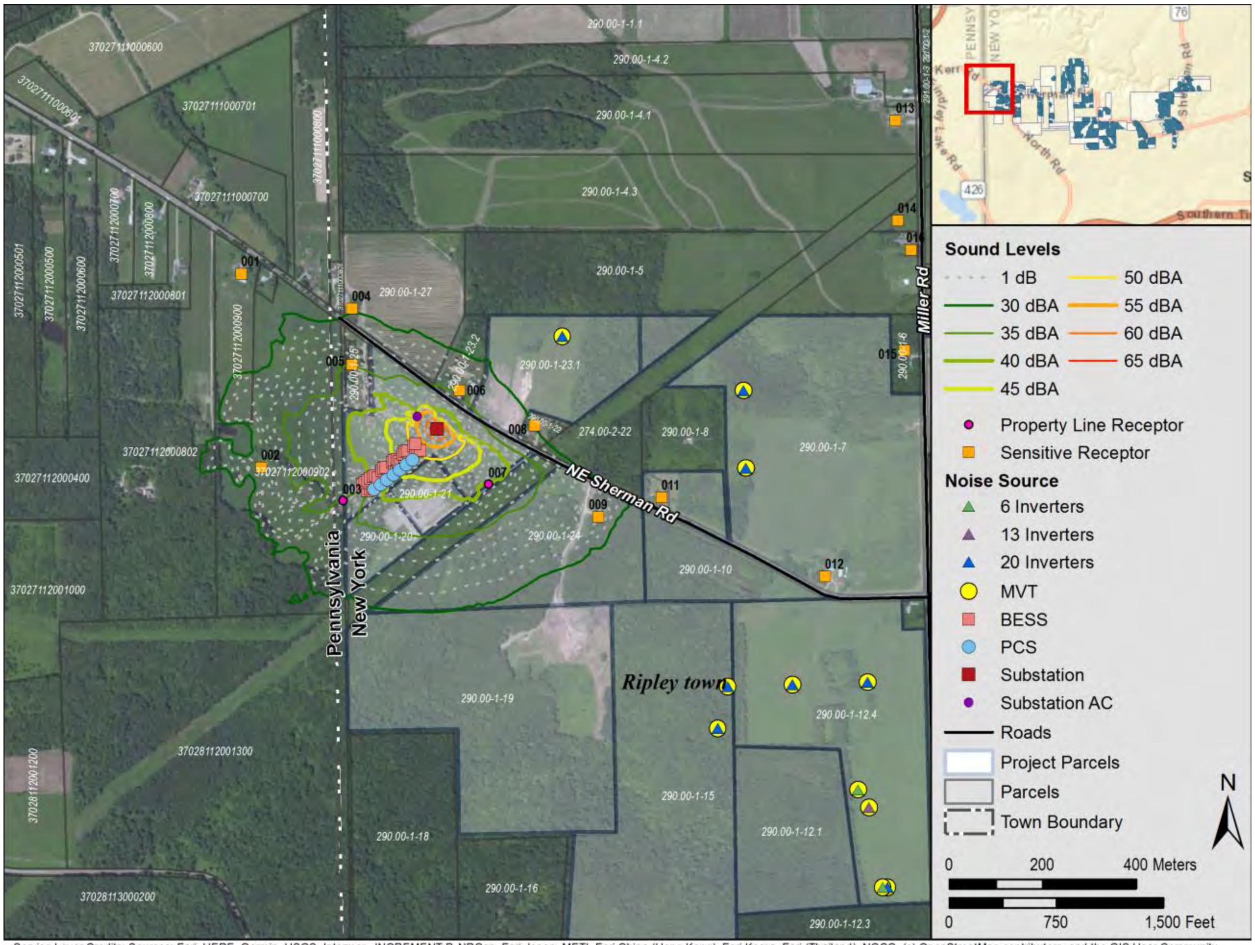


FIGURE 35: MITIGATED MAXIMUM L_{8H} SOUND PROPAGATION MODEL RESULTS – MAP 7



Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 36: MITIGATED MAXIMUM L_{8H} SOUND PROPAGATION MODEL RESULTS – SUBSTATION ONLY

7.5 CONSTRUCTION NOISE

Construction noise modeling was performed using the same standard and software used to model operational noise, ISO 9613-2 implemented in Datakustik's CadnaA, in accordance with the requirements of Section 94-c. Discrete receptor and grid heights are the same as was used in operational sound propagation modeling for the Project, as described in Section 7.1.

Sound source information was obtained from National Cooperative Highway Research Program (NCHRP) Project 25-49 (September 2018). Modeling procedures generally followed guidelines in the FHWA's Highway Construction Noise Handbook, where appropriate and where data was available. For the pile driving equipment, noise data for a representative solar array post driver was used.

Construction across the Project site is proposed to take place from 7 AM to 6 PM for approximately 12 to 19 months. No pile driving would occur on Sundays.

For construction noise modeling, construction activities were categorized into eight groups: road construction, substation construction, trenching, inverter installation, piling, racking, boring, and laydown areas. The Project does not propose a batch plant. For each category, the closest receptors were identified and the worst-case areas around the Project area were modeled assuming the maximum sound emissions of all associated construction equipment operating simultaneously.

Under the construction schedule, there may be one week when all categories of construction activity could occur at the same time. The modeling is therefore a cumulative analysis with all sources in all categories emitting the maximum one-second sound level at the worst-case locations across the entire project area.

The following sections for each construction category include sound contour maps showing the exposure for the worst-case area for each construction category. Several 22x34 inch maps showing the cumulative sound levels are included separately. Sound contour maps in 11X17 inch format can be found in Appendix G.

Road Construction

Project road construction would take place from public roads and through the areas proposed for solar arrays to inverter locations and the substation. The primary sources associated with this activity are excavators, dozers, graders, dump trucks, and rollers.

Cumulative model results of all construction sources operating simultaneously near the closest receptor to road construction is provided in Figure 37. The worst-case receptor for road construction is a residence (Receptor ID 38) on the south side of NE Sherman Road. The cumulative modeled sound level at this receptor is 80 dBA. Table 10 shows the sound level from each road construction source at a distance of 50 feet, the sound level from each source at the closest receptor, and the cumulative sum from all construction sources. Road construction typically only takes place for a few days in any given location, so the potential impact to any given receptor is relatively short in duration.

TABLE 10: MODELED SOURCES FOR ROAD CONSTRUCTION AND MODELED SOUND LEVELS

EQUIPMENT	SOUND PRESSURE LEVEL AT 50 FEET (dBA)	SOUND PRESSURE LEVEL AT CLOSEST SENSITIVE RECEPTOR (dBA)
Excavator	76	67
Dozer	80	72
Grader	78	67
Roller	82	74
Dump Truck	82	73
All Other Construction Sources		76
Cumulative Sound Level at Closest Receptor:		**80**

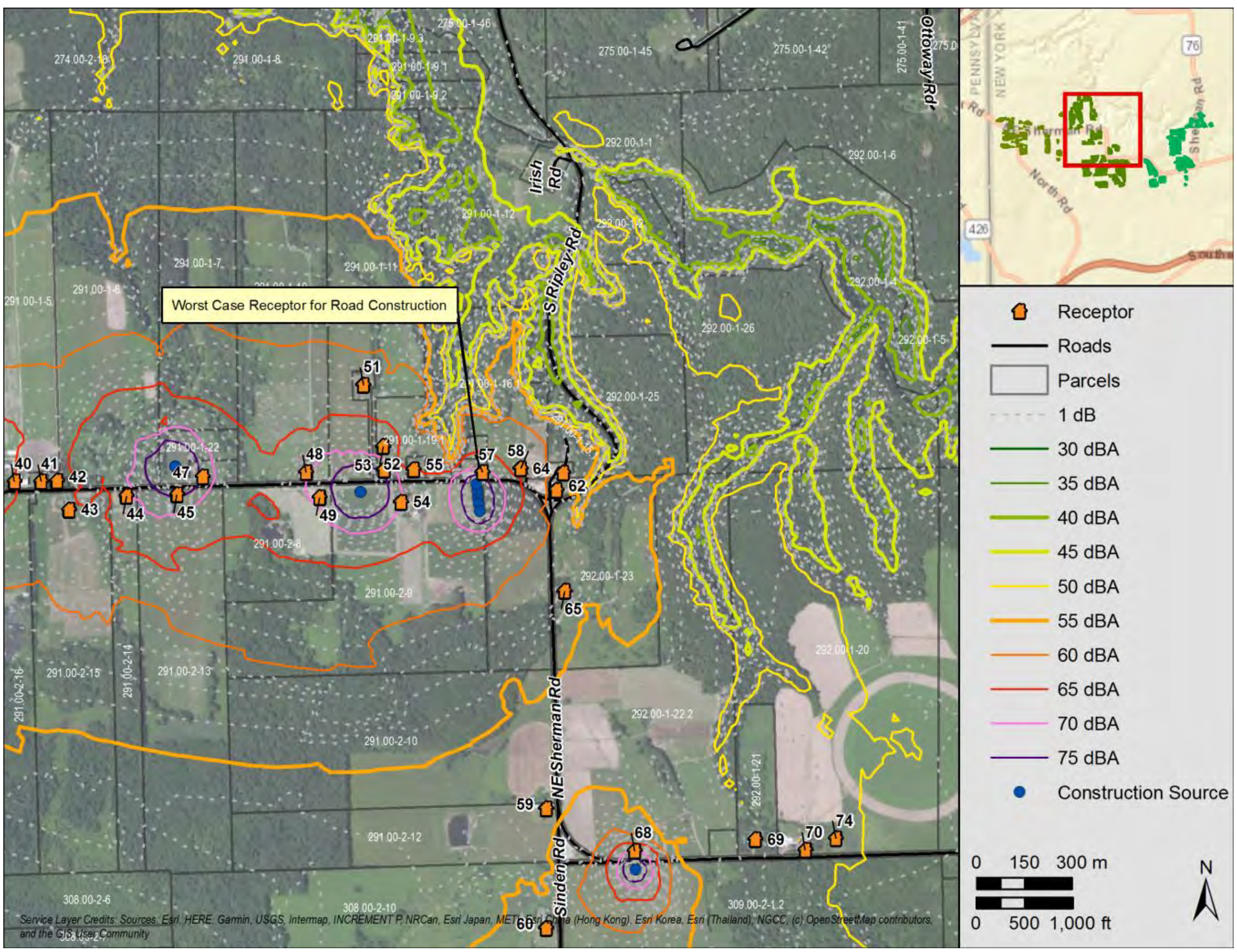


FIGURE 37: ROAD CONSTRUCTION MODEL RESULTS

Substation and Energy Storage Construction

This construction would take place within the substation area shown in Figure 38. The primary sources associated with this activity are excavators, dozers, graders, dump trucks, rollers, concrete mixing trucks, concrete pumper trucks, flatbed trucks, man-lifts, and cranes. Construction of the substation will take approximately 12 months and the energy storage construction will take approximately 15 months.

Cumulative model results of all construction sources operating simultaneously is provided in Figure 38. The worst-case receptor for substation construction is a residence (Receptor ID 06) north of the substation. The cumulative modeled sound level at this receptor is 76 dBA. Table 11 shows the sound level from each source at a distance of 50 feet, and the sound level from each source at the closest receptor.

TABLE 11: MODELED SOURCES FOR SUBSTATION CONSTRUCTION AND MODELED SOUND LEVELS

EQUIPMENT	SOUND PRESSURE LEVEL AT 50 FEET (dBA)	SOUND PRESSURE LEVEL AT CLOSEST SENSITIVE RECEPTOR (dBA)
Excavator	76	60
Dozer	80	62
Grader	78	57
Roller	82	65
Dump Truck	82	64
Concrete Mixing Truck	81	64
Concrete Pumper Truck	84	66
Man-lift	72	56
Flatbed Truck	74	55
Crane (2)	74	59
All Other Construction Sources		73
Cumulative Sound Level at Closest Receptor:		**76**

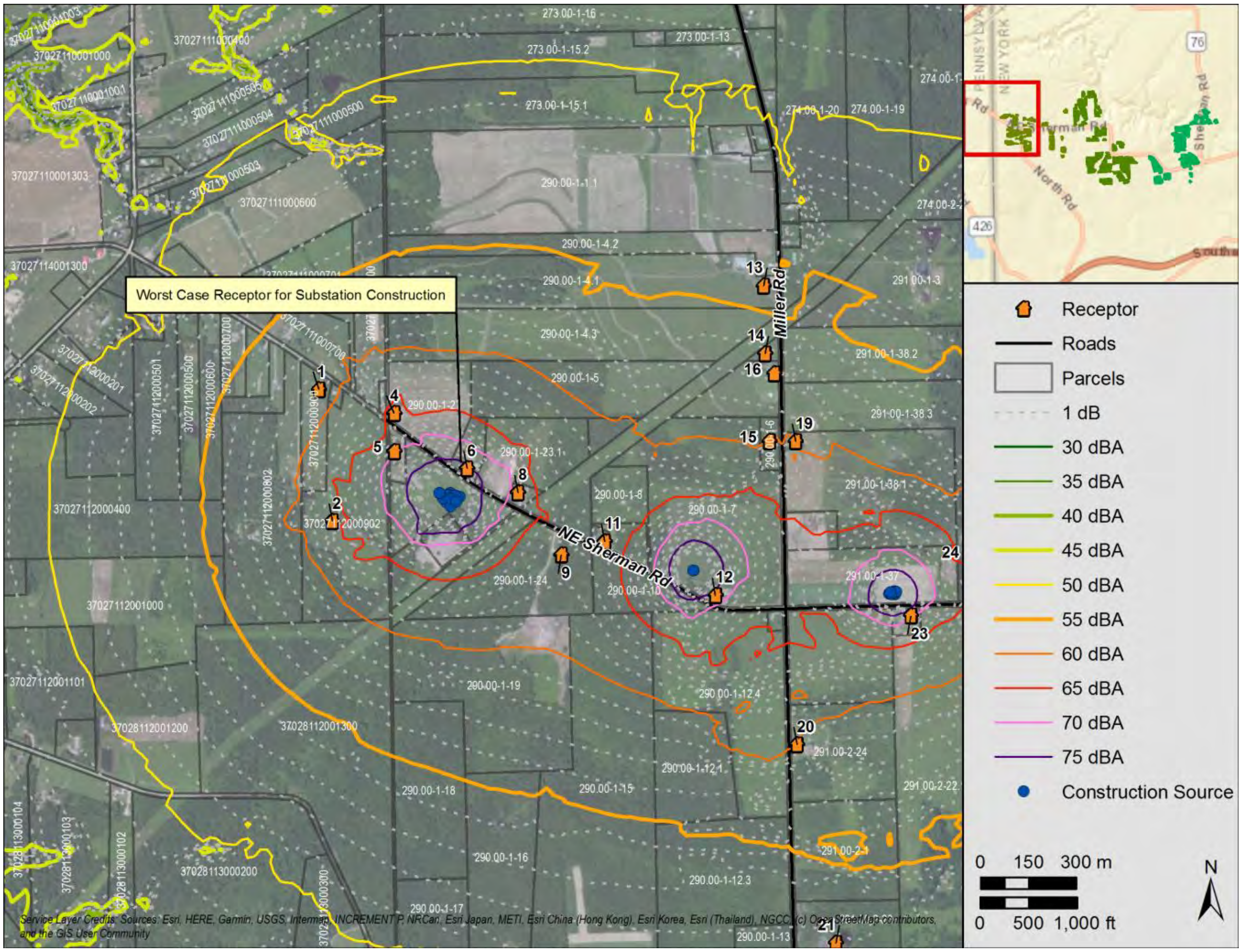


FIGURE 38: SUBSTATION CONSTRUCTION MODEL RESULTS

Trenching

Trenching would take place along the underground collection line routes throughout the Project area. The primary sources associated with this activity are excavators, dozers, rollers, compactors, flatbed trucks, forklifts, and trenchers.

Cumulative model results of all primary trenching sources operating simultaneously near the closest receptor to trenching is provided in Figure 39. The worst-case receptor for trenching is a residence (Receptor ID 38) north of NE Sherman Rd.[13] The cumulative modeled sound level at this receptor is 83 dBA. Table 12 shows the sound level from each source at a distance of 50 feet, and the sound level from each source at the closest receptor. Trenching typically only

[13] There are higher levels at Receptor ID 36, but this receptor is a barn associated with Receptor ID 38. Both receptors are on a Project parcel and are participating.

takes place for a few days in any given location, so the potential impact to any given receptor is relatively short in duration.

TABLE 12: MODELED SOURCES FOR TRENCHING AND MODELED SOUND LEVELS

EQUIPMENT	SOUND PRESSURE LEVEL AT 50 FEET (dBA)	SOUND PRESSURE LEVEL AT CLOSEST SENSITIVE RECEPTOR (dBA)
Excavator	76	76
Dozer	80	69
Trencher	80	79
Roller	82	74
Compactor	75	71
Flatbed Truck	74	69
Forklift	84	75
All Other Construction Sources		57
Cumulative Sound Level at Closest Receptor:		**83**

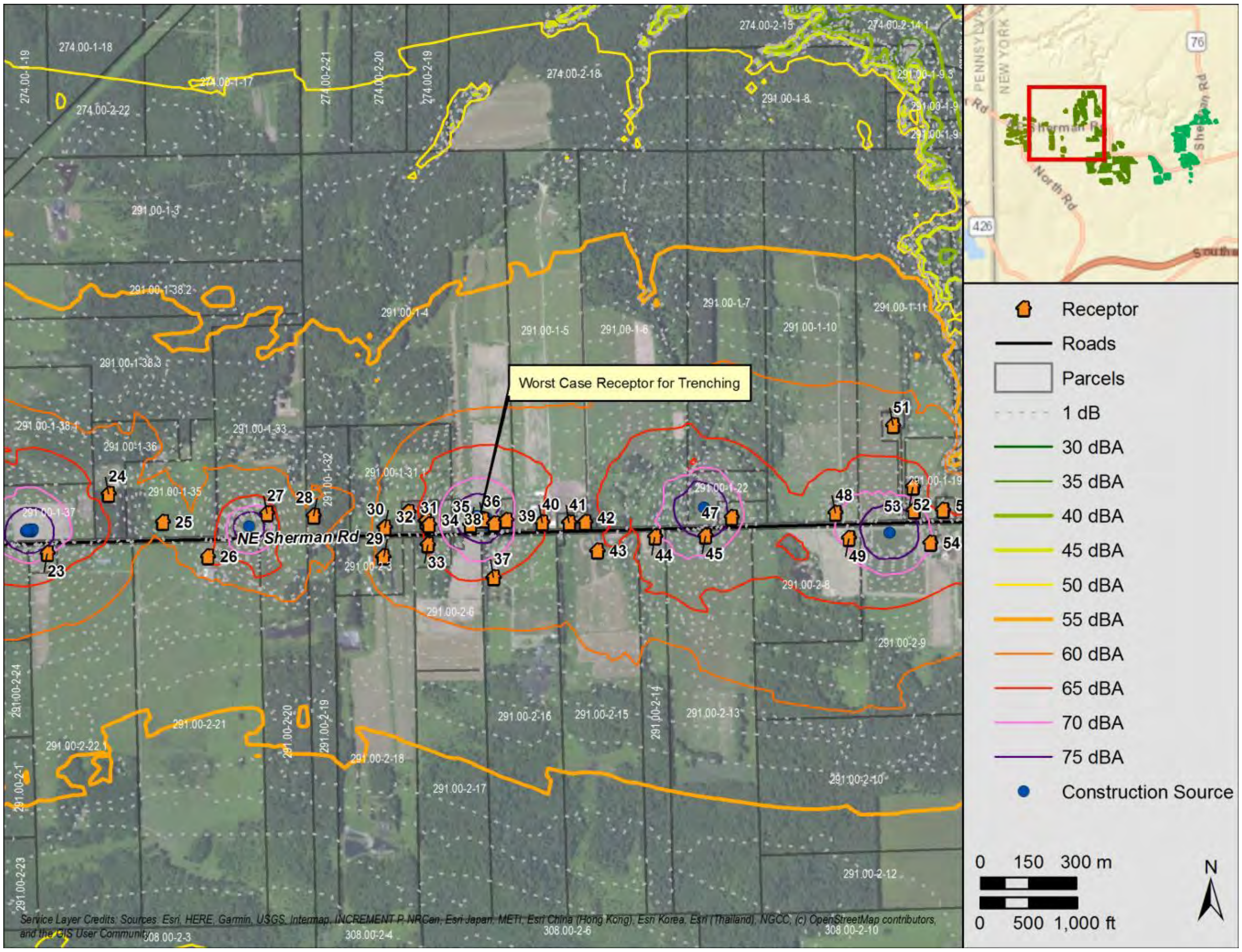


FIGURE 39: TRENCHING MODEL RESULTS

Array Inverter and Transformer Construction

This construction would take place around each inverter pad location throughout the solar arrays shown in Figure 2. The primary sources associated with this activity are excavators, dozers, graders, rollers, dump trucks, concrete mixing trucks, and concrete pumping trucks.

Cumulative model results of all construction sources operating simultaneously near the closest receptor to inverter construction is provided in Figure 40. The worst-case receptor for inverter construction is south of NE Sherman Road (Receptor ID 23). The cumulative modeled sound level at this receptor is 71 dBA. Table 13 shows the sound level from each source at a distance of 50 feet, and the sound level from each source at the closest receptor. Construction at each inverter pad typically lasts for a few days, so the potential impact to any given receptor is relatively short in duration.

TABLE 13: MODELED SOURCES FOR INVERTER CONSTRUCTION AND MODELED SOUND LEVELS

EQUIPMENT	SOUND PRESSURE LEVEL AT 50 FEET (dBA)	SOUND PRESSURE LEVEL AT CLOSEST SENSITIVE RECEPTOR (dBA)
Excavator	76	58
Dozer	80	61
Grader	78	58
Roller	82	63
Dump Truck	82	61
Concrete Mixing Truck	81	63
Concrete Pumping Truck	84	67
All Other Construction Sources		50
Cumulative Sound Level at Closest Receptor:		**71**

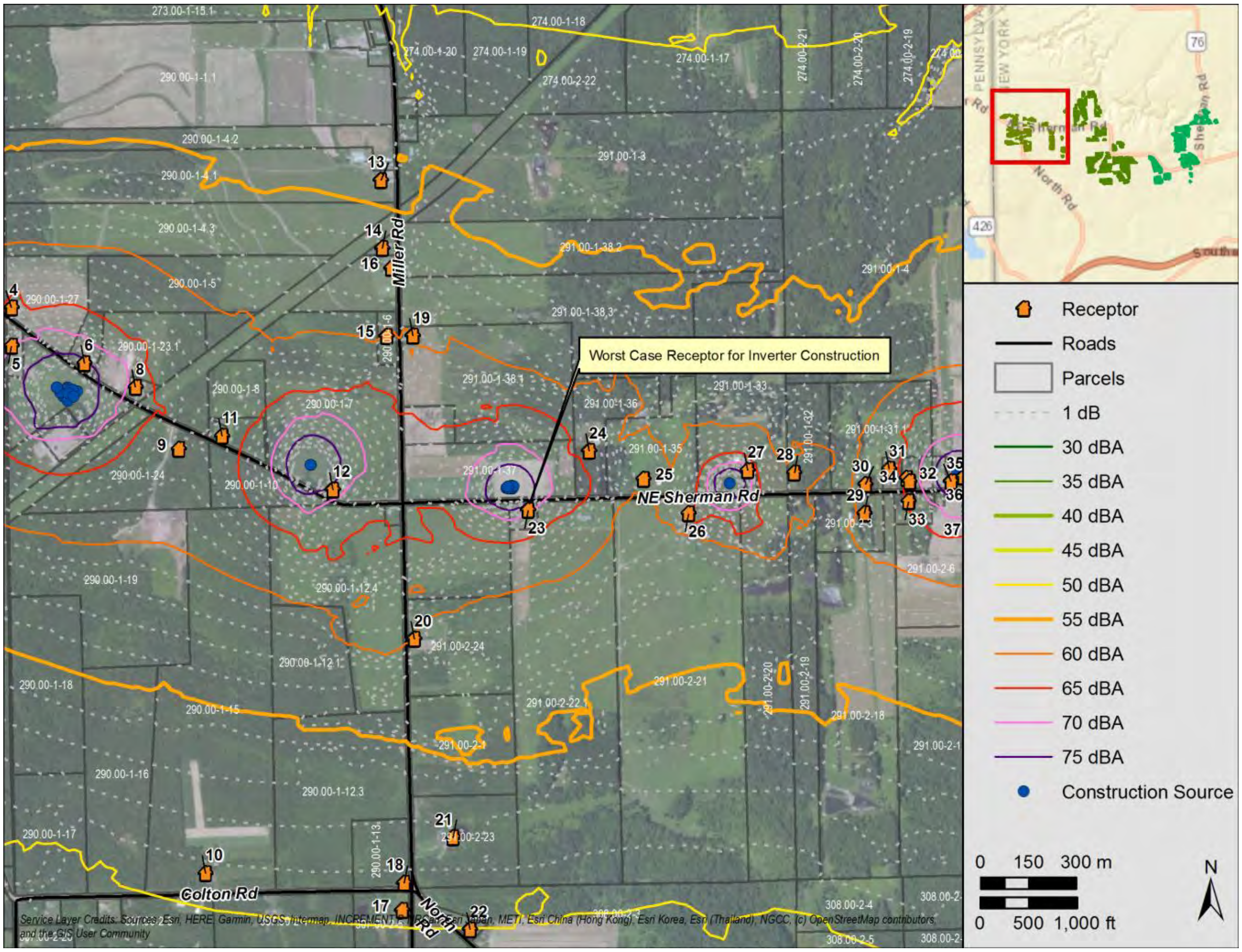


FIGURE 40: INVERTER CONSTRUCTION MODEL RESULTS

Piling

Piling would take place throughout the solar arrays. The primary sources associated with this activity are flatbed trucks, boom trucks, and pile drivers.

Cumulative model results of all construction sources operating simultaneously near the closest receptor to piling is provided in Figure 41. The worst-case receptor for piling is at a residence west of State Highway 76 (Receptor ID 86). The cumulative modeled sound level at this receptor is 70 dBA. Table 14 shows the sound level from each source at a distance of 50 feet, and the sound level from each source at the closest receptor. If there were two crews in the same area, the sound level would be approximately 70 dBA. Piling typically lasts for a few days in any given location, so the potential impact to any given receptor is relatively short in duration.

TABLE 14: MODELED SOURCES FOR PILING AND MODELED SOUND LEVELS

EQUIPMENT	SOUND PRESSURE LEVEL AT 50 FEET (dBA)	SOUND PRESSURE LEVEL AT CLOSEST SENSITIVE RECEPTOR (dBA)
Flatbed Truck	74	62
Boom Truck	72	61
Pile Driver	84	68
All Other Construction Sources		47
Cumulative Sound Level at Closest Receptor:		**70**

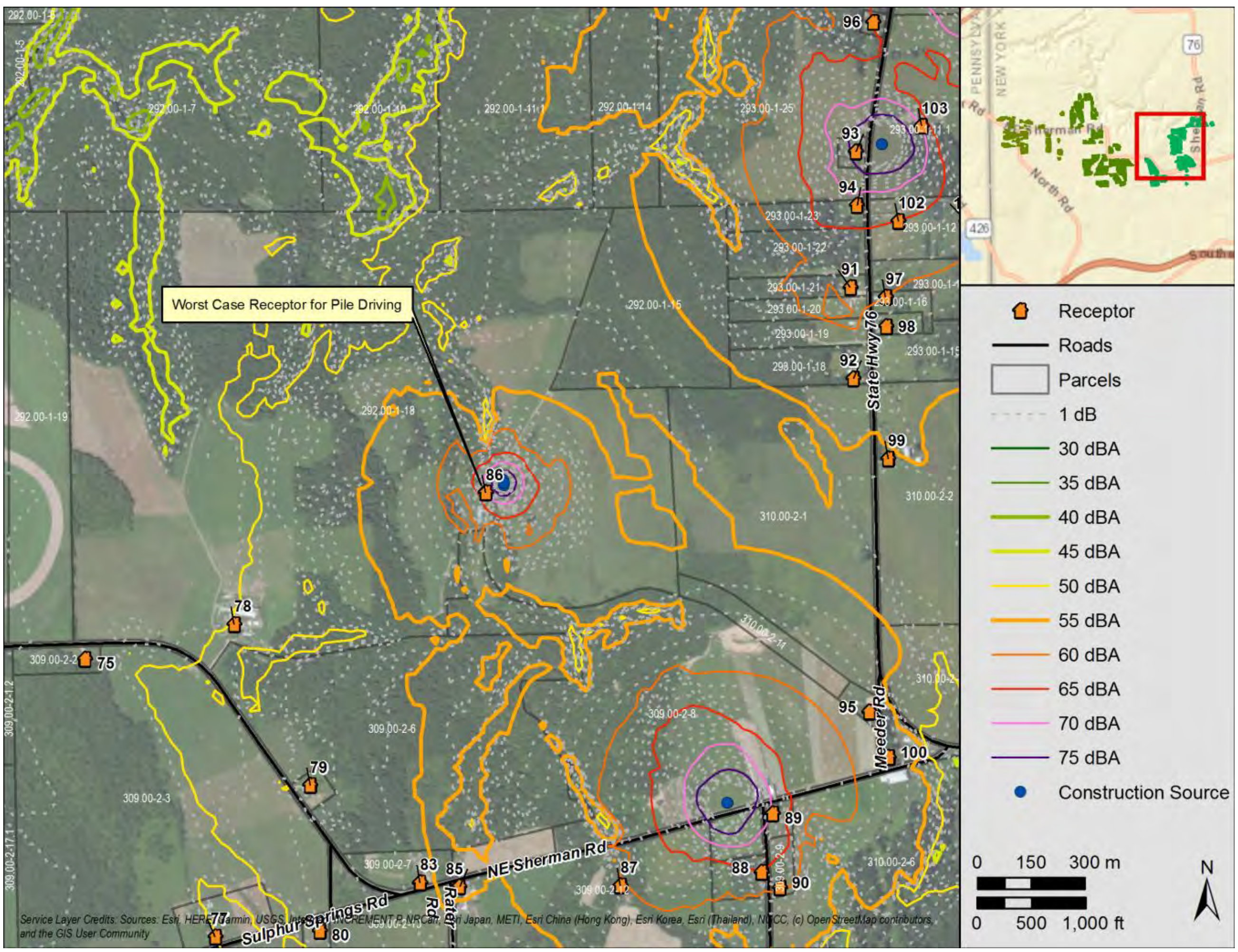


FIGURE 41: PILING MODEL RESULTS

Racking

Racking would take place throughout the solar arrays. The primary sources associated with this activity are flatbed trucks and forklifts.

Cumulative model results of all construction sources with two crews operating simultaneously near the closest receptor to racking is provided in Figure 42. The worst-case receptor for racking is at a residence east of State Highway 76 (Receptor ID 106), in the northeast portion of the project area. The cumulative modeled sound level at this receptor is 76 dBA. Table 15 shows the sound level from each source at a distance of 50 feet, and the sound level from each source at the closest receptor. There are two of each source for racking assuming that two teams may be working in the same area at once. Like piling, racking typically lasts for a few days in any given location, so the potential impact to any given receptor is relatively short in duration.

TABLE 15: MODELED SOURCES FOR RACKING AND MODELED SOUND LEVELS

EQUIPMENT	SOUND PRESSURE LEVEL AT 50 FEET (dBA)	SOUND PRESSURE LEVEL AT CLOSEST SENSITIVE RECEPTOR (dBA)
Flatbed Truck 1	74	60
Forklift 1	84	72
Flatbed Truck 2	74	57
Forklift 2	84	73
All other Construction Sources		66
Cumulative Sound Level at Closest Receptor:		**76**

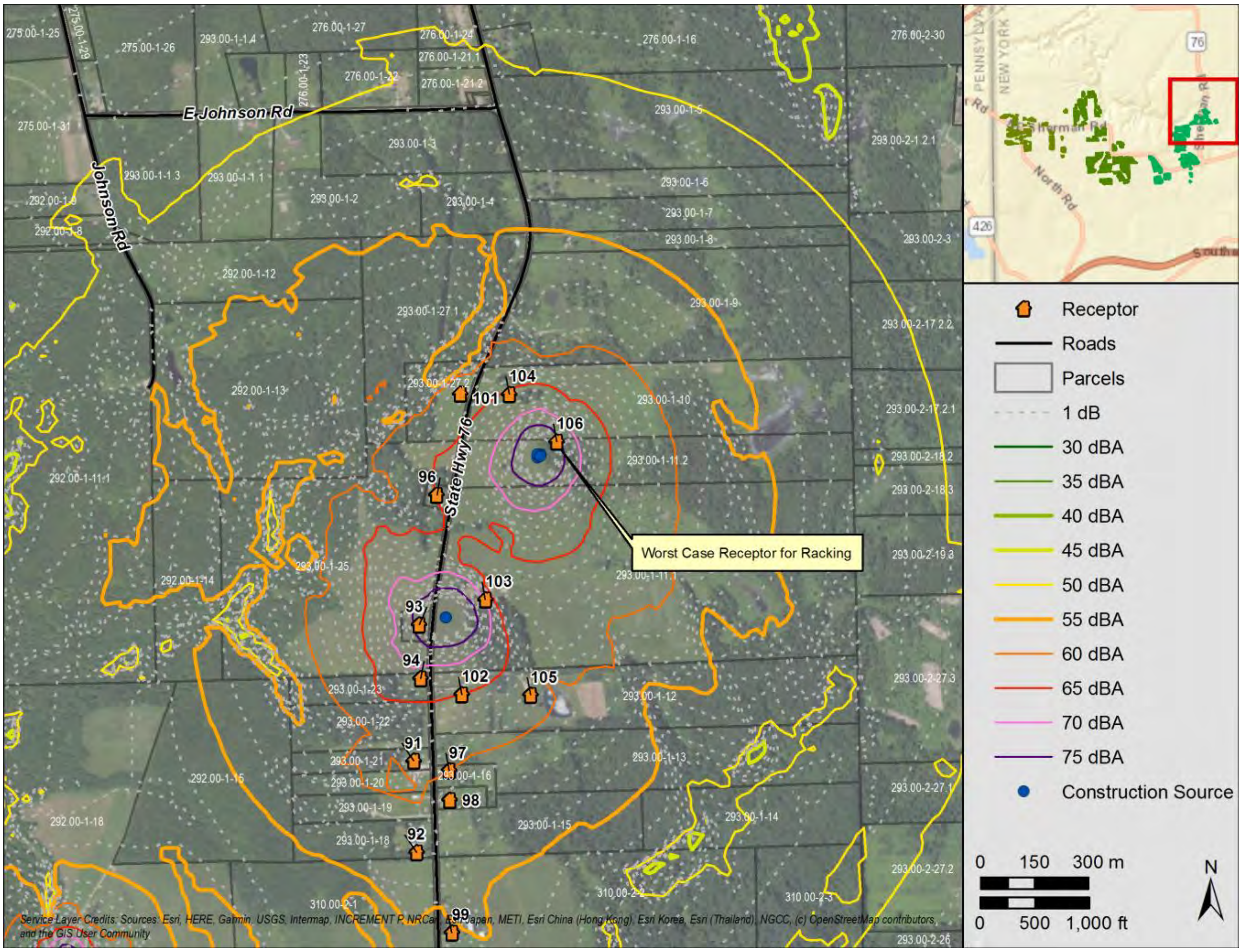


FIGURE 42: RACKING MODEL RESULTS

Boring

Boring would take place on the ends of portions of the underground collection line routes throughout the Project area. The primary source associated with this activity is a horizontal boring machine.

Cumulative model results of all primary boring sources operating simultaneously near the closest receptor to racking is provided in Figure 43. The worst-case receptor for boring is at a residence north of NE Sherman Rd (Receptor ID 27). The cumulative modeled sound level at this receptor is 72 dBA. Table 16 shows the sound level from each source at a distance of 50 feet, and the sound level from each source at the closest receptor. Boring typically lasts for a few days in any given location, so the potential impact to any given receptor is relatively short in duration.

TABLE 16: MODELED SOURCES FOR BORING AND MODELED SOUND LEVELS

EQUIPMENT	SOUND PRESSURE LEVEL AT 50 FEET (dBA)	SOUND PRESSURE LEVEL AT CLOSEST SENSITIVE RECEPTOR (dBA)
Boring Machine	85	72
All Other Construction Sources		58
Cumulative Sound Level at Closest Receptor:		**72**

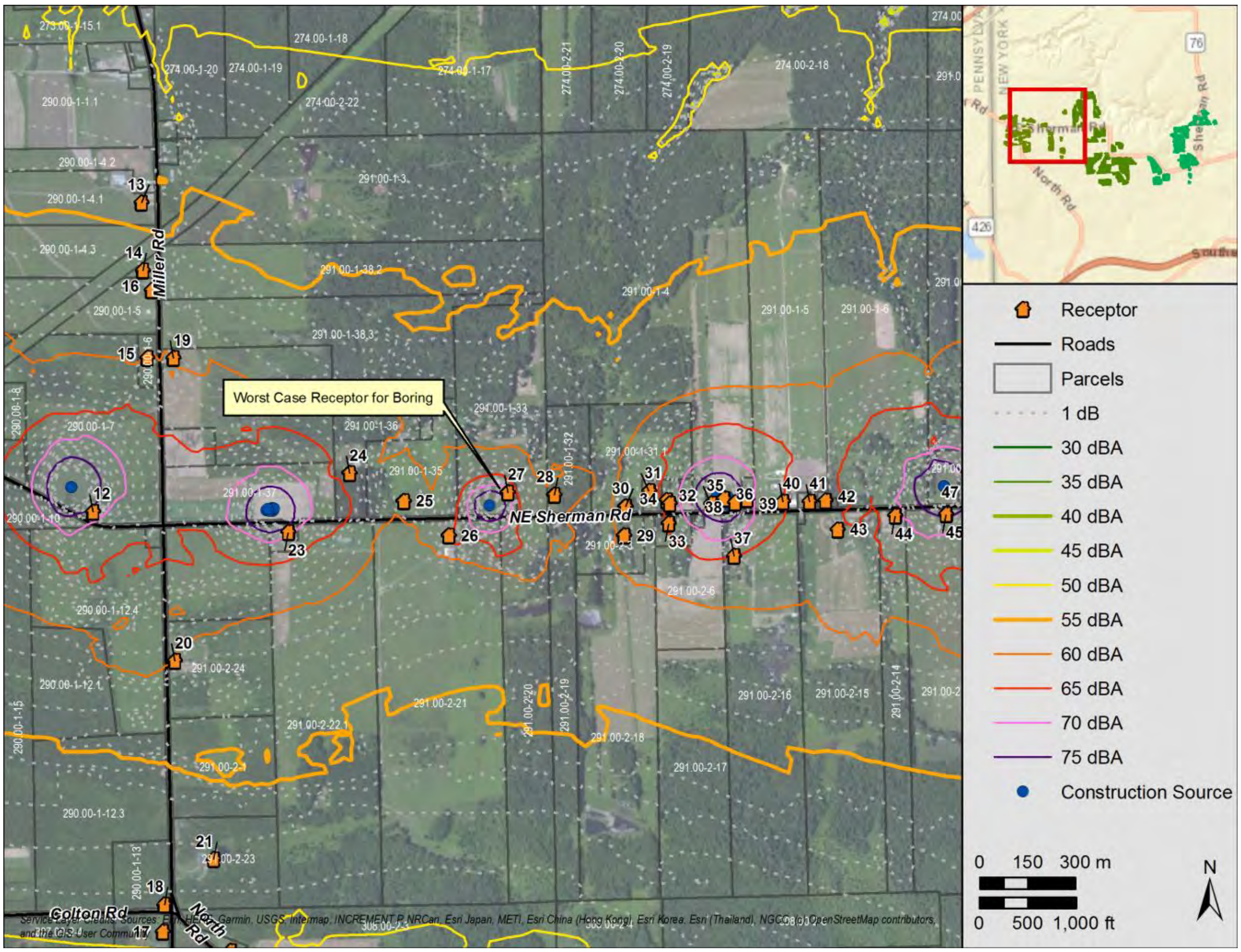


FIGURE 43: BORING MODEL RESULTS

Laydown Areas

There will be 7 laydown areas throughout the project area. The laydown yards are modeled each to include the operation of a flatbed truck, two forklifts, and two front-end loaders.

The sound pressure levels at 50 feet, as reported by NCHRP 25-49 and/or FHWA RCNM v 2.0, are shown in Table 17. The modeled sound levels near the worst-case receptor are shown in Figure 44.

TABLE 17: MODELED SOURCES AND SOUND LEVELS FOR ALL SEVEN LAYDOWN YARDS OPERATING SIMULTANEOUSLY

EQUIPMENT	SOUND PRESSURE LEVEL AT 50 FEET (dBA)	SOUND PRESSURE LEVEL AT CLOSEST SENSITIVE RECEPTOR (dBA)
Flatbed Truck	74 each	See cumulative total below
Forklifts	84 each	
Front-end Loaders	81 each	
Cumulative Sound Level at Closest Receptor (#93):		**77**

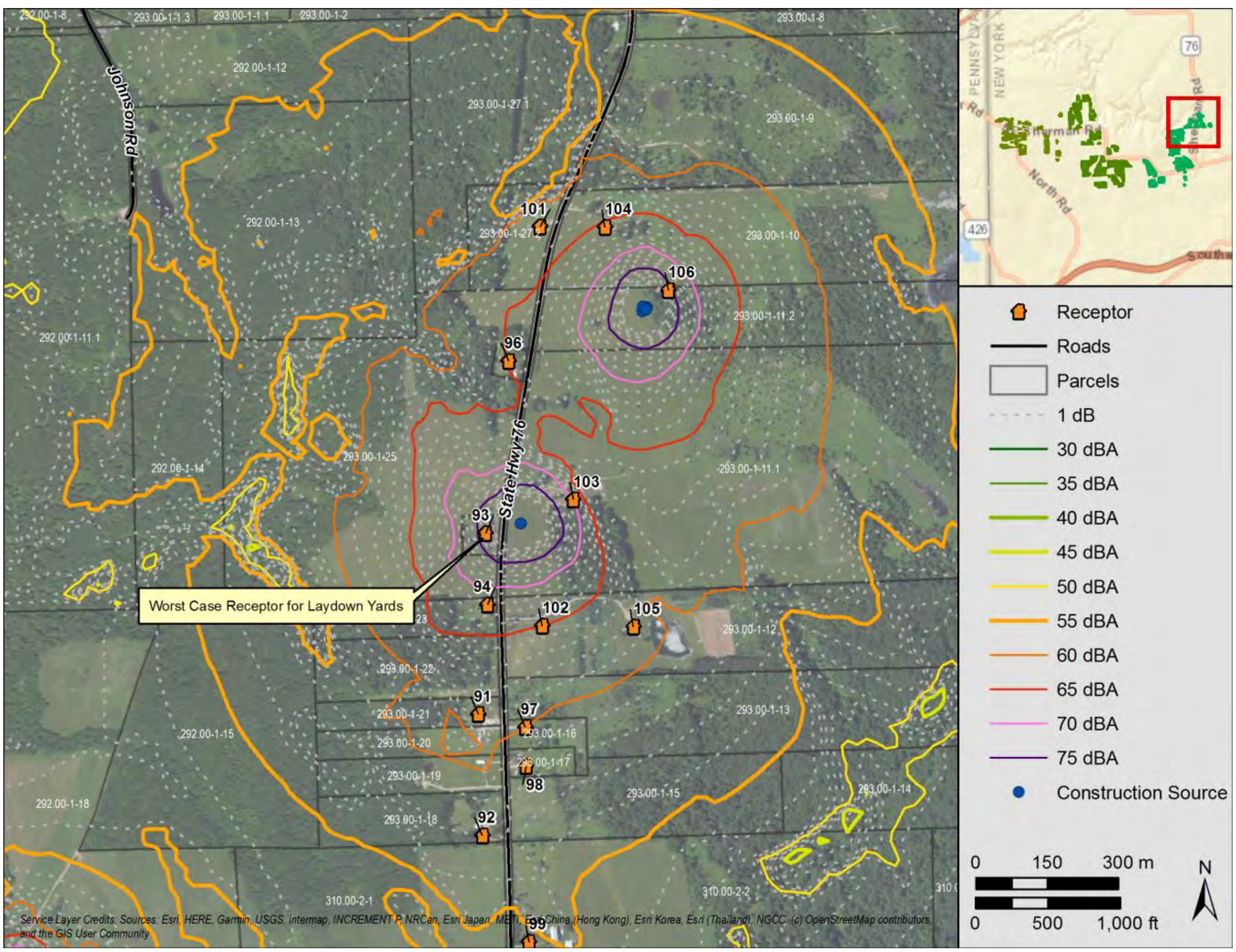


FIGURE 44: LAYDOWN MODEL RESULTS

Cumulative Construction Impacts

The previous sections assume that all construction phases are occurring at the same time nearest to the worst-case receivers for those phases. In this section, we reanalyze cumulative construction impacts assuming that construction is going on at every location at the same time at their maximum one-second sound levels. That is,

- **Road construction** is modeled to occur along the full length of each proposed access road concurrently across the Project. The sound power of all equipment associated with road construction (Table 10) is distributed along each of 61 roadway sections as line sources.
- Construction of the **substation and energy storage** facility is assumed to occur concurrently for all stages of its construction (Table 11) at once the same as in the previous section (see Page 57).
- **Trenching** is modeled to take place along the full length of all underground collection line routes throughout the Facility Site concurrently. The total sound power of all equipment associated with trenching (Table 12) is distributed along each of 246 trench sections as line sources.
- **Array inverter and transformer** construction is assumed to take place at all 136 proposed pads throughout the solar arrays concurrently for all stages of inverter construction at once. The sound power in the model is represented by a point source at each inverter hat has the sound power of the sum of all sources operating in Table 13 operating at their maximum sound power simultaneously.
- **Piling** (as described above) is assumed to take place throughout the solar arrays concurrently. Given the potential for multiple pile drivers is possible within larger arrays of construction, but unlikely in smaller arrays, the Applicant prepared a schedule of 78 locations based on array size to model the concurrent pile driving. Piling driving sound was modeled at all of the identified locations as point sources. The sound power associated with each point source is the sum of all sources in Table 14 at their maximum sound power.
- While **racking** would take place throughout the solar arrays once piling driving and other site preparations are completed, it is unlikely that material amounts of racking would be underway concurrently with all of the other construction activities within this list. Therefore, the Applicant prepared a subset of 22 locations which reflect construction areas large enough for concurrent scheduling of pile driving and racking. Racking sound was modeled at those locations concurrently with the rest of the construction sound on this list. Each racking area is modeled as a point source with a sound power equal to the sum of the sources in Table 15.

- **Boring** is modeled to take place at all bore pits located throughout the Project area concurrently. While each bore is directional (the bore at one end), we assumed that each end would contain the maximum sound power of all equipment associated with boring (Table 16), resulting in 105 modeled point sources.
- **Laydown yards** are modeled the same as the previous section (see Page 66). That is, all laydown equipment (Table 17) would take place at all seven laydown yards across the Facility Site concurrently and at their maximum sound power.

The highest 10 receptor sound pressure levels under this scenario are shown in Table 18. The results for each receptor are shown in Table 25 of Appendix C. Sound contour isolines are shown in Appendix G in 11X17 inch format and separately in 22X34 inch format.

TABLE 18: HIGHEST 10 CONSTRUCTION SOUND LEVELS UNDER CUMULATIVE SCENARIO (Lmax)

RECEPTOR	PARTICIPATING/NON-PARTICIPATING	CUMULATIVE SOUND LEVEL (dBA)
103	Participating, to be removed	90
25	Participating	86
20	Participating	86
35	Participating	85
23	Non-Participating	85
36	Participating	85
93	Non-Participating	84
45	Participating	84
44	Non-Participating	84
47	Non-Participating	83

While this analysis captures a hypothetical maximum potential noise impact of the cumulative impact of all phases of concurrent construction, it inherently overpredicts the potential for noise generation. Specifically, this analysis assumes that all phases of concurrent construction would occur simultaneously at all possible locations across the Facility Site with each piece of equipment at their maximum sound levels.

While this may have a use for permitting, it is not possible for all sites across a Facility of this size to be under construction at a single time. First, the modeled scenario involves the simultaneous maximum sound output of over 3,500 pieces of heavy construction equipment at the same time, which would not be how the construction would be phased. Typically, a project will have a small number of construction teams constructing portions of the project in sequence, with only a handful of locations under construction at a single time. More detail on construction phasing can be found in Exhibit 7.

Thus, this modeling scenario overestimates the total potential for noise generation. Therefore, while the cumulative analysis helps to quantify the maximum potential impact of cumulative construction activities at each sensitive receptor, the actual level of noise generation during construction will be lower across the whole site. Each sensitive receptor will also likely experience less of a noise impact, consistent with a staged construction schedule with less concurrent activities and wider spread between work areas.

Construction Best Management Practices

The following best management construction practices are recommended to limit construction hours and reduce construction noise levels at noise sensitive locations.

- Equipment and trucks used for project construction shall utilize property operating mufflers at all times,
- Locate all stationary noise-generating equipment, such as air compressors and portable power generators, a minimum of 200 feet from adjacent residential structures,
- Maintain equipment and surface irregularities on construction sites to prevent unnecessary noise,
- Locate staging areas and construction material areas a minimum of 200 feet from adjacent residential and classroom structures,
- Prohibit unnecessary idling of internal combustion engines, and
- Require contractors to use approved haul routes to minimize noise at residential and other sensitive noise receptor sites.

8.0 SUMMARY AND CONCLUSIONS

The South Ripley Solar Project ("Project") is a proposed 270 megawatt (MW) photovoltaic solar power facility with supporting infrastructure in Chautauqua County, New York. In preparation for permitting under Chapter XVIII, Title 19 of New York Codes, Rules, and Regulations, Part 900, also known as "Section 94-c", RSG has prepared a Project Noise Impact Assessment (PNIA).

There are no local or federal noise limits that are applicable to the Project. Section 94-c applies several noise limits for solar power projects, along with requirements for noise study content.

Table 19 shows noise limits that are applicable to the project. As shown in the table, there are no receptors analyzed in this PNIA that exceed any applicable quantitative sound level limits.

TABLE 19: SOUND LEVEL LIMITS APPLICABLE TO THE PROJECT AND NUMBER OF RECEPTORS EXCEEDING THE LIMITS

Sound Level Limit or Threshold	Maximum Sound Level (dBA) (including tonal penalty, where applicable)	Number of Receptors Exceeding Standard
45 dBA L_{8h} at non-participating residences	45 dBA	0 (0%)
55 dBA L_{8h} at participating residence	53 dBA[14]	0 (0%)
55 dBA L_{8h} at non-participating property lines	53 dBA	0 (0%)
40 dBA L_{1h} at non-participating residences from substation noise	40 dBA	0 (0%)

A summary of some key points in this assessment and conclusions of the assessment are as follows:

- Background sound level measurements were performed at six locations throughout the Project area in March and July 2020. Monitor locations were chosen to represent different areas and soundscapes throughout the Project area. Descriptions of each monitor location are found in Section 5.0.
- The average ambient preconstruction equivalent sound level across the Project area was 42 dBA during the day and 32 dBA at night. The sound levels and the types of sources that were present during the monitoring period are indicative of a rural area.
- Sound propagation modeling was performed using ISO 9613-2 sound propagation modeling algorithms to calculate projected Project-related construction and operational sound levels at 103 sensitive sound receptors. As a conservative assumption, all participating properties and homes were considered as non-participating for comparison

[14] This participating seasonal structure will be moved or removed as part of the Project.

to noise standards (except for one participating seasonal structure that will be moved or removed as part of the Project).

- The operational sound sources that were included in the sound propagation model included:
  - o 2,244 string inverters skids
  - o A high-voltage transformer at the substation with an air conditioning unit at the operations building
  - o 136 medium voltage transformers (“MVT”) with no cooling fans, and
  - o 20 MW of energy storage.
- Without 1/3 octave band sound emission data available from the equipment manufacturers, all sources were assumed to be tonal with a 5 dB penalty applied for evaluating the projected sound levels against the applicable 94-c sound level limits applied at residences. This is a conservative assumption as tonality is generally reduced at the receiver due to the attenuation of the sound over distance and masking by broadband background sound.
- Modeled Project sound levels (L_{8h}) are reported in Section 7.4.
  - o The highest sound level at a non-participating residence, including tonal penalties on all modeled sources, is 45 dBA L_{8h}. Without the tonal penalty, the highest projected sound level at a non-participating residence is 40 dBA L_{8h}. These levels meet Section 94-c limits.
  - o The highest projected sound level at a non-participating property line is 53 dBA L_{8h} which occurs at a location adjacent to and southeast of the substation next. All property lines are modeled to meet Section 94-c limits.
  - o The substation transformer is expected to be tonal. It is modeled to be 35 dBA L_{8h} or less at all sensitive receptors. Including a 5 dB tonal penalty, the maximum sound level is modelled at 40 dBA, which meets the 40 dBA Section 94-c limit.
- The modeled sound levels are below the WHO criteria for hearing loss (70 dBA L_{24}).
- Construction noise was modeled using ISO 9613-2 for a number of construction activities in the areas where they would be conducted closest to receptors. The projected sound level at the most impacted receptors that would occur from each activity is provided below. These sound levels are from construction equipment associated with a specific activity operating simultaneously and will not be consistently experienced by nearby receptors. Impacts will also be of relatively short duration.
  - o 80 dBA for road construction,

  - 76 dBA for substation construction,
  - 83 dBA for trenching,
  - 71 dBA for inverter construction
  - 70 dBA for piling,
  - 76 dBA for racking,
  - 72 dBA for boring, and
  - 77 dBA for laydown yards.
  - 86 dBA for all sources, all phases, and all locations operating at the maximum sound level simultaneously.
- The Project has incorporated several noise-mitigating elements into the design, including the use of low-noise equipment in the energy storage facility (relative to other commercially available equipment), a low-noise substation transformer (NEMA TR-1 minus 10 dB), and a noise barrier around a portion of the substation fence line.

Based upon the results from the analysis completed in this report and the information presented in this report, we conclude that the Project will meet the noise limits set in Section 94-c, and the noise reporting requirements of Section 94-c have been met as detailed in Appendix A.

APPENDIX A. ORES NOISE REGULATIONS

The relevant excerpt from ORES Regulations is found below. Sections only applying to wind power facilities have been removed. Shown within **square brackets** are the sections in this report where specific provisions are found.

§900-2.8 Exhibit 7: Noise and Vibration

Exhibit 7 shall contain:

(a) A study of the noise impacts of the construction and operation of the facility. The name(s) of the preparer(s) of the study and qualifications to perform such analyses shall be stated. If the study is prepared by certified member(s) of a relevant professional society or state, the details of such certification(s) shall be stated. **[Section 1.0]**

(b) Design Goals: The study shall demonstrate that noise levels from noise sources at the facility will comply with the following:

(1) For wind facilities:

…

(2) For solar facilities: **[Table 1, Section 7.4 and Appendix C]**

(i) A maximum noise limit of forty-five (45) dBA Leq (8-hour), at the outside of any existing non-participating residence, and fifty-five (55) dBA Leq (8-hour) at the outside of any existing participating residence; **[Table 1, Section 7.4 and Appendix C]**

(ii) A maximum noise limit of forty (40) dBA Leq (1-hour) at the outside of any existing non- participating residence from the collector substation equipment; **[Table 1 and Section 7.4]**

(iii) Prominent tones are as defined by using the constant level differences listed under ANSI/ASA S12.9-2005/Part 4 Annex C (sounds with tonal content) (see section 900-15.1(a)(1)(iii) of this Part), 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 subparagraphs (i) and (ii) of this paragraph; and **[Sections 7.3, and 7.4]**

(iv) A maximum noise limit of fifty-five (55) dBA Leq (8-hour), short-term equivalent continuous average sound level from the facility 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. **[Table 1, Section 7.4 and Appendix C]**

(c) Radius of Evaluation: Evaluation of the maximum noise levels to be produced during operation of the facility shall be conducted on a cumulative (if any) and non-cumulative basis for all sensitive receptors within the sound study area, defined as follows:

…

(2) For solar facilities, the evaluation shall include, at a minimum, all sensitive receptors within a one thousand five hundred (1,500) foot radius from any noise source (e.g., substation transformer(s), medium to low voltage transformers, inverters, energy storage) proposed for the facility or within the thirty (30) dBA noise contour, whichever is greater. For the cumulative noise analysis, the evaluation shall include noise from any solar facility and substation existing and proposed by the time of filing the application and any existing sensitive receptors within a three thousand (3,000)- foot radius from any noise source proposed for the facility or within the thirty (30) dBA cumulative noise contour, whichever is greater. **[Section 7.4]**

(d) Modeling standards, input parameters, and assumptions:

(1) For both wind and solar facilities, the evaluation shall use computer noise modeling software that follows the ANSI/ASA S12.62-2012/ISO 9613-2:1996 (MOD) (see section 900-15.1(a)(1)(v) of this Part) or the ISO-9613-2:1996 propagation standards (see section 900-15.1(g)(1)(i) of this Part) with no meteorological correction (Cmet) added. The model shall: **[Section 7.1]**

(i) Set all noise sources operating simultaneously at maximum sound power levels; **[Section 7.1]**

(ii) Use a ground absorption factor of no more than G=0.5 for lands and G=0 for water bodies; **[Section 7.1]**

(iii) Use a temperature of ten (10) degrees Celsius and seventy (70) percent relative humidity; **[Section 7.1]**

(iv) Report, at a minimum, the maximum A-weighted dBA Leq (1-hour or 8-hour) sound pressure levels in a year, and the maximum linear/unweighted/Z dB (Leq 1-hour) sound pressure levels in a year 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; **[Appendix C and Appendix D]**

(v) Report the maximum A-weighted dBA Leq sound pressure levels in a year (Leq (8-hour)) at the most critically impacted external property boundary lines of the facility site (e.g., non-participating boundary lines); **[Table 8 and Appendix C]**

(vi) Report the information in tabular and spreadsheet compatible format as specified herein and in subdivisions (f)(3) and (q)(2) of this section. A summary of the number of receptors exposed to sound levels greater than thirty-five (35) dBA will also be reported in tabular format grouped in one (1)-dB bins; and **[Table 9]**

(vii) Report noise impacts with sound level contours (specified in subdivision (k) of this section) on the map described in subdivision (h) of this section. **[Section 7.4]**

(2) For wind facilities, the model shall:

…

(3) For solar facilities, the model shall use a one and a half (1.5) meter assessment point above the ground and the addition of an uncertainty factor of zero (0) dBA or greater. **[Section 7.1]**

(e) Evaluation of prominent tones for the design:

(1) For wind and solar facility noise sources: The evaluation shall be conducted by using manufacturer sound information, the ANSI/ASA S12.62-2012/ISO 9613-2:1996 (MOD) (see section 900-15.1(a)(1)(v) of this Part) or the ISO 9613-2:1996 propagation standard (see section 900-15.1(g)(1)(i) of this Part) attenuations (Adiv, Aatm, Agr, and Abar), and the “prominent discrete tone” constant level differences (Kt) specified in ANSI/ASA S12.9-2013/Part 3 Annex B, Section B.1 (see section 900-15.1(a)(1)(ii) of this Part), as follows: fifteen (15) dB in low-frequency one-third-octave bands (from twenty-five (25) up to one hundred twenty-five (125) Hz); eight (8) dB in middle-frequency one-third-octave bands (from one hundred sixty (160) up to four hundred (400) Hz); and five (5) dB in high-frequency one-third-octave bands (from five hundred (500) up to ten thousand (10,000) Hz). **[Section 7.3]**

(2) For substation transformers and other solar facility noise sources (such as inverters/medium to low voltage transformers) where no manufacturer’s information or pre-construction field tests are available, the sounds will be assumed to be tonal and prominent. **[Section 7.3]**

…

(h) A map of the study area showing the location of sensitive sound receptors in relation to the facility (including any related substations), as follows.

(1) The sensitive sound receptors shown shall include all residences, outdoor public facilities and public areas, hospitals, schools, libraries, parks, camps, summer camps, places of worship, cemeteries, any historic resources listed or eligible for listing on the State or National Register of Historic Places, any public (federal, state and local) lands, cabins and hunting camps identified by property tax codes, and any other seasonal residences with septic systems/running water within the Sound Study Area. **[Appendix C]**

(2) All residences shall be 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 shall be identified as "participating." Other properties may be designated either as "non-participating" or "potentially participating." Updates with ID-tax numbers may be filed after the application is filed. **[All receptors designated as non-participating in this study]**

(i) An evaluation of ambient pre-construction baseline noise conditions by using the L90 statistical and the Leq 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 (see section 900-15.1(a)(1)(iv) of this Part). Sound surveys shall be conducted for, at a minimum, a seven (7) day-long period for wind facilities and a four (4) day-long period for solar facilities. **[Section 4.0]**

(j) An evaluation of future noise levels during construction of the facility including predicted A- weighted/dBA sound levels using computer noise modeling as follows: **[Section 7.5]**

(1) The model shall use the ANSI/ASA S12.62-2012/ISO 9613-2:1996 (MOD) (see section 900- 15.1(a)(1)(v) of this Part) or the ISO-9613-2:1996 propagation standard (see section 900- 15.1(g)(1)(i) of this Part) for the main phases of construction, and from activities at any proposed batch plant area/laydown area; **[Section 7.5]**

(2) The model shall include, at a minimum, all noise sources and construction sites that may operate simultaneously to meet the proposed construction schedule for the most critical timeframes of each phase; **[Section 7.5]**

(3) For wind and solar facilities, the operational modeling requirements included in subdivisions (d)(1)(i) through (d)(1)(iii), and (d)(3) of this section shall be used for modeling of construction noise; and **[Section 7.5]**

(4) Sound impacts shall be reported with sound level contours (specified in subdivision (k) of this section) on the map described in subdivision (h) of this section and sound levels at the most critically impacted receptors in tabular format (as specified in subdivision (q)(2) of this section). **[Section 7.5]**

(k) Sound Levels in Graphical Format:

(1) The application shall include legible sound contours rendered above the map specified in subdivision (h) of this section. **[Section 7.4]**

(2) Sound contours shall include all sensitive sound receptors and boundary lines (differentiating participating and non-participating) and all noise sources (e.g., wind turbines for wind facilities, substation(s), transformers, HVAC equipment, energy storage systems and emergency generators for wind and solar facilities; and inverters and medium to low voltage transformers for solar). **[Section 7.4]**

(3) Sound contours shall be rendered at a minimum, until the thirty (30) dBA noise contour is reached, in one (1)-dBA steps, with sound contours multiples of five (5) dBA differentiated. **[Section 7.4]**

(4) Full-size hard copy maps (22" x 34") in 1:12,000 scale shall be submitted. **[Provided separately, model result maps in this report are also produced at an 1:12,000 scale]**

(l) A tabular comparison between 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 facility site. **[Section 8.0]**

(m) An evaluation as to whether any of the following potential community noise impacts will occur:

(1) Hearing loss for the public, as addressed by the World Health Organization (WHO) Guidelines for Community Noise published in 1999 (see section 900-15.1(d)(1)(i) of this Part). The requirements for the public are not to exceed an average sound level of seventy (70) dBA from operation of the facility **[Section 8.0]** and one hundred twenty (120) dB-peak for children and one hundred forty (140) dB-peak for adults for impulsive sound levels (e.g., construction blasting).

(2) The potential for structural damage from some construction activities (e.g., blasting, pile driving, excavation, horizontal directional drilling or rock hammering,

if any) to produce any cracks, settlements, or structural damage on any existing proximal buildings, including any residences, historical buildings, and public or private infrastructure.

(n) An identification and evaluation of reasonable noise abatement measures for construction activities. **[Section 7.5]**

(o) An identification and evaluation of noise abatement measures for the design and operation of the facility to comply with the design limits set forth in subdivision (b) of this section. **[Section 7.4 and 7.2]**

(1) For wind facilities:

…

(2) For solar facilities: If noise mitigation measures are necessary for the design, those mitigation measures shall be implemented no later than the start date of operations.

(p) The software input parameters, assumptions, and associated data used for the computer modeling shall be provided as follows:

(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 shall be delivered by digital means;

(2) Computer noise modeling files shall be submitted by digital/electronic means;

(3) Site plan and elevation details of substations, as related to the location of all relevant noise sources (e.g., transformers, emergency generator, HVAC equipment, and energy storage systems, if any); specifications, any identified mitigations, and appropriate clearances for sound walls, barriers, mufflers, silencers, and enclosures, if any.

…

(5) For solar facilities, the application shall contain:

(i) The locations of all noise sources (e.g., substation transformer(s), medium to low voltage transformers, inverters, energy storage system, HVAC equipment, emergency generators, if any) identified with GIS coordinates and GIS files. **[Table 21]**

(ii) Sound information from the manufacturers for all noise sources as listed above, and any other relevant noise sources. **[Table 22]**

(q) Miscellaneous:

(1) The application shall include a glossary of terminology, definitions, abbreviations and references mentioned in the application. **[Appendix F]**

(2) Information shall be reported in tabular, spreadsheet compatible or graphical format as follows:

> (i) Data reported in tabular format shall be clearly identified to include headers and summary footer rows. Headers shall include identification of the information contained on each column, such as noise descriptors (e.g., Leq, L90, etc.); weighting (dBA, linear, dB, dBZ) duration of evaluation (e.g., 1-hour, 8-hour), time of the day (day time, nighttime); whether the value is a maximum or average value and the corresponding time frame of evaluation (e.g., maximum 8-h-Leq-nighttime in a year, etc.);
>
> (ii) Titles shall identify whether the tabular or graphical information correspond to the "unmitigated" or "mitigated" results, if any mitigation measures are evaluated, 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, shall identify the requirement to which the information relates;
>
> (iv) Tables shall be sorted by sound impacts or rows at the bottom summarizing the results to report maximum and minimum values of the information contained in the columns. For this purpose, sound receptors shall be separated in different tables according to their use (e.g., participating residences, non-participating residences, non-participating boundary lines, schools, parks, cemeteries, historic places, etc.); and
>
> (v) The application shall report 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)-dB bins). **[Table 9 and Table 19]**

APPENDIX B. MODEL INPUT DATA

TABLE 20: MODEL PARAMETER SETTINGS

Model Parameter	Setting
Atmospheric Absorption	Based on 10°C and 70% RH
Foliage	None
Ground Absorption	ISO 9613-2 spectral and G=0.5, except energy storage facility (G=0.0)
Receiver Height	1.5 meters for sound level isolines and discrete receptors
Search Radius	10,000 meters from each source

TABLE 21: OPERATIONAL SOURCE INPUT DATA[15]

Source	Modeled Sound Power Level (dBA)	Relative Height (m)	Coordinates (UTM NAD83 Z18N)		Modeled Absolute Height (m)
	Day		X (m)	Y (m)	
Substation Transformer	107	2	602419	4672517	454
Battery Storage Device	78	2	602263	4672397	451
Battery Storage Device	78	2	602273	4672384	452
Battery Storage Device	78	2	602279	4672388	452
Battery Storage Device	78	2	602284	4672392	452
Battery Storage Device	78	2	602290	4672397	452
Battery Storage Device	78	2	602296	4672401	452
Battery Storage Device	78	2	602299	4672406	452
Battery Storage Device	78	2	602268	4672402	451
Battery Storage Device	78	2	602274	4672406	451
Battery Storage Device	78	2	602280	4672410	451
Battery Storage Device	78	2	602285	4672415	451
Battery Storage Device	78	2	602291	4672417	452
Battery Storage Device	78	2	602295	4672411	452
Battery Storage Device	78	2	602313	4672416	452
Battery Storage Device	78	2	602309	4672422	452

[15] Each "Array Inverter" point source represents a group of string inverters. While each inverter has the same sound power, the total sound power for the point source in the model is a function of how many string inverters are in the group. The calculation is ***Total Point Source Lw = 78 dBA + 10 Log (n),*** where n is the number of string inverters in the group.

Source	Modeled Sound Power Level (dBA)	Relative Height (m)	Coordinates (UTM NAD83 Z18N)		Modeled Absolute Height (m)
	Day		X (m)	Y (m)	
Battery Storage Device	78	2	602304	4672427	452
Battery Storage Device	78	2	602308	4672432	451
Battery Storage Device	78	2	602318	4672419	452
Battery Storage Device	78	2	602322	4672423	452
Battery Storage Device	78	2	602318	4672429	452
Battery Storage Device	78	2	602313	4672434	452
Battery Storage Device	78	2	602327	4672445	452
Battery Storage Device	78	2	602331	4672439	452
Battery Storage Device	78	2	602336	4672433	452
Battery Storage Device	78	2	602341	4672436	452
Battery Storage Device	78	2	602330	4672449	452
Battery Storage Device	78	2	602336	4672452	452
Battery Storage Device	78	2	602340	4672446	452
Battery Storage Device	78	2	602345	4672440	452
Battery Storage Device	78	2	602358	4672451	453
Battery Storage Device	78	2	602354	4672457	452
Battery Storage Device	78	2	602349	4672462	452
Battery Storage Device	78	2	602353	4672467	452
Battery Storage Device	78	2	602363	4672454	453
Battery Storage Device	78	2	602367	4672458	453
Battery Storage Device	78	2	602363	4672464	452
Battery Storage Device	78	2	602359	4672469	452
Battery Storage Device	78	2	602372	4672480	452
Battery Storage Device	78	2	602376	4672474	452
Battery Storage Device	78	2	602381	4672468	453
Battery Storage Device	78	2	602386	4672471	453
Battery Storage Device	78	2	602375	4672484	452
Storage Inverters	92	2	602288	4672387	453
Storage Inverters	92	2	602302	4672397	453
Storage Inverters	92	2	602315	4672408	453
Storage Inverters	92	2	602329	4672419	453
Storage Inverters	92	2	602343	4672429	453
Storage Inverters	92	2	602356	4672440	453
Storage Inverters	92	2	602370	4672450	453

Source	Modeled Sound Power Level (dBA)	Relative Height (m)	Coordinates (UTM NAD83 Z18N)		Modeled Absolute Height (m)
	Day		X (m)	Y (m)	
Array Inverter	91	2	603385	4671538	478
Array Inverter	86	2	610362	4670007	436
Array Inverter	89	2	610403	4670177	442
Array Inverter	86	2	610351	4670545	460
Array Inverter	91	2	610349	4670848	461
Array Inverter	91	2	610329	4670847	460
Array Inverter	91	2	610344	4670790	459
Array Inverter	91	2	610344	4670781	459
Array Inverter	91	2	609423	4670180	454
Array Inverter	91	2	609423	4670192	454
Array Inverter	91	2	609031	4670016	473
Array Inverter	86	2	609029	4670099	472
Array Inverter	91	2	609031	4670085	472
Array Inverter	91	2	608879	4670477	477
Array Inverter	91	2	608865	4670604	485
Array Inverter	91	2	608805	4670728	492
Array Inverter	86	2	607016	4671124	454
Array Inverter	91	2	607504	4670338	474
Array Inverter	91	2	607634	4670162	472
Array Inverter	91	2	607592	4670236	473
Array Inverter	86	2	607659	4670080	473
Array Inverter	86	2	610692	4672175	472
Array Inverter	91	2	607608	4670435	475
Array Inverter	91	2	607604	4670590	477
Array Inverter	91	2	607632	4670435	476
Array Inverter	91	2	607628	4670591	478
Array Inverter	91	2	607700	4670775	476
Array Inverter	91	2	607700	4670747	477
Array Inverter	91	2	607627	4670722	476
Array Inverter	91	2	607600	4670784	476
Array Inverter	91	2	607119	4670422	462
Array Inverter	91	2	606971	4669997	468
Array Inverter	91	2	606886	4669976	465
Array Inverter	89	2	606798	4669994	457

Source	Modeled Sound Power Level (dBA)	Relative Height (m)	Coordinates (UTM NAD83 Z18N)		Modeled Absolute Height (m)
	Day		X (m)	Y (m)	
Array Inverter	91	2	606927	4670547	457
Array Inverter	91	2	606909	4670680	460
Array Inverter	91	2	606923	4670680	460
Array Inverter	91	2	606277	4670745	454
Array Inverter	91	2	606252	4670745	453
Array Inverter	91	2	606281	4670590	451
Array Inverter	91	2	606256	4670589	451
Array Inverter	91	2	606261	4670424	451
Array Inverter	91	2	606286	4670425	452
Array Inverter	91	2	610326	4670946	459
Array Inverter	91	2	610346	4670947	458
Array Inverter	91	2	610323	4671053	454
Array Inverter	91	2	610343	4671054	454
Array Inverter	91	2	609929	4671254	439
Array Inverter	91	2	609965	4671343	444
Array Inverter	91	2	609961	4671470	445
Array Inverter	91	2	609958	4671576	445
Array Inverter	91	2	609956	4671654	446
Array Inverter	91	2	609954	4671712	447
Array Inverter	89	2	609922	4671788	446
Array Inverter	89	2	609741	4671748	430
Array Inverter	91	2	609740	4671765	430
Array Inverter	91	2	608752	4670872	497
Array Inverter	89	2	608682	4670919	494
Array Inverter	86	2	608678	4670929	494
Array Inverter	91	2	607597	4670872	476
Array Inverter	91	2	607593	4670928	475
Array Inverter	91	2	607614	4671521	467
Array Inverter	89	2	607613	4671541	467
Array Inverter	91	2	607245	4671408	462
Array Inverter	86	2	607008	4671173	454
Array Inverter	91	2	606856	4670813	455
Array Inverter	91	2	606274	4670862	456
Array Inverter	91	2	606610	4671013	450

Source	Modeled Sound Power Level (dBA)	Relative Height (m)	Coordinates (UTM NAD83 Z18N)		Modeled Absolute Height (m)
	Day		X (m)	Y (m)	
Array Inverter	86	2	606867	4671736	454
Array Inverter	89	2	606868	4671929	454
Array Inverter	86	2	606515	4671746	447
Array Inverter	89	2	606440	4671746	447
Array Inverter	89	2	606382	4671744	446
Array Inverter	86	2	605156	4671004	447
Array Inverter	91	2	605125	4671386	449
Array Inverter	86	2	605081	4671836	446
Array Inverter	86	2	604601	4671378	449
Array Inverter	91	2	604590	4671596	449
Array Inverter	91	2	604588	4671685	448
Array Inverter	86	2	604580	4671806	445
Array Inverter	91	2	603710	4671435	467
Array Inverter	91	2	603593	4671432	472
Array Inverter	86	2	603611	4671599	466
Array Inverter	86	2	603374	4671537	478
Array Inverter	89	2	603345	4671709	474
Array Inverter	86	2	603322	4671746	473
Array Inverter	91	2	610941	4672785	472
Array Inverter	89	2	610992	4672668	474
Array Inverter	91	2	610944	4672534	479
Array Inverter	89	2	611374	4672491	478
Array Inverter	91	2	611056	4672548	477
Array Inverter	86	2	610820	4672580	481
Array Inverter	91	2	610584	4672524	473
Array Inverter	91	2	610521	4672538	468
Array Inverter	91	2	610258	4672086	461
Array Inverter	91	2	610203	4672099	458
Array Inverter	91	2	610171	4672083	457
Array Inverter	91	2	610084	4672081	452
Array Inverter	91	2	609908	4672091	443
Array Inverter	89	2	606863	4672133	452
Array Inverter	91	2	606474	4671974	442
Array Inverter	91	2	606470	4672061	443

Source	Modeled Sound Power Level (dBA)	Relative Height (m)	Coordinates (UTM NAD83 Z18N)		Modeled Absolute Height (m)
	Day		X (m)	Y (m)	
Array Inverter	91	2	606457	4672770	428
Array Inverter	86	2	606452	4673049	417
Array Inverter	91	2	605960	4673069	409
Array Inverter	89	2	605999	4673130	405
Array Inverter	89	2	606028	4673114	408
Array Inverter	91	2	606050	4672965	412
Array Inverter	89	2	606091	4672675	422
Array Inverter	89	2	606073	4672344	421
Array Inverter	86	2	605937	4672277	429
Array Inverter	91	2	605600	4672558	439
Array Inverter	91	2	605597	4672683	432
Array Inverter	91	2	605594	4672819	428
Array Inverter	89	2	605590	4672965	424
Array Inverter	89	2	605163	4672845	428
Array Inverter	89	2	604584	4671929	444
Array Inverter	89	2	604257	4672329	444
Array Inverter	86	2	603810	4672207	446
Array Inverter	91	2	603022	4671878	473
Array Inverter	91	2	603043	4671967	471
Array Inverter	91	2	603181	4671971	469
Array Inverter	91	2	603342	4671975	463
Array Inverter	91	2	603714	4671968	452
Array Inverter	91	2	603599	4671964	455
Array Inverter	86	2	603572	4672306	448
Array Inverter	89	2	603735	4672483	447
Array Inverter	86	2	603604	4672517	448
Array Inverter	91	2	603082	4672433	468
Array Inverter	91	2	603077	4672598	464
Array Inverter	91	2	602690	4672715	457
Array Inverter	91	2	606461	4673212	410
Array Inverter	91	2	606471	4673473	387
Array Inverter	91	2	606471	4673551	386
Array Inverter	91	2	605916	4673267	405
Array Inverter	91	2	605918	4673416	401

Source	Modeled Sound Power Level (dBA)	Relative Height (m)	Coordinates (UTM NAD83 Z18N)		Modeled Absolute Height (m)
	Day		X (m)	Y (m)	
Array Transformer	79	2	603385	4671538	478
Array Transformer	74	2	610362	4670007	435
Array Transformer	77	2	610403	4670177	441
Array Transformer	74	2	610351	4670545	460
Array Transformer	79	2	610349	4670848	460
Array Transformer	79	2	610329	4670847	459
Array Transformer	79	2	610344	4670790	458
Array Transformer	79	2	610344	4670781	458
Array Transformer	79	2	609423	4670180	453
Array Transformer	79	2	609423	4670192	453
Array Transformer	79	2	609031	4670016	472
Array Transformer	74	2	609029	4670099	471
Array Transformer	79	2	609031	4670085	472
Array Transformer	79	2	608879	4670477	476
Array Transformer	79	2	608865	4670604	484
Array Transformer	79	2	608805	4670728	492
Array Transformer	74	2	607016	4671124	454
Array Transformer	79	2	607504	4670338	473
Array Transformer	79	2	607634	4670162	472
Array Transformer	79	2	607592	4670236	473
Array Transformer	74	2	607659	4670080	473
Array Transformer	74	2	610692	4672175	472
Array Transformer	79	2	607608	4670435	475
Array Transformer	79	2	607604	4670590	477
Array Transformer	79	2	607632	4670435	475
Array Transformer	79	2	607628	4670591	478
Array Transformer	79	2	607700	4670775	476
Array Transformer	79	2	607700	4670747	476
Array Transformer	79	2	607627	4670722	476
Array Transformer	79	2	607600	4670784	476
Array Transformer	79	2	607119	4670422	462
Array Transformer	79	2	606971	4669997	468
Array Transformer	79	2	606886	4669976	464
Array Transformer	77	2	606798	4669994	457

Source	Modeled Sound Power Level (dBA)	Relative Height (m)	Coordinates (UTM NAD83 Z18N)		Modeled Absolute Height (m)
	Day		X (m)	Y (m)	
Array Transformer	79	2	606927	4670547	456
Array Transformer	79	2	606909	4670680	459
Array Transformer	79	2	606923	4670680	460
Array Transformer	79	2	606277	4670745	453
Array Transformer	79	2	606252	4670745	453
Array Transformer	79	2	606281	4670590	451
Array Transformer	79	2	606256	4670589	450
Array Transformer	79	2	606261	4670424	451
Array Transformer	79	2	606286	4670425	452
Array Transformer	79	2	610326	4670946	458
Array Transformer	79	2	610346	4670947	458
Array Transformer	79	2	610323	4671053	454
Array Transformer	79	2	610343	4671054	454
Array Transformer	79	2	609929	4671254	439
Array Transformer	79	2	609965	4671343	443
Array Transformer	79	2	609961	4671470	444
Array Transformer	79	2	609958	4671576	444
Array Transformer	79	2	609956	4671654	446
Array Transformer	79	2	609954	4671712	447
Array Transformer	77	2	609922	4671788	446
Array Transformer	77	2	609741	4671748	429
Array Transformer	79	2	609740	4671765	430
Array Transformer	79	2	608752	4670872	497
Array Transformer	77	2	608682	4670919	493
Array Transformer	74	2	608678	4670929	493
Array Transformer	79	2	607597	4670872	475
Array Transformer	79	2	607593	4670928	474
Array Transformer	79	2	607614	4671521	467
Array Transformer	77	2	607613	4671541	467
Array Transformer	79	2	607245	4671408	461
Array Transformer	74	2	607008	4671173	454
Array Transformer	79	2	606856	4670813	455
Array Transformer	79	2	606274	4670862	456
Array Transformer	79	2	606610	4671013	450

Source	Modeled Sound Power Level (dBA)	Relative Height (m)	Coordinates (UTM NAD83 Z18N)		Modeled Absolute Height (m)
	Day		X (m)	Y (m)	
Array Transformer	74	2	606867	4671736	454
Array Transformer	77	2	606868	4671929	454
Array Transformer	74	2	606515	4671746	446
Array Transformer	77	2	606440	4671746	446
Array Transformer	77	2	606382	4671744	446
Array Transformer	74	2	605156	4671004	447
Array Transformer	79	2	605125	4671386	449
Array Transformer	74	2	605081	4671836	446
Array Transformer	74	2	604601	4671378	449
Array Transformer	79	2	604590	4671596	448
Array Transformer	79	2	604588	4671685	448
Array Transformer	74	2	604580	4671806	445
Array Transformer	79	2	603710	4671435	466
Array Transformer	79	2	603593	4671432	471
Array Transformer	74	2	603611	4671599	466
Array Transformer	74	2	603374	4671537	478
Array Transformer	77	2	603345	4671709	474
Array Transformer	74	2	603322	4671746	473
Array Transformer	79	2	610941	4672785	471
Array Transformer	77	2	610992	4672668	473
Array Transformer	97	1	602423	4672518	479
Array Transformer	77	2	611374	4672491	478
Array Transformer	79	2	611056	4672548	477
Array Transformer	74	2	610820	4672580	481
Array Transformer	79	2	610584	4672524	473
Array Transformer	79	2	610521	4672538	468
Array Transformer	79	2	610258	4672086	460
Array Transformer	79	2	610203	4672099	458
Array Transformer	79	2	610171	4672083	456
Array Transformer	79	2	610084	4672081	452
Array Transformer	79	2	609908	4672091	443
Array Transformer	77	2	606863	4672133	452
Array Transformer	79	2	606474	4671974	442
Array Transformer	79	2	606470	4672061	443

Source	Modeled Sound Power Level (dBA)	Relative Height (m)	Coordinates (UTM NAD83 Z18N)		Modeled Absolute Height (m)
	Day		X (m)	Y (m)	
Array Transformer	79	2	606457	4672770	428
Array Transformer	74	2	606452	4673049	417
Array Transformer	79	2	605960	4673069	409
Array Transformer	77	2	605999	4673130	404
Array Transformer	77	2	606028	4673114	407
Array Transformer	79	2	606050	4672965	411
Array Transformer	77	2	606091	4672675	422
Array Transformer	77	2	606073	4672344	421
Array Transformer	74	2	605937	4672277	429
Array Transformer	79	2	605600	4672558	438
Array Transformer	79	2	605597	4672683	432
Array Transformer	79	2	605594	4672819	427
Array Transformer	77	2	605590	4672965	423
Array Transformer	77	2	605163	4672845	428
Array Transformer	77	2	604584	4671929	444
Array Transformer	77	2	604257	4672329	443
Array Transformer	74	2	603810	4672207	446
Array Transformer	79	2	603022	4671878	472
Array Transformer	79	2	603043	4671967	470
Array Transformer	79	2	603181	4671971	469
Array Transformer	79	2	603342	4671975	462
Array Transformer	79	2	603714	4671968	452
Array Transformer	79	2	603599	4671964	455
Array Transformer	74	2	603572	4672306	448
Array Transformer	77	2	603735	4672483	447
Array Transformer	74	2	603604	4672517	447
Array Transformer	79	2	603082	4672433	468
Array Transformer	79	2	603077	4672598	464
Array Transformer	79	2	602690	4672715	457
Array Transformer	79	2	606461	4673212	410
Array Transformer	79	2	606471	4673473	386
Array Transformer	79	2	606471	4673551	385
Array Transformer	79	2	605916	4673267	405
Array Transformer	79	2	605918	4673416	400

Source	Modeled Sound Power Level (dBA)	Relative Height (m)	Coordinates (UTM NAD83 Z18N)		Modeled Absolute Height (m)
	Day		X (m)	Y (m)	
HVAC	78	1	602380	4672543	450

TABLE 22: OPERATIONAL SOURCE SOUND POWER LEVEL SPECTRA

Source	1/1 Octave Band Sound Power (dBZ)										
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Sum (dBA)	Sum (dBZ)
Substation Transformer ONAF	36	52	81	79	84	83	81	74	64	89	98
Battery Energy Storage System	57	62	74	75	65	65	59	53	48	78	98
Storage Inverters (PCS)	81	80	84	81	86	76	75	71	74	92	96
Array Transformer	23	41	54	57	62	60	55	51	45	66	74
Array Inverter	81	78	76	84	76	70	65	60	53	78	87
Substation AC	-	-	-	-	-	-	-	-	-	78	-

APPENDIX C. RECEPTOR INFORMATION & MODEL RESULTS

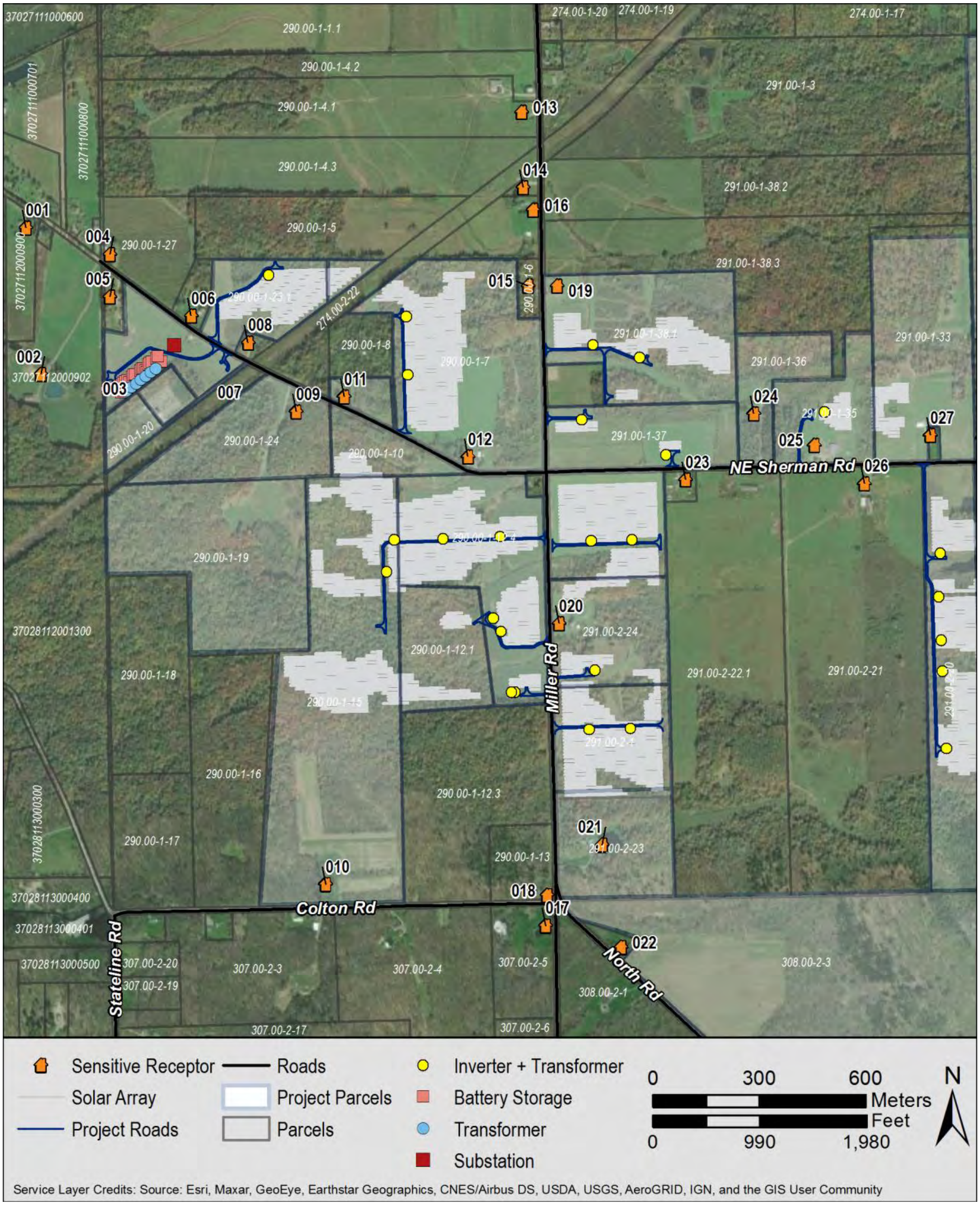


FIGURE 45: MAP OF MODELED RECEPTORS – WEST AREA

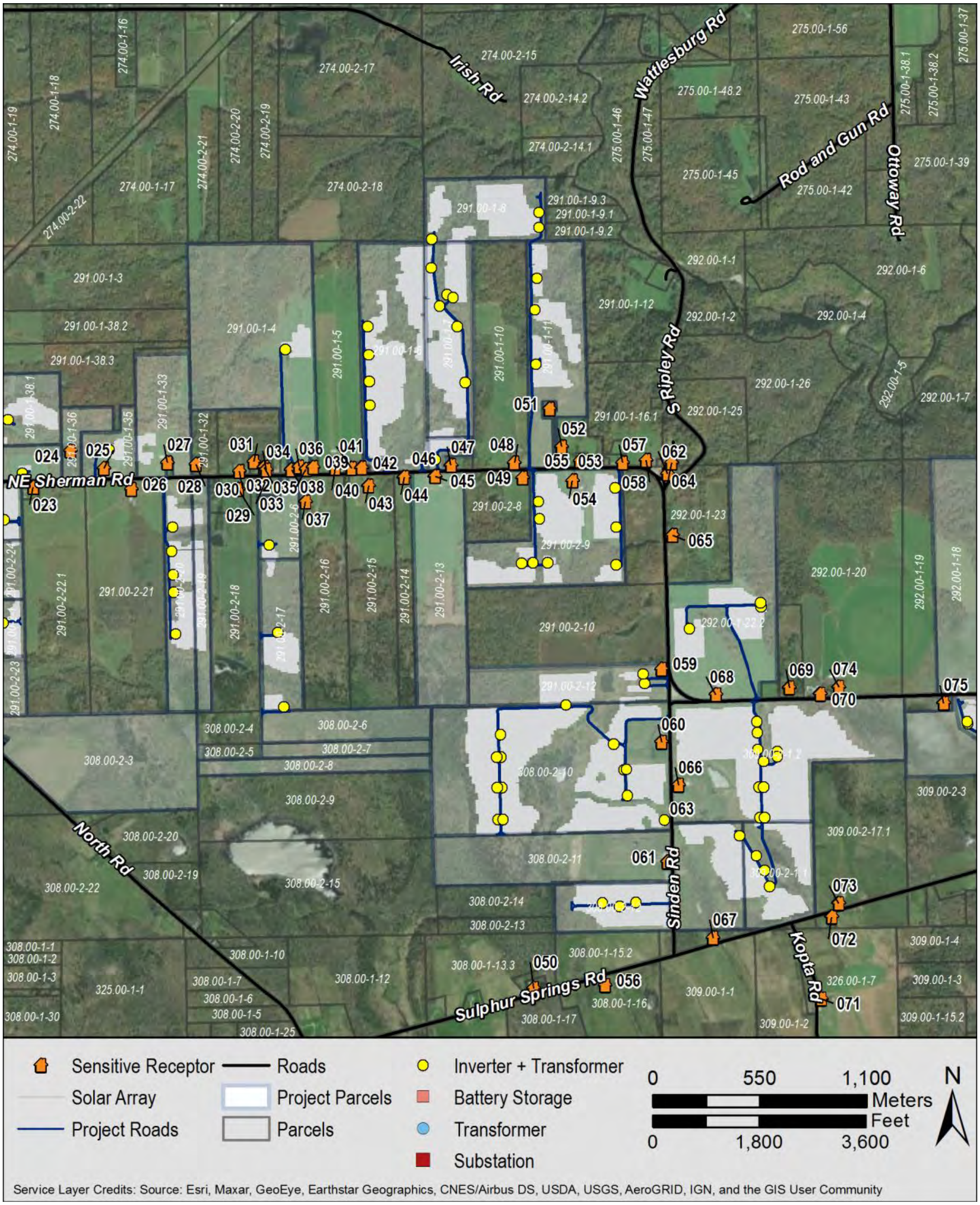


FIGURE 46: MAP OF MODELED RECEPTORS – CENTRAL AREA

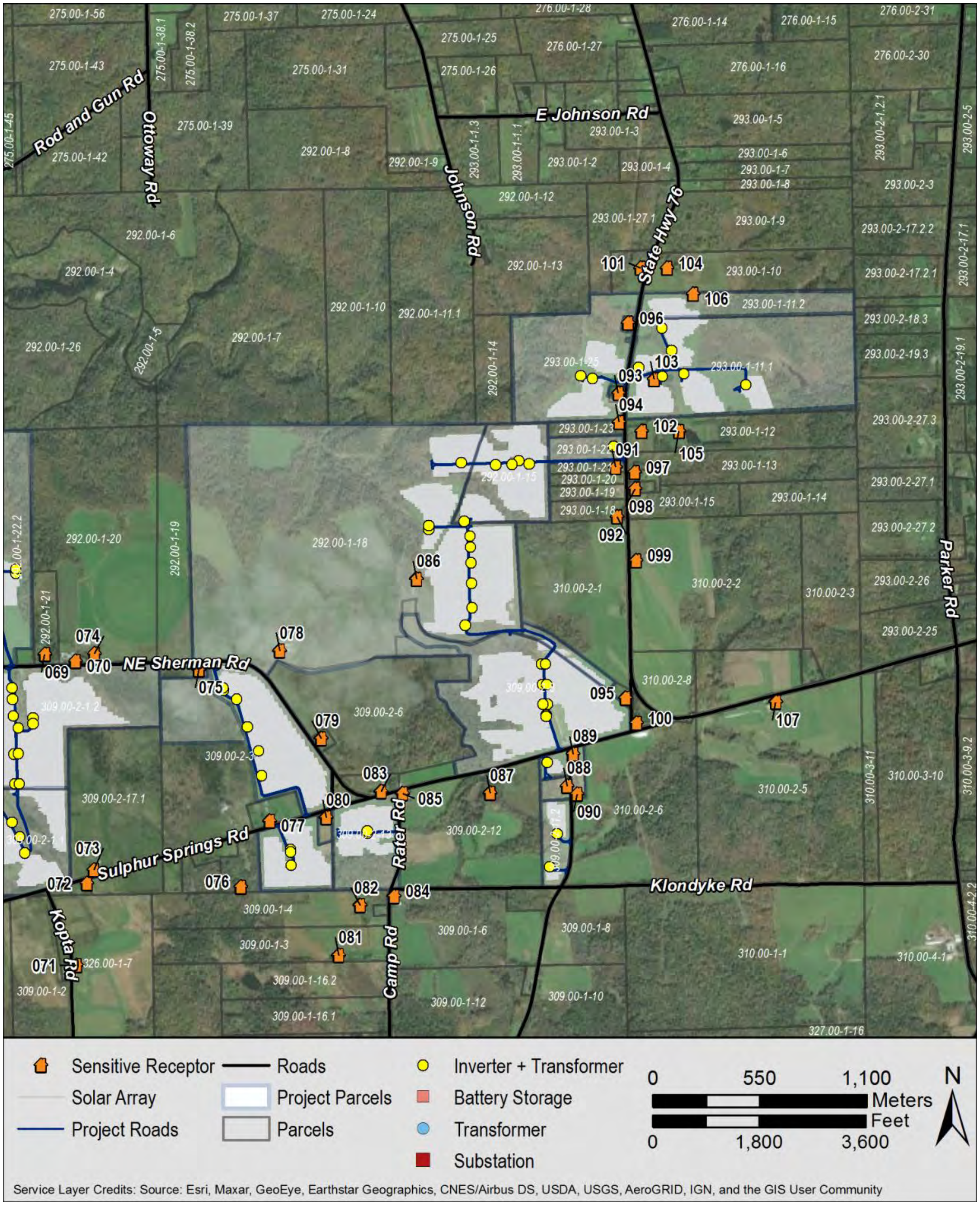


FIGURE 47: MAP OF MODELED RECEPTORS – EAST AREA

TABLE 23: RECEIVER LOCATIONS AND MODELING RESULTS[16]

Receptor ID	Tax ID Number	Type	Relative Height (m)	Coordinates (UTM NAD 83 Z18N)			Sound Pressure Level - L_{8h}	Sound Pressure Level - Sub Transformer Only - L_{1h}
				X (m)	Y(m)	Z (m)	dBA	dBA
1	37027112000900	Residence	1.5	602004	4672848	440	31	28
2	37027112000902	Residence	1.5	602046	4672434	446	36	31
4	290.00-1-27	Residence	1.5	602241	4672773	444	34	30
5	290.00-1-25	Residence	1.5	602241	4672653	447	39	35
6	290.00-1-23.2	Residence	1.5	602470	4672599	454	38	35
8	290.00-1-22	Residence	1.5	602631	4672523	458	38	30
9	290.00-1-24	Residence	1.5	602767	4672328	466	36	33
10	290.00-1-15	Residence	1.5	602851	4670994	481	23	14
11	290.00-1-9	Residence	1.5	602903	4672370	467	35	27
12	290.00-1-7	Residence	1.5	603251	4672201	462	36	18
13	290.00-1-4.1	Residence	1.5	603402	4673175	437	25	10
14	290.00-1-4.3	Residence	1.5	603407	4672961	438	27	10
15	290.00-1-6	Residence	1.5	603421	4672684	448	32	11
16	290.00-1-5	Residence	1.5	603436	4672898	441	27	11
17	307.00-2-5	Residence	1.5	603470	4670878	472	24	12
18	290.00-1-13	Residence	1.5	603475	4670963	468	24	12
19	291.00-1-38.1	Residence	1.5	603503	4672684	446	31	10
20	291.00-2-24	Residence	1.5	603508	4671730	467	39	17
21	291.00-2-23	Residence	1.5	603630	4671106	471	28	12
22	308.00-2-2	Residence	1.5	603683	4670816	468	24	11
23	291.00-2-22.2	Residence	1.5	603866	4672136	448	39	11
24	291.00-1-36	Residence	1.5	604058	4672322	442	35	10
25	291.00-1-35	Residence	1.5	604229	4672234	445	38	10
26	291.00-2-21	Residence	1.5	604370	4672126	446	34	10
27	291.00-1-34	Residence	1.5	604556	4672262	446	30	9
28	291.00-1-32	Residence	1.5	604703	4672254	444	29	8
29	291.00-2-3	Residence	1.5	604923	4672126	442	27	8
30	291.00-1-31.1	Residence	1.5	604927	4672218	437	26	4

[16] These results do not have the tonal penalty added. Add 5 dB to the results to account for the assumed tonal penalty.

Receptor ID	Tax ID Number	Type	Relative Height (m)	Coordinates (UTM NAD 83 Z18N)			Sound Pressure Level - L_{8h}	Sound Pressure Level - Sub Transformer Only - L_{1h}
				X (m)	Y(m)	Z (m)	dBA	dBA
31	291.00-1-31.2	Residence	1.5	605001	4672266	439	26	7
32	291.00-1-30	Residence	1.5	605057	4672237	441	26	7
33	291.00-2-4	Residence	1.5	605063	4672164	443	26	7
34	291.00-1-30	Residence	1.5	605066	4672227	441	26	7
35	291.00-1-4	Residence	1.5	605196	4672226	442	26	6
36	291.00-1-4	Residence	1.5	605237	4672242	443	26	6
37	291.00-2-16	Residence	1.5	605269	4672061	445	27	6
38	291.00-1-4	Residence	1.5	605271	4672229	443	27	6
39	291.00-1-27	Residence	1.5	605309	4672240	442	27	6
40	291.00-1-5	Residence	1.5	605423	4672233	440	28	6
41	291.00-1-26	Residence	1.5	605507	4672233	439	28	5
42	291.00-1-24	Residence	1.5	605557	4672235	437	29	2
43	291.00-2-15	Residence	1.5	605595	4672144	437	29	0
44	291.00-2-14	Residence	1.5	605777	4672188	430	32	1
45	291.00-2-13	Residence	1.5	605936	4672192	431	38	2
47	291.00-1-21	Residence	1.5	606018	4672250	430	40	2
48	291.00-1-10	Residence	1.5	606344	4672263	440	36	3
49	291.00-2-8	Residence	1.5	606387	4672184	439	39	3
50	308.00-1-14	Residence	1.5	606444	4669554	442	28	1
51	291.00-1-20	Residence	1.5	606526	4672539	443	32	2
52	291.00-1-19.1	Residence	1.5	606588	4672345	448	29	2
53	291.00-1-19.1	Residence	1.5	606591	4672271	453	31	2
54	291.00-2-9	Residence	1.5	606643	4672169	457	33	2
55	291.00-1-19.2	Residence	1.5	606683	4672273	449	29	0
56	308.00-1-16	Residence	1.5	606812	4669570	468	29	0
57	291.00-1-17	Residence	1.5	606902	4672262	448	35	0
58	291.00-1-16.1	Residence	1.5	607022	4672274	447	29	0
59	291.00-2-12	Residence	1.5	607103	4671200	464	37	1
60	308.00-2-10	Residence	1.5	607103	4670822	471	35	1
61	308.00-2-11	Residence	1.5	607133	4670205	481	34	0
62	292.00-1-24	Residence	1.5	607134	4672206	443	27	0
64	291.00-1-15.2	Residence	1.5	607155	4672261	444	26	0
65	292.00-1-23	Residence	1.5	607160	4671887	453	32	1

Receptor ID	Tax ID Number	Type	Relative Height (m)	Coordinates (UTM NAD 83 Z18N)			Sound Pressure Level - L_{8h}	Sound Pressure Level - Sub Transformer Only - L_{1h}
				X (m)	Y(m)	Z (m)	dBA	dBA
66	309.00-2-1.2	Residence	1.5	607190	4670600	468	37	0
67	309.00-1-1	Residence	1.5	607367	4669815	470	29	0
68	292.00-1-22.2	Residence	1.5	607382	4671067	484	34	0
69	292.00-1-21	Residence	1.5	607762	4671103	471	34	0
70	292.00-1-20	Residence	1.5	607920	4671069	473	33	0
71	326.00-1-7	Residence	1.5	607925	4669500	475	24	0
72	309.00-2-17.2	Residence	1.5	607980	4669921	467	28	0
73	309.00-2-17.1	Residence	1.5	608015	4669991	470	29	0
74	292.00-1-20	Residence	1.5	608017	4671106	474	32	0
75	309.00-2-2	Residence	1.5	608556	4671024	482	34	0
77	309.00-2-4	Residence	1.5	608921	4670245	473	38	0
78	292.00-1-18	Residence	1.5	608973	4671122	479	29	0
79	309.00-2-5	Residence	1.5	609187	4670669	472	31	0
80	309.00-2-14	Residence	1.5	609213	4670261	465	37	0
81	309.00-1-3	Residence	1.5	609277	4669553	455	24	0
82	309.00-1-4	Residence	1.5	609387	4669808	454	30	0
83	309.00-2-7	Residence	1.5	609495	4670396	447	36	0
84	309.00-1-6	Residence	1.5	609563	4669857	451	33	0
85	309.00-2-12	Residence	1.5	609606	4670385	442	35	0
86	292.00-1-18	Residence	1.5	609679	4671490	420	35	0
87	309.00-2-12	Residence	1.5	610057	4670388	436	31	0
88	309.00-2-10	Residence	1.5	610453	4670426	463	32	0
89	309.00-2-8	Residence	1.5	610485	4670590	462	36	0
90	309.00-2-9	Residence	1.5	610504	4670383	460	30	0
91	293.00-1-21	Residence	1.5	610702	4672067	473	34	0
92	293.00-1-18	Residence	1.5	610710	4671811	474	27	0
93	293.00-1-24	Residence	1.5	610717	4672448	478	36	0
94	293.00-1-23	Residence	1.5	610721	4672298	475	35	0
95	310.00-2-10	Residence	1.5	610755	4670877	470	31	0
96	293.00-1-26	Residence	1.5	610766	4672811	472	36	0
97	293.00-1-16	Residence	1.5	610801	4672040	473	30	0
98	293.00-1-17	Residence	1.5	610803	4671957	472	27	0
99	310.00-2-2	Residence	1.5	610808	4671586	477	27	0

Receptor ID	Tax ID Number	Type	Relative Height (m)	Coordinates (UTM NAD 83 Z18N)			Sound Pressure Level - L_{8h}	Sound Pressure Level - Sub Transformer Only - L_{1h}
				X (m)	Y(m)	Z (m)	dBA	dBA
100	310.00-2-7	Residence	1.5	610810	4670749	468	29	0
101	293.00-1-27.2	Residence	1.5	610831	4673094	476	28	0
102	293.00-1-12	Residence	1.5	610836	4672253	476	32	0
104	293.00-1-10	Residence	1.5	610969	4673093	483	29	0
105	293.00-1-12	Residence	1.5	611028	4672251	480	30	0
107	310.00-2-5	Residence	1.5	611528	4670857	472	20	0
76	309.00-2-15	Seasonal Structure	1.5	608771	4669905	461	32	0
103	293.00-1-11.1	Seasonal Structure	1.5	610902	4672519	484	48	0
106	293.00-1-11.2	Seasonal Structure	1.5	611102	4672960	483	33	0
Avg							**31**	**5**
Min							**20**	**0**
Max							**40**[17]	**35**

[17] This maximum does not include Receptor 103, which is a structure on a participating parcel located relatively close to inverters that will be moved or removed as part of the Project.

TABLE 24: PROPERTY LINE RECEIVER LOCATIONS AND MODELING RESULTS, NO TONAL PENALTY

Receptor ID	Type	Sound Pressure Level (dBA) - Maximum L_{8h}	Relative Height (m)	Coordinates (UTM NAD 83 Z18N)		
		Day		X (m)	Y (m)	Z (m)
3	Property Line	47	1.5	602221	4672364	450
7	Property Line	42	1.5	602532	4672398	458
46	Property Line	42	1.5	605941	4672227	430
63	Property Line	53	1.5	607146	4670422	463

TABLE 25: CUMULATIVE CONSTRUCTION SOUND LEVELS WITH ALL SOURCES OPERATING AT L_{max} AND ALL PHASES OPERATING CONCURRENTLY

Receptor ID	Tax ID	Type	Relative Height (m)	Coordinates (UTM NAD 83 Z18N)			Sound Pressure Level
				X (m)	Y (m)	Z (m)	(dBA)
1	37027112000900	Residence	1.5	602004	4672848	440	67
2	37027112000902	Residence	1.5	602046	4672434	446	71
4	290.00-1-27	Residence	1.5	602241	4672773	444	71
5	290.00-1-25	Residence	1.5	602241	4672653	447	74
6	290.00-1-23.2	Residence	1.5	602470	4672599	454	80
8	290.00-1-22	Residence	1.5	602631	4672523	458	81
9	290.00-1-24	Residence	1.5	602767	4672328	466	75
10	290.00-1-15	Residence	1.5	602851	4670994	481	69
11	290.00-1-9	Residence	1.5	602903	4672370	467	76
12	290.00-1-7	Residence	1.5	603251	4672201	462	81
13	290.00-1-4.1	Residence	1.5	603402	4673175	437	70
14	290.00-1-4.3	Residence	1.5	603407	4672961	438	73
15	290.00-1-6	Residence	1.5	603421	4672684	448	80
16	290.00-1-5	Residence	1.5	603436	4672898	441	74
17	307.00-2-5	Residence	1.5	603470	4670878	472	70
18	290.00-1-13	Residence	1.5	603475	4670963	468	71
19	291.00-1-38.1	Residence	1.5	603503	4672684	446	80
20	291.00-2-24	Residence	1.5	603508	4671730	467	86
21	291.00-2-23	Residence	1.5	603630	4671106	471	73
22	308.00-2-2	Residence	1.5	603683	4670816	468	70
23	291.00-2-22.2	Residence	1.5	603866	4672136	448	85
24	291.00-1-36	Residence	1.5	604058	4672322	442	82
25	291.00-1-35	Residence	1.5	604229	4672234	445	86
26	291.00-2-21	Residence	1.5	604370	4672126	446	82
27	291.00-1-34	Residence	1.5	604556	4672262	446	82
28	291.00-1-32	Residence	1.5	604703	4672254	444	81
29	291.00-2-3	Residence	1.5	604923	4672126	442	75
30	291.00-1-31.1	Residence	1.5	604927	4672218	437	74
31	291.00-1-31.2	Residence	1.5	605001	4672266	439	75
32	291.00-1-30	Residence	1.5	605057	4672237	441	75
33	291.00-2-4	Residence	1.5	605063	4672164	443	76
34	291.00-1-30	Residence	1.5	605066	4672227	441	75
35	291.00-1-4	Residence	1.5	605196	4672226	442	85
36	291.00-1-4	Residence	1.5	605237	4672242	443	85

Receptor ID	Tax ID	Type	Relative Height (m)	Coordinates (UTM NAD 83 Z18N)			Sound Pressure Level
				X (m)	Y (m)	Z (m)	(dBA)
37	291.00-2-16	Residence	1.5	605269	4672061	445	81
38	291.00-1-4	Residence	1.5	605271	4672229	443	80
39	291.00-1-27	Residence	1.5	605309	4672240	442	76
40	291.00-1-5	Residence	1.5	605423	4672233	440	75
41	291.00-1-26	Residence	1.5	605507	4672233	439	77
42	291.00-1-24	Residence	1.5	605557	4672235	437	79
43	291.00-2-15	Residence	1.5	605595	4672144	437	78
44	291.00-2-14	Residence	1.5	605777	4672188	430	84
45	291.00-2-13	Residence	1.5	605936	4672192	431	84
47	291.00-1-21	Residence	1.5	606018	4672250	430	83
48	291.00-1-10	Residence	1.5	606344	4672263	440	80
49	291.00-2-8	Residence	1.5	606387	4672184	439	81
50	308.00-1-14	Residence	1.5	606444	4669554	442	72
51	291.00-1-20	Residence	1.5	606526	4672539	443	79
52	291.00-1-19.1	Residence	1.5	606588	4672345	448	77
53	291.00-1-19.1	Residence	1.5	606591	4672271	453	79
54	291.00-2-9	Residence	1.5	606643	4672169	457	79
55	291.00-1-19.2	Residence	1.5	606683	4672273	449	75
56	308.00-1-16	Residence	1.5	606812	4669570	468	72
57	291.00-1-17	Residence	1.5	606902	4672262	448	76
58	291.00-1-16.1	Residence	1.5	607022	4672274	447	74
59	291.00-2-12	Residence	1.5	607103	4671200	464	83
60	308.00-2-10	Residence	1.5	607103	4670822	471	79
61	308.00-2-11	Residence	1.5	607133	4670205	481	78
62	292.00-1-24	Residence	1.5	607134	4672206	443	72
64	291.00-1-15.2	Residence	1.5	607155	4672261	444	72
65	292.00-1-23	Residence	1.5	607160	4671887	453	77
66	309.00-2-1.2	Residence	1.5	607190	4670600	468	79
67	309.00-1-1	Residence	1.5	607367	4669815	470	74
68	292.00-1-22.2	Residence	1.5	607382	4671067	484	80
69	292.00-1-21	Residence	1.5	607762	4671103	471	82
70	292.00-1-20	Residence	1.5	607920	4671069	473	81
71	326.00-1-7	Residence	1.5	607925	4669500	475	69
72	309.00-2-17.2	Residence	1.5	607980	4669921	467	72
73	309.00-2-17.1	Residence	1.5	608015	4669991	470	72
74	292.00-1-20	Residence	1.5	608017	4671106	474	78

Receptor ID	Tax ID	Type	Relative Height (m)	Coordinates (UTM NAD 83 Z18N) X (m)	Y (m)	Z (m)	Sound Pressure Level (dBA)
75	309.00-2-2	Residence	1.5	608556	4671024	482	80
77	309.00-2-4	Residence	1.5	608921	4670245	473	80
78	292.00-1-18	Residence	1.5	608973	4671122	479	78
79	309.00-2-5	Residence	1.5	609187	4670669	472	76
80	309.00-2-14	Residence	1.5	609213	4670261	465	80
81	309.00-1-3	Residence	1.5	609277	4669553	455	69
82	309.00-1-4	Residence	1.5	609387	4669808	454	73
83	309.00-2-7	Residence	1.5	609495	4670396	447	77
84	309.00-1-6	Residence	1.5	609563	4669857	451	75
85	309.00-2-12	Residence	1.5	609606	4670385	442	77
86	292.00-1-18	Residence	1.5	609679	4671490	420	79
87	309.00-2-12	Residence	1.5	610057	4670388	436	77
88	309.00-2-10	Residence	1.5	610453	4670426	463	82
89	309.00-2-8	Residence	1.5	610485	4670590	462	81
90	309.00-2-9	Residence	1.5	610504	4670383	460	79
91	293.00-1-21	Residence	1.5	610702	4672067	473	81
92	293.00-1-18	Residence	1.5	610710	4671811	474	76
93	293.00-1-24	Residence	1.5	610717	4672448	478	84
94	293.00-1-23	Residence	1.5	610721	4672298	475	82
95	310.00-2-10	Residence	1.5	610755	4670877	470	74
96	293.00-1-26	Residence	1.5	610766	4672811	472	82
97	293.00-1-16	Residence	1.5	610801	4672040	473	76
98	293.00-1-17	Residence	1.5	610803	4671957	472	75
99	310.00-2-2	Residence	1.5	610808	4671586	477	71
100	310.00-2-7	Residence	1.5	610810	4670749	468	73
101	293.00-1-27.2	Residence	1.5	610831	4673094	476	75
102	293.00-1-12	Residence	1.5	610836	4672253	476	79
104	293.00-1-10	Residence	1.5	610969	4673093	483	75
105	293.00-1-12	Residence	1.5	611028	4672251	480	77
107	310.00-2-5	Residence	1.5	611528	4670857	472	65
76	309.00-2-15	Seasonal Structure	1.5	608771	4669905	461	76
103	293.00-1-11.1	Seasonal Structure	1.5	610902	4672519	484	90
106	293.00-1-11.2	Seasonal Structure	1.5	611102	4672960	483	78
						Maximum	90

Receptor ID	Tax ID	Type	Relative Height (m)	Coordinates (UTM NAD 83 Z18N)			Sound Pressure Level
				X (m)	Y (m)	Z (m)	(dBA)
						Minimum	65
						Average	77

APPENDIX D. 1/1 OCTAVE BAND MODEL RESULTS

TABLE 26: MITIGATED DAYTIME 1/1 OCTAVE BAND SOUND PROPAGATION MODELING RESULTS, NO TONAL PENALTY

Receptor ID	Type	1/1 Octave Band Sound Pressure Level (dBZ), Maximum L_{8h}								
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
1	Residence	45	38	40	32	30	24	18	9	0
2	Residence	49	41	44	37	35	28	25	24	0
3	Property Line	60	52	53	45	44	37	35	40	28
4	Residence	51	43	44	35	33	26	22	19	0
5	Residence	51	43	47	39	37	31	27	27	0
6	Residence	49	42	48	39	36	29	25	22	0
7	Property Line	52	44	49	41	40	36	33	32	10
8	Residence	48	41	44	37	37	30	28	28	0
9	Residence	45	39	43	34	34	31	26	18	0
10	Residence	32	31	28	22	22	18	11	0	0
11	Residence	43	39	39	31	31	30	28	22	1
12	Residence	41	45	34	28	31	33	30	22	0
13	Residence	34	35	28	22	23	21	16	0	0
14	Residence	35	37	28	23	24	24	20	7	0
15	Residence	36	39	30	25	28	29	26	17	0
16	Residence	34	35	29	23	25	23	19	7	0
17	Residence	33	35	27	21	22	20	14	0	0
18	Residence	32	33	27	22	22	20	15	0	0
19	Residence	35	36	29	24	27	26	25	18	0
20	Residence	41	46	34	29	33	35	34	27	6
21	Residence	33	36	28	23	25	24	20	8	0
22	Residence	33	36	26	21	22	21	14	0	0
23	Residence	41	46	32	27	32	35	33	28	14
24	Residence	38	43	30	24	29	31	29	22	0
25	Residence	38	42	30	26	32	34	32	28	15
26	Residence	38	42	29	24	28	30	28	20	0
27	Residence	35	40	27	23	26	27	24	13	0
28	Residence	35	40	26	22	25	26	21	8	0
29	Residence	31	35	26	22	24	23	18	6	0

Receptor ID	Type	1/1 Octave Band Sound Pressure Level (dBZ), Maximum L_{8h}								
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
30	Residence	30	34	25	21	23	22	17	3	0
31	Residence	31	35	25	21	23	22	17	1	0
32	Residence	32	36	25	21	24	23	17	1	0
33	Residence	33	37	25	21	24	23	17	4	0
34	Residence	32	36	25	21	24	23	17	2	0
35	Residence	32	37	25	21	24	23	17	2	0
36	Residence	31	35	25	21	24	23	18	3	0
37	Residence	32	36	25	22	25	24	20	10	0
38	Residence	32	37	25	22	24	24	18	3	0
39	Residence	33	37	25	22	24	24	19	4	0
40	Residence	32	37	25	22	25	24	19	7	0
41	Residence	32	36	26	22	25	25	20	9	0
42	Residence	34	39	26	22	26	26	22	10	0
43	Residence	34	39	25	22	25	26	22	9	0
44	Residence	35	40	27	23	27	28	26	19	0
45	Residence	38	43	31	26	31	33	32	29	17
46	Property Line	42	47	34	30	35	37	37	34	25
47	Residence	40	45	32	27	32	35	34	31	18
48	Residence	39	44	29	25	30	32	30	22	0
49	Residence	41	46	32	26	32	35	33	28	10
50	Residence	34	39	23	19	24	25	20	4	0
51	Residence	34	39	27	24	28	28	25	18	0
52	Residence	32	37	26	23	26	25	21	11	0
53	Residence	34	39	27	24	28	28	24	15	0
54	Residence	34	40	27	25	29	29	26	19	0
55	Residence	32	37	25	23	26	25	23	17	0
56	Residence	33	38	24	21	25	26	23	11	0
57	Residence	33	38	26	24	29	30	29	24	8
58	Residence	31	36	25	22	25	25	23	18	0
59	Residence	36	41	29	27	31	33	31	27	14
60	Residence	35	41	29	27	31	31	29	22	0
61	Residence	36	41	28	26	30	31	28	19	0
62	Residence	30	35	24	21	24	23	20	11	0
63	Property Line	52	57	44	41	45	47	47	45	38
64	Residence	30	35	23	21	24	23	18	8	0

Receptor ID	Type	1/1 Octave Band Sound Pressure Level (dBZ), Maximum L_{8h}								
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
65	Residence	36	41	27	23	27	29	26	17	0
66	Residence	39	44	31	27	32	33	31	25	3
67	Residence	30	36	24	22	26	26	22	10	0
68	Residence	36	41	28	26	30	30	27	17	0
69	Residence	34	40	27	26	29	30	29	21	0
70	Residence	37	42	28	24	29	30	27	17	0
71	Residence	30	36	21	19	22	21	14	0	0
72	Residence	30	35	24	22	25	24	20	10	0
73	Residence	32	37	24	22	25	25	21	10	0
74	Residence	36	41	26	23	27	28	25	12	0
75	Residence	34	39	27	25	29	29	29	24	5
76	Seasonal Structure	36	41	26	22	27	29	26	18	0
77	Residence	41	46	31	26	31	34	33	27	5
78	Residence	31	36	24	22	26	25	23	13	0
79	Residence	35	40	26	23	27	28	24	12	0
80	Residence	39	44	30	26	31	33	31	24	0
81	Residence	27	33	21	19	22	21	15	0	0
82	Residence	34	40	24	22	26	27	23	12	0
83	Residence	40	45	30	25	30	33	31	24	1
84	Residence	38	43	26	22	27	30	27	16	0
85	Residence	39	44	28	24	29	32	29	21	0
86	Residence	36	41	28	26	30	31	30	22	0
87	Residence	35	40	25	22	26	28	24	12	0
88	Residence	33	39	26	24	28	28	26	19	1
89	Residence	36	42	29	26	30	32	30	25	5
90	Residence	31	36	25	23	27	27	23	16	0
91	Residence	32	37	26	24	28	29	28	24	10
92	Residence	30	35	24	22	25	24	19	7	0
93	Residence	34	40	28	27	30	31	31	26	8
94	Residence	36	42	28	25	29	31	29	24	9
95	Residence	31	36	25	23	27	27	25	15	0
96	Residence	34	41	28	25	30	32	31	24	3
97	Residence	30	36	24	23	26	26	24	18	0
98	Residence	30	35	24	22	25	24	19	9	0
99	Residence	32	37	23	21	24	24	18	0	0

Receptor ID	Type	1/1 Octave Band Sound Pressure Level (dBZ), Maximum L_{8h}								
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
100	Residence	30	36	24	22	26	26	23	11	0
101	Residence	32	37	23	21	24	25	21	10	0
102	Residence	35	40	27	23	27	28	26	21	2
103	Seasonal Structure	44	49	37	35	41	43	42	39	30
104	Residence	32	37	23	21	25	26	23	13	0
105	Residence	31	36	25	23	26	26	23	14	0
106	Seasonal Structure	36	42	27	23	27	30	28	20	0
107	Residence	25	31	18	16	18	16	7	0	0
Maxiumum		51	49	48	39	41	43	42	39	30
Minimum		25	31	18	16	18	16	7	0	0
Average		36	39	28	24	28	27	24	15	2

APPENDIX E. ACOUSTICS PRIMER

Expressing Sound in Decibel Levels

The varying air pressure that constitutes sound can be characterized in many different ways. The human ear is the basis for the metrics that are used in acoustics. Normal human hearing is sensitive to sound fluctuations over an enormous range of pressures, from about 20 micropascals (the "threshold of audibility") to about 20 pascals (the "threshold of pain").[18] This factor of one million in sound pressure difference is challenging to convey in engineering units. Instead, sound pressure is converted to sound "levels" in units of "decibels" (dB, named after Alexander Graham Bell). Once a measured sound is converted to dB, it is denoted as a level with the letter "L".

The conversion from sound pressure in pascals to sound level in dB is a four-step process. First, the sound wave's measured amplitude is squared and the mean is taken. Second, a ratio is taken between the mean square sound pressure and the square of the threshold of audibility (20 micropascals). Third, using the logarithm function, the ratio is converted to factors of 10. The final result is multiplied by 10 to give the decibel level. By this decibel scale, sound levels range from 0 dB at the threshold of audibility to 120 dB at the threshold of pain.

Typical sound sources, and their sound pressure levels, are listed on the scale in Figure 48.

Human Response to Sound Levels: Apparent Loudness

For every 20 dB increase in sound level, the sound pressure increases by a *factor* of 10; the sound *level* range from 0 dB to 120 dB covers 6 factors of 10, or one million, in sound *pressure*. However, for an increase of 10 dB in sound *level* as measured by a meter, humans perceive an approximate doubling of apparent loudness: to the human ear, a sound level of 70 dB sounds about "twice as loud" as a sound level of 60 dB. Smaller changes in sound level, less than 3 dB up or down, are generally not perceptible.

[18] The pascal is a measure of pressure in the metric system. In Imperial units, they are themselves very small: one pascal is only 145 millionths of a pound per square inch (psi). The sound pressure at the threshold of audibility is only 3 one-billionths of one psi: at the threshold of pain, it is about 3 one-thousandths of one psi.

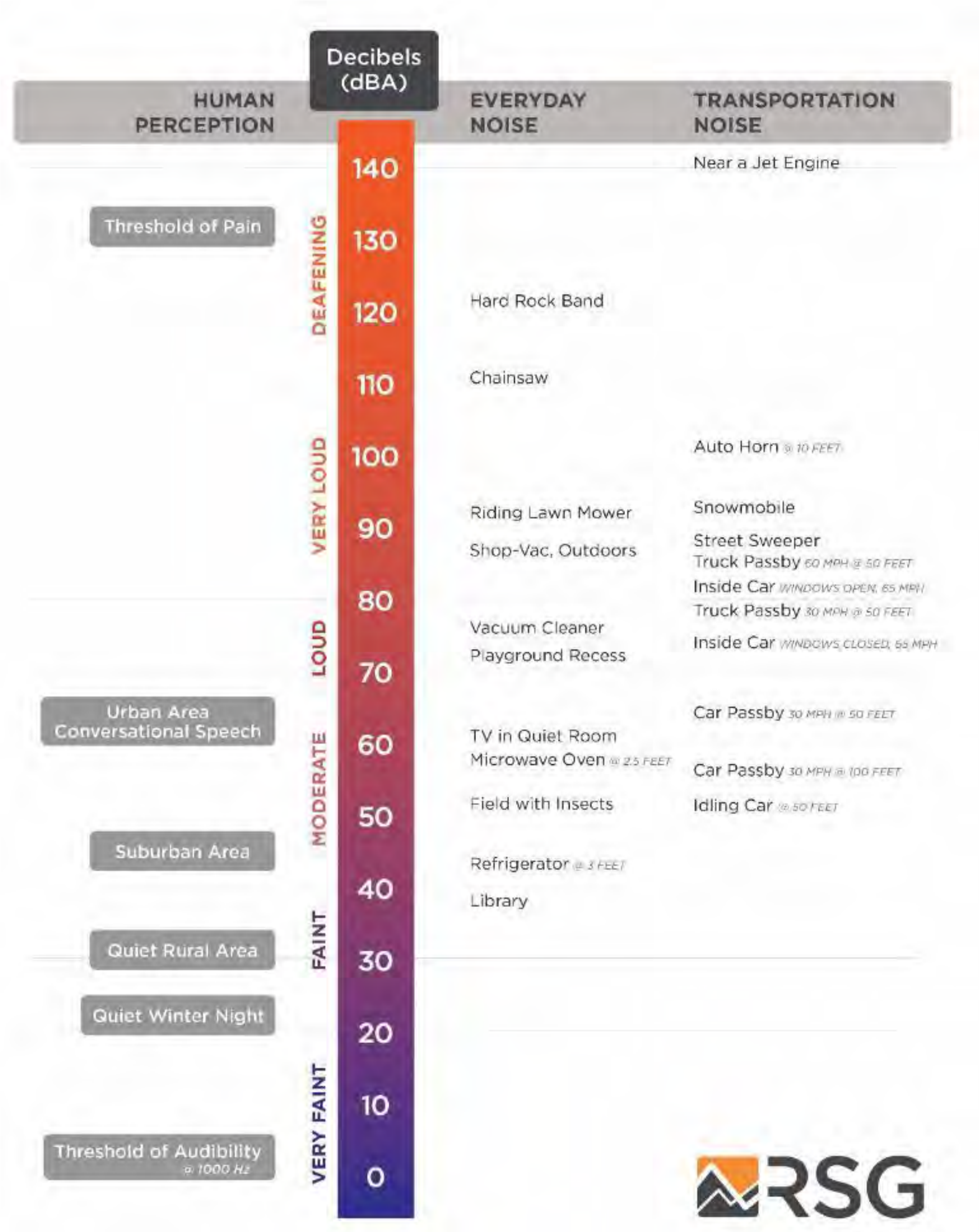


FIGURE 48: A SCALE OF SOUND PRESSURE LEVELS FOR TYPICAL SOUND SOURCES

Frequency Spectrum of Sound

The “frequency” of a sound is the rate at which it fluctuates in time, expressed in Hertz (Hz), or cycles per second. Very few sounds occur at only one frequency: most sound contains energy at many different frequencies, and it can be broken down into different frequency divisions, or bands. These bands are similar to musical pitches, from low tones to high tones. The most common division is the standard octave band. An octave is the range of frequencies whose upper frequency limit is twice its lower frequency limit, exactly like an octave in music. An octave band is identified by its center frequency: each successive band’s center frequency is twice as high (one octave) as the previous band. For example, the 500 Hz octave band includes all sound whose frequencies range between 354 Hz (Hertz, or cycles per second) and 707 Hz. The next band is centered at 1,000 Hz with a range between 707 Hz and 1,414 Hz. The range of human hearing is divided into 10 standard octave bands: 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1,000 Hz, 2,000 Hz, 4,000 Hz, 8,000 Hz, and 16,000 Hz. For analyses that require finer frequency detail, each octave-band can be subdivided. A commonly used subdivision creates three smaller bands within each octave band, or so-called 1/3-octave bands.

Human Response to Frequency: Weighting of Sound Levels

The human ear is not equally sensitive to sounds of all frequencies. Sounds at some frequencies seem louder than others, despite having the same decibel level as measured by a sound level meter. In particular, human hearing is much more sensitive to medium pitches (from about 500 Hz to about 4,000 Hz) than to very low or very high pitches. For example, a tone measuring 80 dB at 500 Hz (a medium pitch) sounds quite a bit louder than a tone measuring 80 dB at 60 Hz (a very low pitch). The frequency response of normal human hearing ranges from 20 Hz to 20,000 Hz. Below 20 Hz, sound pressure fluctuations are not “heard”, but sometimes can be “felt”. This is known as “infrasound”. Likewise, above 20,000 Hz, sound can no longer be heard by humans; this is known as “ultrasound”. As humans age, they tend to lose the ability to hear higher frequencies first; many adults do not hear very well above about 16,000 Hz. Most natural and man-made sound occurs in the range from about 40 Hz to about 4,000 Hz. Some insects and birdsongs reach to about 8,000 Hz.

To adjust measured sound pressure levels so that they mimic human hearing response, sound level meters apply filters, known as “frequency weightings”, to the signals. There are several defined weighting scales, including “A”, “B”, “C”, “D”, “G”, and “Z”. The most common weighting scale used in environmental noise analysis and regulation is A-weighting. This weighting represents the sensitivity of the human ear to sounds of low to moderate level. It attenuates sounds with frequencies below 1000 Hz and above 4000 Hz; it amplifies very slightly sounds between 1000 Hz and 4000 Hz, where the human ear is particularly sensitive. The C-weighting scale is sometimes used to describe louder sounds. The B- and D- scales are seldom used. All of these frequency weighting scales are normalized to the average human hearing response at

1000 Hz: at this frequency, the filters neither attenuate nor amplify. G-weighting is a standardized weighting used to evaluate infrasound.

When a reported sound level has been filtered using a frequency weighting, the letter is appended to "dB". For example, sound with A-weighting is usually denoted "dBA". When no filtering is applied, the level is denoted "dB" or "dBZ". The letter is also appended as a subscript to the level indicator "L", for example "L_A" for A-weighted levels.

Time Response of Sound Level Meters

Because sound levels can vary greatly from one moment to the next, the time over which sound is measured can influence the value of the levels reported. Often, sound is measured in real time, as it fluctuates. In this case, acousticians apply a so-called "time response" to the sound level meter, and this time response is often part of regulations for measuring sound. If the sound level is varying slowly, over a few seconds, "Slow" time response is applied, with a time constant of one second. If the sound level is varying quickly (for example, if brief events are mixed into the overall sound), "Fast" time response can be applied, with a time constant of one-eighth of a second.[19] The time response setting for a sound level measurement is indicated with the subscript "S" for Slow and "F" for Fast: L_S or L_F. A sound level meter set to Fast time response will indicate higher sound levels than one set to Slow time response when brief events are mixed into the overall sound, because it can respond more quickly.

In some cases, the maximum sound level that can be generated by a source is of concern. Likewise, the minimum sound level occurring during a monitoring period may be required. To measure these, the sound level meter can be set to capture and hold the highest and lowest levels measured during a given monitoring period. This is represented by the subscript "max", denoted as "L_{max}". One can define a "max" level with Fast response L_{Fmax} (1/8-second time constant), Slow time response L_{Smax} (1-second time constant), or Continuous Equivalent level over a specified time period $L_{eq,max}$.

Accounting for Changes in Sound Over Time

A sound level meter's time response settings are useful for continuous monitoring. However, they are less useful in summarizing sound levels over longer periods. To do so, acousticians apply simple statistics to the measured sound levels, resulting in a set of defined types of sound level related to averages over time. An example is shown in Figure 49. The sound level at each instant of time is the grey trace going from left to right. Over the total time it was measured (1 hour in the figure), the sound energy spends certain fractions of time near various levels, ranging from the minimum (about 27 dB in the figure) to the maximum (about 65 dB in the

[19] There is a third time response defined by standards, the "Impulse" response. This response was defined to enable use of older, analog meters when measuring very brief sounds; it is no longer in common use.

figure). The simplest descriptor is the average sound level, known as the Equivalent Continuous Sound Level. Statistical levels are used to determine for what percentage of time the sound is louder than any given level. These levels are described in the following sections.

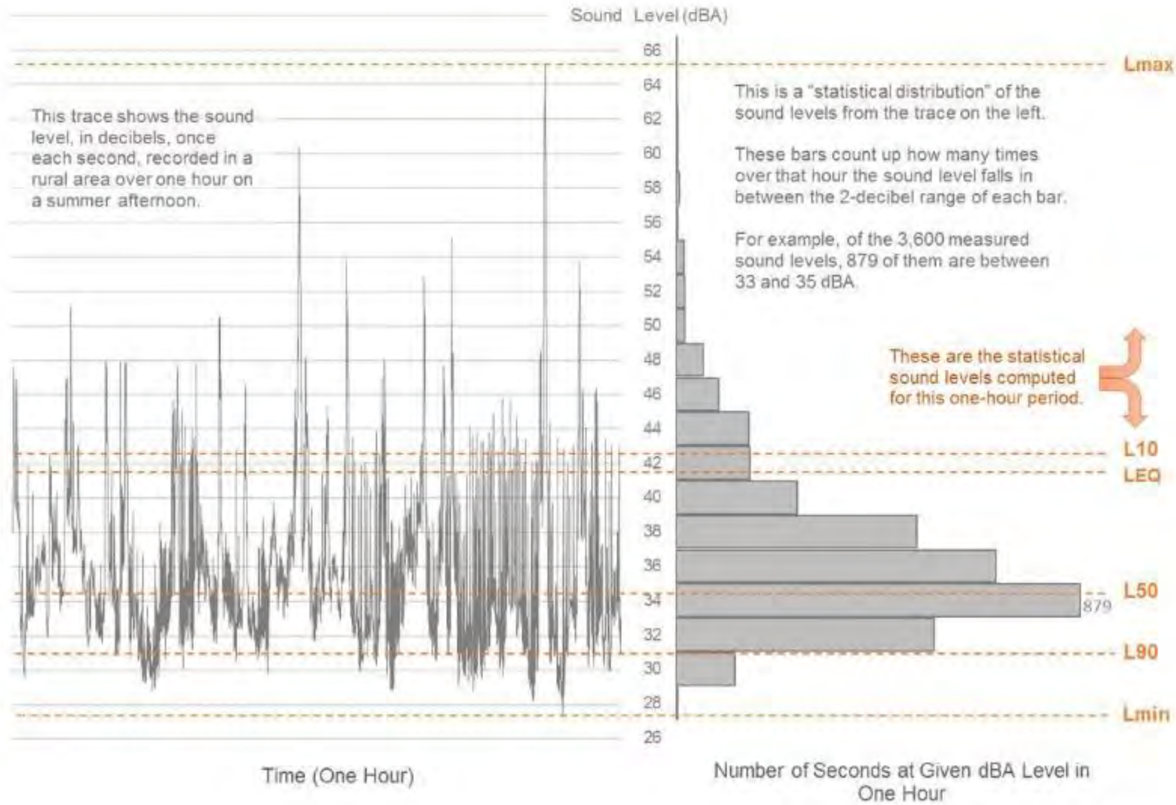


FIGURE 49: EXAMPLE OF DESCRIPTIVE TERMS OF SOUND MEASUREMENT OVER TIME

Equivalent Continuous Sound Level - Leq

One straightforward, common way of describing sound levels is in terms of the Continuous Equivalent Sound Level, or L_{EQ}. The L_{EQ} is the average sound pressure level over a defined period of time, such as one hour or one day. L_{EQ} is the most commonly used descriptor in noise standards and regulations. L_{EQ} is representative of the overall sound to which a person is exposed. Because of the logarithmic calculation of decibels, L_{EQ} tends to favor higher sound levels: loud and infrequent sources have a larger impact on the resulting average sound level than quieter but more frequent sounds. For example, in Figure 49, even though the sound levels spend most of the time near about 34 dBA, the L_{EQ} is 41 dBA, having been "inflated" by the maximum level of 65 dBA and other occasional spikes over the course of the hour.

Percentile Sound Levels – Ln

Percentile sound levels describe the statistical distribution of sound levels over time. "L_N" is the level above which the sound spends "N" percent of the time. For example, L_{90} (sometimes called the "residual base level") is the sound level exceeded 90% of the time: the sound is louder than L_{90} most of the time. L_{10} is the sound level that is exceeded only 10% of the time. L_{50} (the "median level") is exceeded 50% of the time: half of the time the sound is louder than , and half the time it is quieter than . Note that (median) and L_{EQ} (mean) are not always the same, for reasons described in the previous section.

L_{90} is often a good representation of the "ambient sound" in an area. This is the sound that persists for longer periods, and below which the overall sound level seldom falls. It tends to filter out other short-term environmental sounds that aren't part of the source being investigated. L_{10} represents the higher, but less frequent, sound levels. These could include such events as barking dogs, vehicles driving by and aircraft flying overhead, gusts of wind, and work operations. L_{90} represents the background sound that is present when these event sounds are excluded.

Note that if one sound source is very constant and dominates the soundscape in an area, all of the descriptive sound levels mentioned here tend toward the same value. It is when the sound is varying widely from one moment to the next that the statistical descriptors are useful.

APPENDIX F. ACOUSTICS GLOSSARY

Definitions of acoustical term or general scientific terms are included here if not explained within the body of the report.

A-Weighting The A-weighting filter de-emphasizes 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.

Ambient The “all-encompassing sound at a given place, usually a composite of sounds from many sources near and far.” (ANSI S1.1)

ANSI American National Standards Institute

Audible For the purposes of this report, able to be heard by ontologically normal healthy young adults (18 to 25 years), according to ISO 389-7 (see Figure 50).

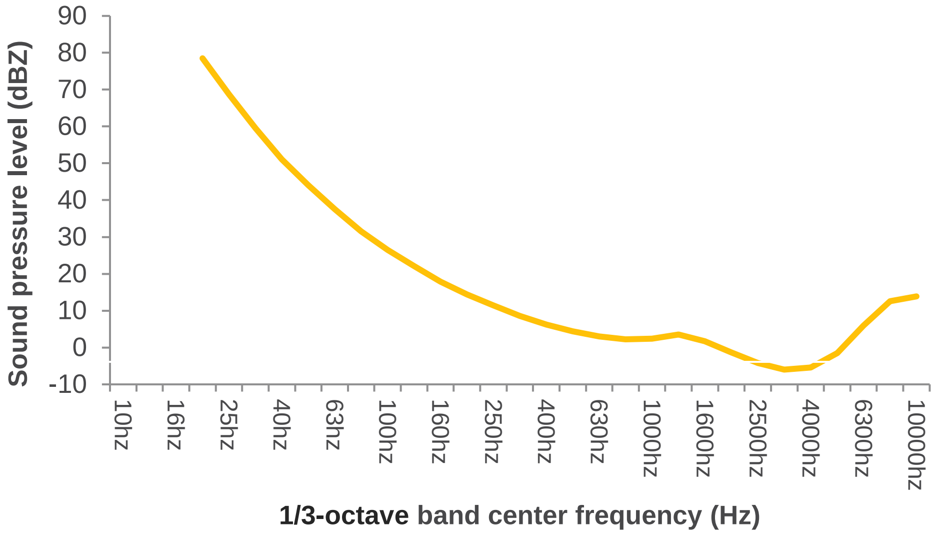


FIGURE 50: ISO 387-7 AUDIBILITY CURVE IN A FREE FIELD

Background Sound Level – the sound level in absence of the source of interest.

Biogenic Produced of brought about by living organisms

Broadband Sound – Sound with a broad spectral distribution, with no tones, such as white noise, static, and airflow.

dBA A-Weighted decibels (see A-Weighting, Decibel)

Decibel, dB A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20 micro Pascals.

Frequency In acoustics, the number of times in a second one cycle of a waveform passes a fixed space. The perceived pitch of a sound is proportional to its frequency. The relationship between wavelength and frequency is dependent on the speed of sound.

	$$f = \frac{c}{\lambda}$$ where λ is wavelength, c is the speed of sound, and f is frequency. The typical hearing range for young healthy individuals is roughly between frequencies of 20 Hz (1 Hertz is one cycle per second) and 20,000 Hz (also designated as 20 kHz, where 1 kHz is one thousand cycles per second).
G	The proportion of ground that is considered porous, as defined under ISO 9613-2. For example, G = 1 represents all porous ground, G = 0 represents all hard ground, and G = 0.5 represents half-porous and half-hard ground.
Geophonic	Naturally occurring sound produced by a habitat, excluding sounds made by living organisms.
Infrasound	Sound that is of such low frequency that it is not readily audible by humans at nominal levels – generally considered to be below 20 Hz (Figure 50)
ISO	The International Organization for Standards
ISO 9613	The International Standards Organization Standard ISO 9613, “Acoustics – Attenuation of sound during propagation outdoors”. The standard is used to predict how sound propagates outdoors. It is currently the standard used by most noise control engineers in the U.S. to predict sound levels in communities. Part 1 of the standard estimates atmospheric attenuation, and Part 2 uses the results from Part 1 with sound emissions from the source and propagation path factors to estimate sound levels at some distance from the source.
L_{1h}	The average A-weighted sound pressure level, in decibels, during a period of 1-hour.
L_{8h}	The average A-weighted sound pressure level, in decibels, during a period of 8-hours.
L_F	Fast-response sound level, where the exponential response time is set to 125 ms. A sound level meter set to fast-response is relatively faster to respond to rapidly changing sound levels. It can be expressed as an instantaneous level, in a percentile, or in a statistic such as a one-second L_{Fmax}, for example. (See “sound level meter response”)
$L_{Fmax\ (1\text{-}sec)}$	The A-weighted, fast-response maximum sound level, as measured over a one-second period, in decibels.
L_{eq}	Equivalent average sound level. The average of the mean square sound *pressure* over an entire monitoring period and expressed as a decibel: $$Leq_T = 10 * log_{10}\left(\frac{1}{T}\int_{\theta}^{T} p_A^2(t)dt \Big/ p_{ref}^2\right)$$ where p_A^2 is the squared instantaneous weighted sound pressure signal, as a function of elapsed time t, p_{ref} is the reference pressure of 20 µPa, and T is the stated time interval. The reference pressure of 20 µPa is used for all measurements in this document. The monitoring period, T, can be for any defined length of time. It could be one second ($L_{eq\ 1\text{-}sec}$), one hour (L_{1h}), eight hours (L_{8h}), or 24 hours (L_{24h}). Because L_{eq} is a logarithmic function of the average pressure, loud and

infrequent sounds have a greater effect on the resulting L_{eq} than quieter and more frequent sounds.

L_n — See "n^{th} percentile"

L_p — See "Sound Pressure Level"

L_S — Slow response sound level, where the exponential response time is set to 1.0 second. This is a relatively slower response time to Fast and results in a longer rise and fall time in the displayed sound level. The five-second instantaneous A-weighted L_S is the metric currently used by MassDEP for compliance monitoring. L_S is often used in local sound regulations as it tends to filter short-term contamination by responding more slowly to rapidly changing sound levels, and is easier to read on a sound level meter display. (See "sound level meter response")

Lw — See "Sound Power Level"

Low Frequency Sound – Sound with frequency content between 20 Hz and 200 Hz.

Measured — An observed quantity. In this report, we differentiate between measured values, for example, those that are logged by a sound level meter, and modeled values, such as those that are predicted by a sound propagation model.

m/s — Velocity in meters per second

Mph — Velocity in miles per hour

ms — Milliseconds; one thousandth of a second

MVA — The apparent electrical power rating. The product of the voltage and current (in amperes).

MVT — Medium voltage transformer

n^{th} Percentile — In statistics, the value which represents the highest n^{th} percent of a series of values. For example, in 100 measurements sorted from high to low, the 10^{th} percentile would be the 90^{th} measurement down from the top. That is, 10 percent of the observations fall below that value. In acoustics, the n^{th} percentile level is the level exceeded n percent of the time, which is the opposite of the statistical definition. Thus, the acoustic L_{90} represents the statistical 10^{th} percentile level. In this document, if we use "n^{th} percentile" it will refer to the statistical definition, and if we use "L*n*", it refers to the acoustical definition. L_{50} is the median sound level.

NYCRR — New York Codes, Rules, and Regulations

Octave bands - A band of frequencies whose lower frequency limit is one half of its upper frequency limit. An octave-band is identified by its center frequency. As an example, the 500 Hz octave band is the range which includes frequencies between 360 Hz and 720 Hz. An octave higher would be twice this. That is, it would be centered at 1,000 Hz with a range between 720 and 1,440 Hz. The range of human hearing is divided into 10 standardized octave-bands: 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, and 16 kHz. For analyses that require even further frequency detail, each octave-band divided into equal parts, such as 1/3-octave-bands.

ONAF — Oil Natural Air Forced, Under ONAF conditions, the air of a transformer is circulated using fans.

ONAN Oil Natural Air Natural, Under ONAN conditions, the oil and air of a transformer are circulated without the use of fans, resulting in quieter operation of the transformer.

PNIA Project Noise Impact Assessment

Section 94c Chapter XVIII Title 19 Part 900 of New York Codes, Rules, and Regulations

Site The entire area of a project and its surroundings.

Sound [Pressure] Level – the sound pressure level as measured in decibels:

$$\text{Lp (in dB)} = 10log_{10}\left(\frac{p}{p_{ref}}\right)^2$$

where p is the sound pressure in Pascals and p_{ref} is the reference sound pressure of 20 µPa. All sound pressure levels shown in this document use this p_{ref}.

Sound level meter response – The rate at which a sound level meter display can change related to a change in actual sound level. Sound levels vary over time. In fact, the variation is so fast, that one would not be reliably able to read the level on a sound level meter. For that reason, the displayed sound level is damped in time, to make it readable.

There are three standard time responses available on most sound level meters: Slow, Fast, and Impulse (see “Ls”, “Lf”, and” Li”, respectively). Fast response has a time constant of 125 ms. This response is similar to the response of the human ear. The Slow response has a time constant of 1 second. This is often used in environmental noise measurement because its slow rise and fall time eliminates very short spikes in noise that are not related to the measurement. The Impulse response has a very fast rise time of 35 ms and a slow decay time of 1.5 seconds. It is rarely used in environmental noise measurements, but can be used with other metrics to evaluate the impulsivity of a sound event.

Fast, slow, and impulse sound levels cannot be averaged over time, since they are not representative of the actual sound level over time. They are simply applied to the actual sound level to slow the meter reading. A true energy average can be calculated using the L_{eq} metric, which is independent of the sound level meter response setting (see “L_{eq}”).

Sound Power Level – The level of sound power (sound generation) of a source, independent of environmental factors, measured in decibels:

$$\text{Lw (in dB)} = 10log_{10}\left(\frac{w}{w_{ref}}\right)^2$$

where w is the sound power measured in Watts and w_{ref} is the reference sound power of 10^{-12} Watts. A simple way of thinking about the difference between sound pressure and sound power is by the analogy of a light bulb: the sound pressure is similar to the lumens of light measured in a certain place under specific conditions, while the sound power would be equivalent to the wattage rating of the bulb, which does not change.

Sound Propagation - The spreading of sound from the sound source through the environment.

Spectrum The components of a sound broken down into individual frequencies or frequency bands.

Tonal Sound - Sound where narrow frequency band(s) are pronounced, such as in alarms, sirens, squeals, and horns.

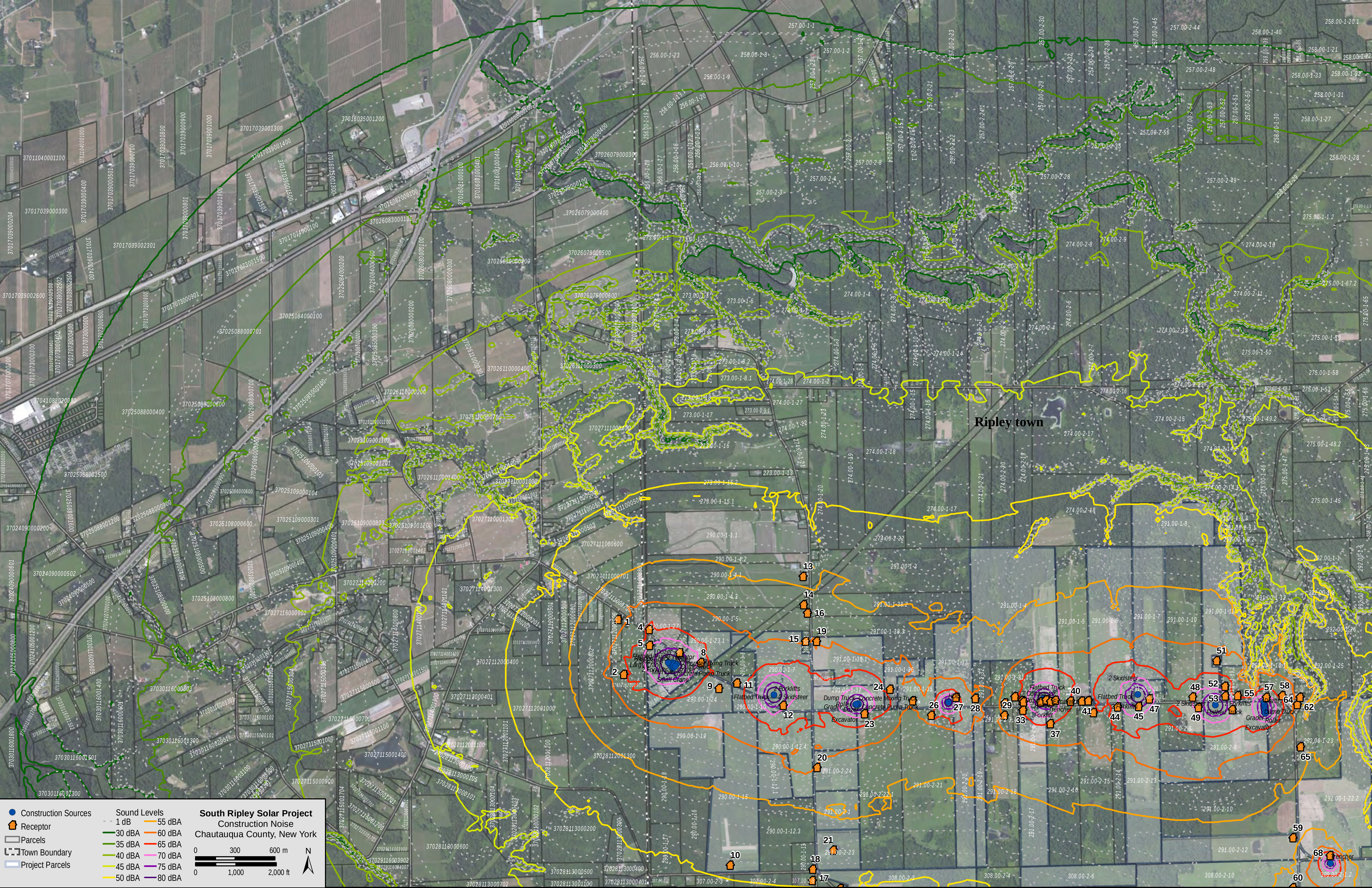
Unattended Monitoring – Sound monitoring where a sound level meter and associated equipment is left unattended for some length of time. Sound recordings may be taken along with the logged sound levels to aid in identification of different sources of sound.

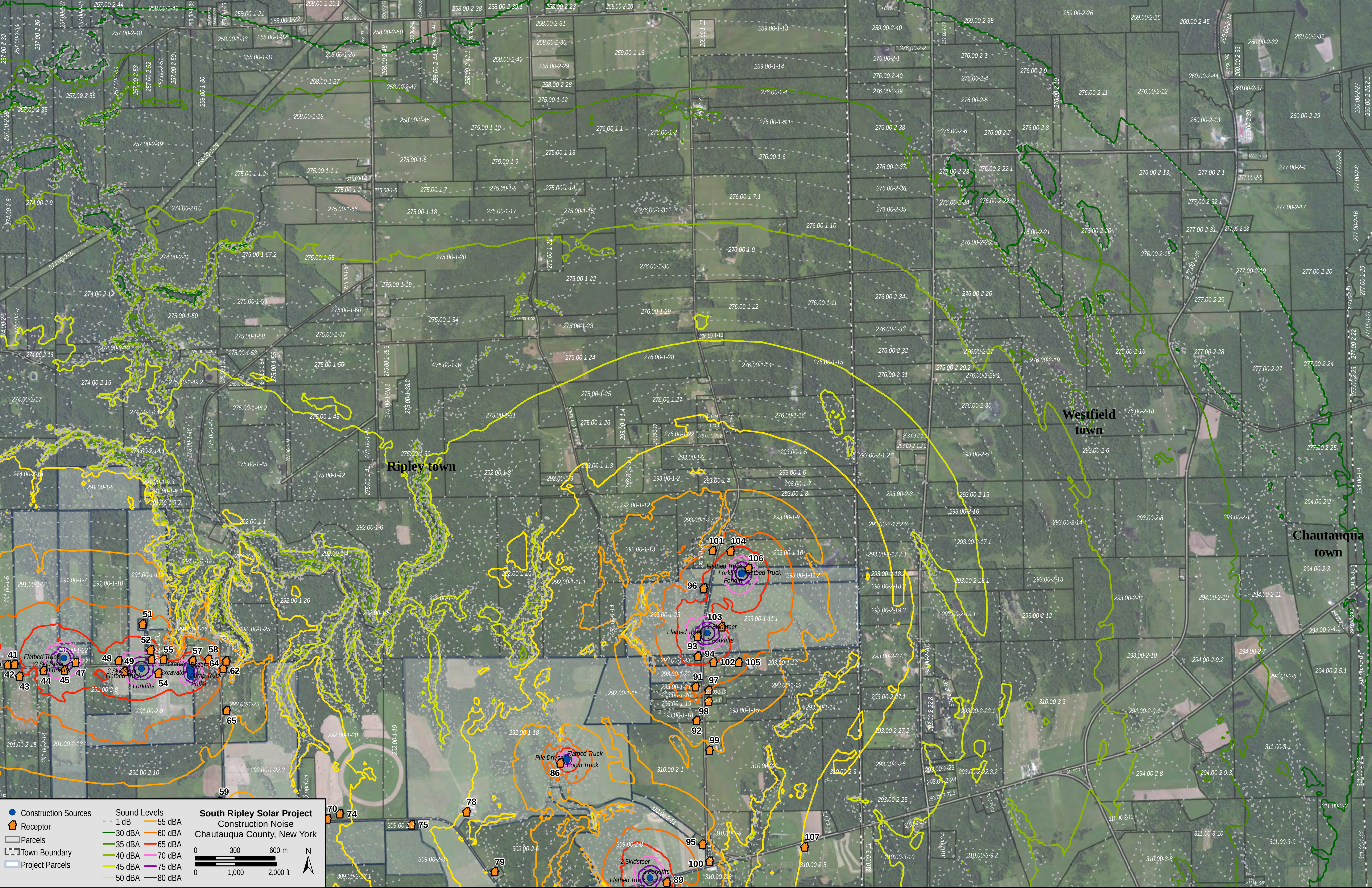
VAR Control Reactive power management through power distribution systems.

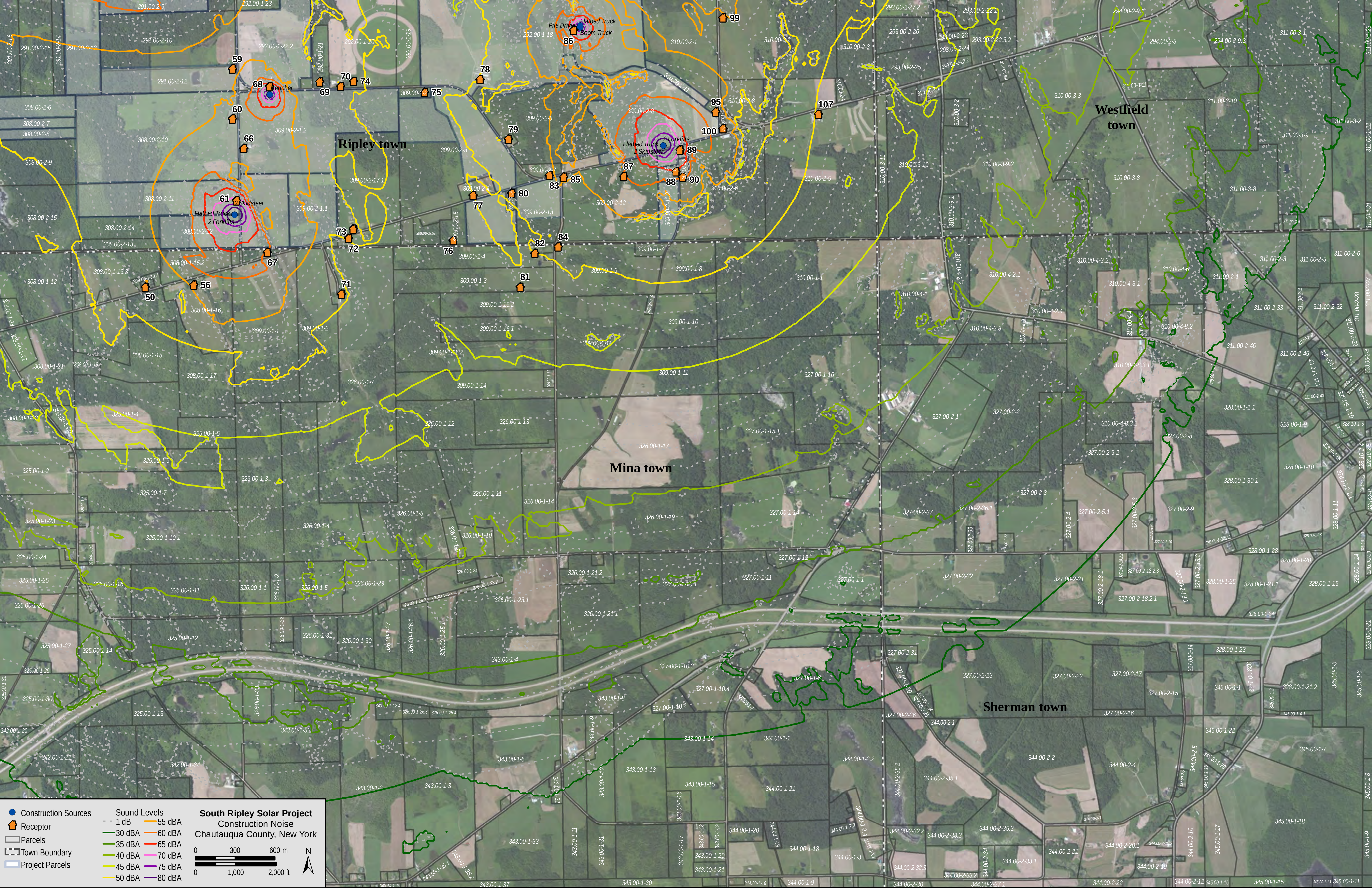
WHO The United Nation’s World Health Organization.

APPENDIX G. CONSTRUCTION SOUND MAPS

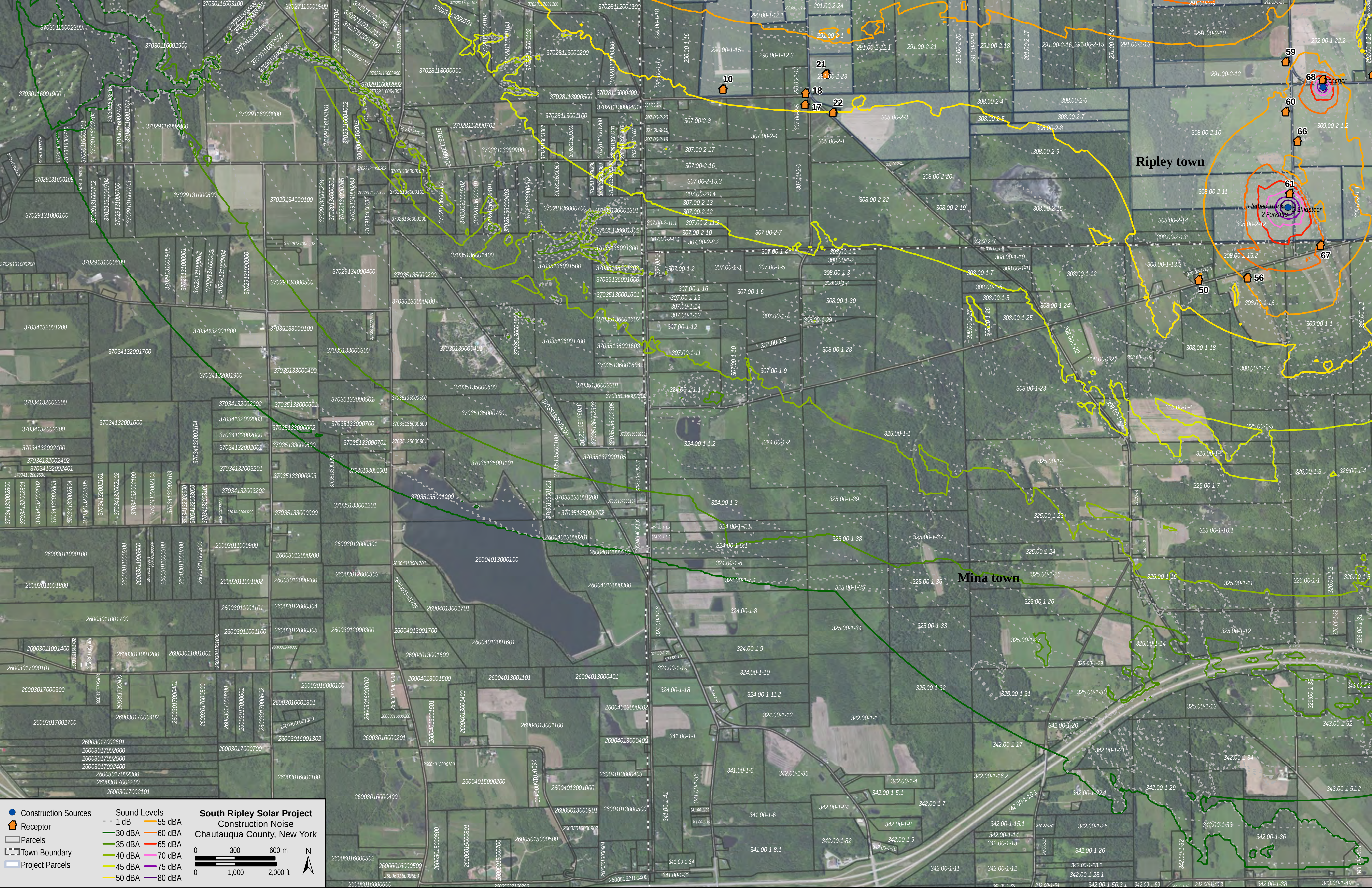
Maps scaled 1:12,000 and sized 22” X 34” are provided separately.

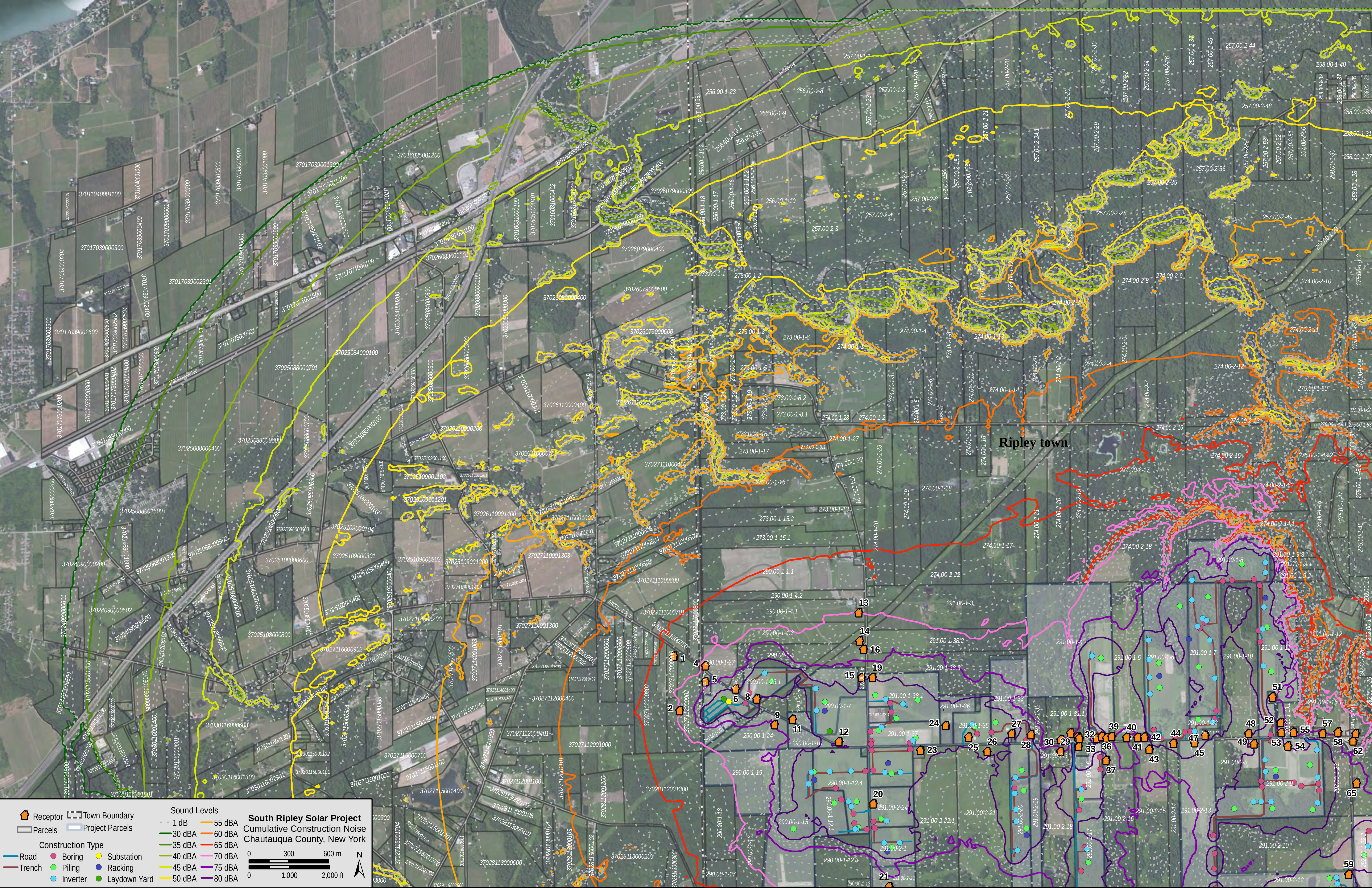

Ripley town
Construction Sources
Receptor
Parcels
Town Boundary
Project Parcels
Sound Levels
1 dB
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
60 dBA
65 dBA
70 dBA
75 dBA
80 dBA
South Ripley Solar Project
Construction Noise
Chautauqua County, New York
0
300
600 m
0
1,000
2,000 ft
N


South Ripley Solar Project
Construction Noise
Chautauqua County, New York
Construction Sources
Receptor
Parcels
Town Boundary
Project Parcels
Sound Levels
1 dB
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
60 dBA
65 dBA
70 dBA
75 dBA
80 dBA
0 300 600 m
0 1,000 2,000 ft
N
Ripley town
Westfield town
Chautauqua town

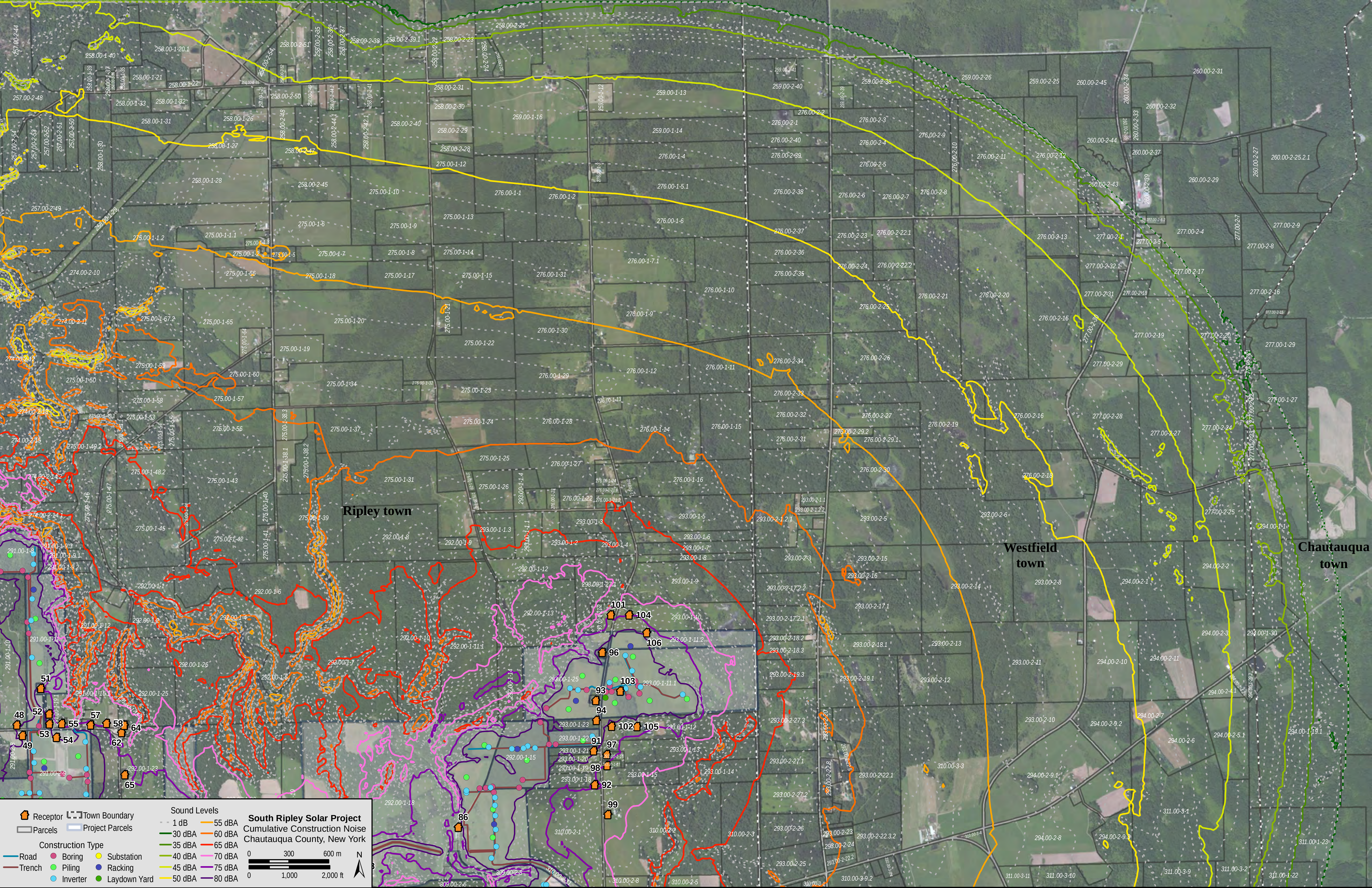


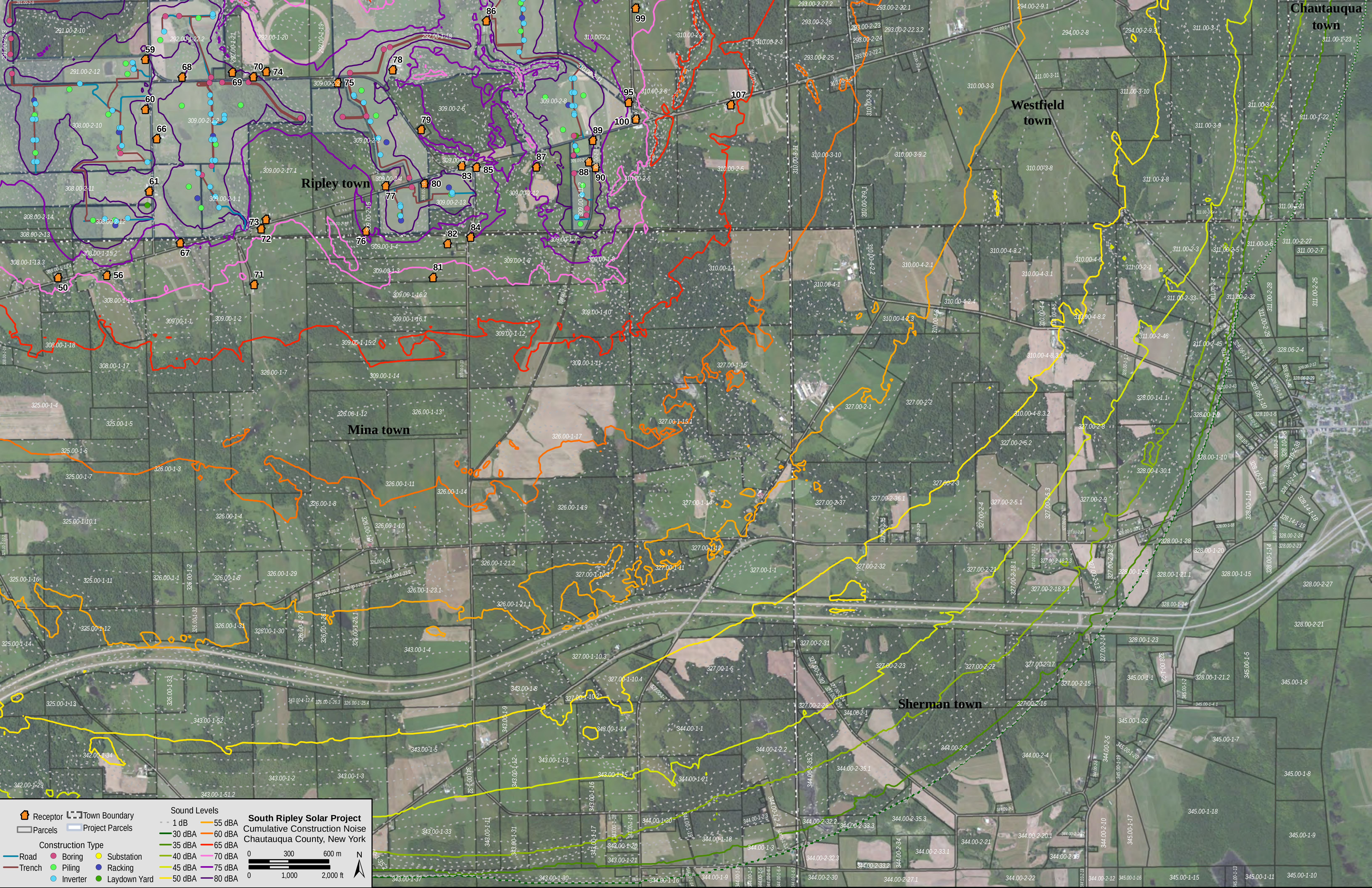
South Ripley Solar Project
Construction Noise
Chautauqua County, New York
Construction Sources
Receptor
Parcels
Town Boundary
Project Parcels
Sound Levels
1 dB
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
60 dBA
65 dBA
70 dBA
75 dBA
80 dBA
0 300 600 m
0 1,000 2,000 ft
N
Ripley town
Westfield town
Mina town
Sherman town
Flatbed Truck
Boom Truck
Pile Driver
Trencher
Skidsteer
Forklifts
2 Skidsteer
2 Forklifts

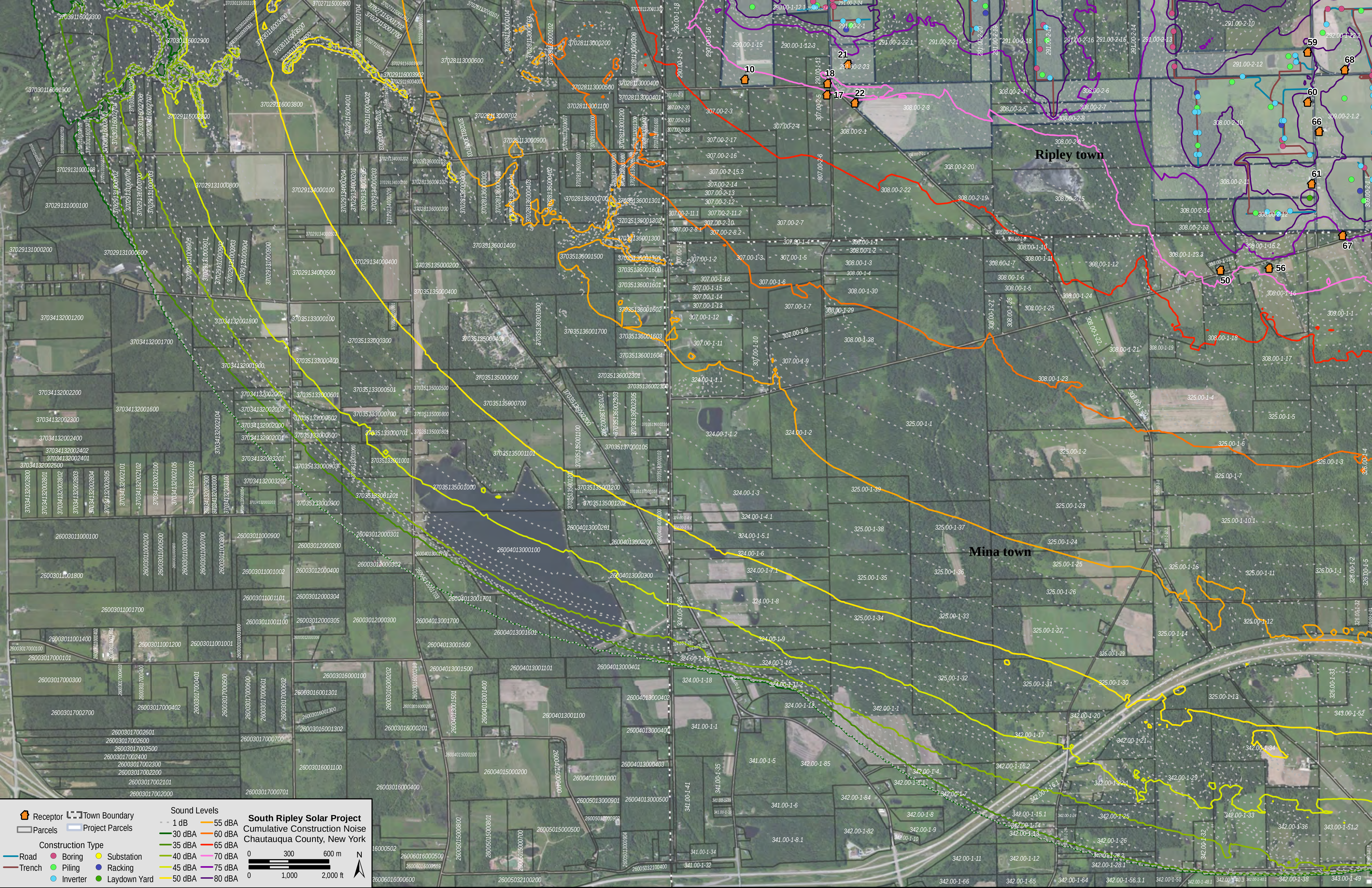

Ripley town
Mina town
Flatbed Truck
2 Forklifts
Skidsteer
Trencher
Construction Sources
Receptor
Parcels
Town Boundary
Project Parcels
Sound Levels
1 dB
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
60 dBA
65 dBA
70 dBA
75 dBA
80 dBA
South Ripley Solar Project
Construction Noise
Chautauqua County, New York
0 300 600 m
0 1,000 2,000 ft
N



Ripley town
Receptor
Town Boundary
Parcels
Project Parcels
Construction Type
Road
Trench
Boring
Piling
Inverter
Substation
Racking
Laydown Yard
Sound Levels
1 dB
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
60 dBA
65 dBA
70 dBA
75 dBA
80 dBA
South Ripley Solar Project
Cumulative Construction Noise
Chautauqua County, New York
0 300 600 m
0 1,000 2,000 ft
N


South Ripley Solar Project
Cumulative Construction Noise
Chautauqua County, New York
Receptor
Town Boundary
Parcels
Project Parcels
Construction Type
Road
Trench
Boring
Piling
Inverter
Substation
Racking
Laydown Yard
Sound Levels
1 dB
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
60 dBA
65 dBA
70 dBA
75 dBA
80 dBA
0 300 600 m
0 1,000 2,000 ft
N
Ripley town
Westfield town
Chautauqua town


Ripley town
Westfield town
Chautauqua town
Mina town
Sherman town
Receptor
Town Boundary
Parcels
Project Parcels
Construction Type
Road
Trench
Inverter
Boring
Piling
Substation
Racking
Laydown Yard
Sound Levels
1 dB
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
60 dBA
65 dBA
70 dBA
75 dBA
80 dBA
South Ripley Solar Project
Cumulative Construction Noise
Chautauqua County, New York
0 300 600 m
0 1,000 2,000 ft
N


South Ripley Solar Project
Cumulative Construction Noise
Chautauqua County, New York
Receptor
Town Boundary
Parcels
Project Parcels
Sound Levels
1 dB
30 dBA
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
60 dBA
65 dBA
70 dBA
75 dBA
80 dBA
Construction Type
Road
Trench
Boring
Piling
Inverter
Substation
Racking
Laydown Yard
0 300 600 m
0 1,000 2,000 ft
N
Ripley town
Mina town
10
17
18
21
22
50
56
59
60
61
66
67
68

APPENDIX H. ADDITIONAL EQUIPMENT SPECIFICATIONS AND TEST DATA

11EER W18A-W60A Series WALL-MOUNT™
11EER W18L-W36L Series WALL-MOUNT™
10EER W72A Series WALL-MOUNT™

The Bard Wall-Mount Air Conditioner is an energy efficient self contained system, which is designed to offer maximum indoor comfort at a minimal cost without using valuable indoor floor space or outside ground space. This unit is the ideal product for versatile applications such as: new construction, modular offices, school modernization, telecommunication structures, portable structures, correctional facilities and many more. Factory or field installed accessories are available to meet specific job requirements for your unique application.

- Complies with efficiency requirements of ANSI/ASHRAE/IES 90.1-2019.
- Certified to AHRI Standard 390-2003 for SPVU (Single Package Vertical Units).
- Intertek ETL Listed to Standard for Safety Heating and Cooling Equipment ANSI/UL 1995/CSA 22.2 No. 236-05 Fourth Edition.
- Commercial Product - Not intended for residential applications.
- Bard is an ISO 9001:2015 Certified Manufacturer.
- The AHRI Certified® mark indicates Bard Manufacturing Company participation in the AHRI Certification program. For verification of individual certified products, go to www.ahridirectory.org.

Bard® SINCE 1914

ENGINEERED • BUILT • SUPPORTED IN THE USA

c ETL LISTED us Intertek

ISO 9001:2015 CERTIFICATION Intertek

AHRI CERTIFIED® www.ahridirectory.org Globally Recognized. Industry Respected.

Climate Control Solutions

/////// Interactive Table of Contents (Select topic with cursor to go to location, pick to return)

Wall-Mount Nomenclature

Digit #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	W	6	0	A	C	-	A	0	Z	X	P	X	X	X	X

UNIT SERIES
Wall-Mount

NOMINAL CAPACITY
18 - 1.5 Ton
24 - 2.0 Ton
30 - 2.5 Ton
36 - 3.0 Ton
42 - 3.5 Ton
48 - 4.0 Ton
60 - 5.0 Ton
72 - 6.0 Ton

TYPE AND CONTROL LOCATION
A - Air conditioner
L - Air Conditioner with Left Side Control Panel (W18-W36 Only)

REVISION
B - Revision W18-W36
C - Revision W42-W72

PLACEHOLDER
- - Standard Unit
D - Hot Gas Reheat Dehumidification
R - Motor Isolation (460V only for High Res. Ground)

VOLTAGE
A - 230 Volt 1 Phase 60 Hz
B - 230 Volt 3 Phase 60 Hz
C - 460 Volt 3 Phase 60 Hz

ELECTRIC HEAT
00 - 0Kw with Lug Connection
0Z - 0Kw with Circuit Breaker
05 to 20 - Kw Heat with Circuit Breaker
See Electrical Specs for further details

VENT PACKAGE
X - Standard Fresh Air Damper (Intake only)
A - Fresh Air Damper w/Exhaust
B - Block Off Plate
M - Commercial Room Ventilator, ON/OFF
V - Comm. Room Ventilator, Modulating
D - Economizer, 0-10V No Controls
Y - Full Flow Economizer, Temperature
Z - Full Flow Economizer, Enthalpy
R - Energy Recovery Ventilator

FILTER
X - Standard 1" MERV2 Disposable Filter
W - 1" MERV2 Permanent Filter
P - 2" MERV8 Disposable Filter
M - 2" MERV11 Disposable Filter
N - 2" MERV13 Disposable Filter
A - 2" MERV13 Filter with UVC-LED Light.

COLOR AND CABINET FINISH
X - Standard Beige baked enamel finish
1 - White baked enamel finish
4 - Buckeye Gray baked enamel finish
5 - Desert Brown baked enamel finish
8 - Dark Bronze baked enamel finish
S - Stainless Steel
A - Aluminum

SUPPLY OUTLET
X - Standard

COIL & UNIT COATING OPTIONS
X - Standard Copper/Aluminum coils.
1 - Coated Evaporator coil.
2 - Coated Condenser coil.
3 - Coated Evaporator and Condenser coils.
4 - Coated coils and unit condenser section coating.
5 - Coated coils and inside/outside of unit coating.

ACCESSORIES AND CONTROLS OPTIONS
X - Standard controls (HPS,LPS,CCM)
E - Low Ambient Control (LAC)
F - LAC, Alarm Relay (ALR), Filter Press. Switch (FPS)
J - LAC and Alarm Relay (ALR)
K - LAC and PTCR Start Kit
M - LAC, ALR, and PTCR Start Kit
V - DDC Control Sensor kit with 10K Discharge air sensor, indoor blower airflow sensor, compressor current sensor, filter press. switch, LAC, ALR.

Nomenclature Notes:

- W18, W24, W30 and W36 models are available with the unit control panel located on the left or right unit side. W42, W48, W60, and W72 models have the unit control panel located in the front of the unit.
- Hot Gas Reheat Dehumidification is available with W30, W36, W42, W48, W60, and W72 models.
- Accessories and control options may not be available for all models. See factory installed controls options section for further details.
- All units have an external data tag with the model and serial number on the left or right side of the unit. A secondary data tag with the model and serial number is located inside the conttol panel area on or near the low voltage terminal box.

Non-Ducted Supply Grilles - Spread and Throw Characteristics

One of the most important setup procedures for non-ducted supply applications is to adjust the 4 way supply grille blade positions. Placement of equipment, occupants, the thermostat, and room size can all play an important role in deciding how the conditioned supply air must be directed in an indoor area. The chart below may be used as a reference tool to help with this process.

SUPPLY GRILLE	AIRFLOW CFM	DEFLECTION	VELOCITY	TOTAL PRESSURE	THROW
SG-2W	800 CFM	0°	1053	.076" WC	37-52 ft.
		22.5°	1143	.1" WC	28-40 ft.
		45°	1428	.162" WC	20-29 ft.
	865 CFM	0°	1138	.054" WC	40-55 ft.
		22.5°	1236	.075" WC	31-42 ft.
		45°	1544	.113" WC	21-30 ft.
SG-3W	885 CFM	0°	852	.054" WC	37-54 ft.
		22.5°	1075	.075" WC	35-49 ft.
		45°	1162	.113" WC	21-30 ft.
	1285 CFM	0°	1237	.108" WC	42-66 ft.
		22.5°	1359	.147" WC	35-50 ft.
		45°	1687	.249" WC	25-37 ft.
SG-5W	1450 CFM	0°	968	.073" WC	51-73 ft.
		22.5°	1071	.103" WC	39-56 ft.
		45°	1331	.169" WC	28-40 ft.
	2000 CFM	0°	1336	.130" WC	61-86 ft.
		22.5°	1477	.188" WC	54-65 ft.
		45°	1835	.335" WC	33-46 ft.

Sound Data - dBA @ 5 ft. and 10 ft.*

UNIT	DUCT FREE INDOOR COOLING OPERATION @ 5 FT.	DUCT FREE INDOOR COOLING OPERATION @ 10 FT.	DUCTED INDOOR COOLING OPERATION @ 5 FT.	DUCTED INDOOR COOLING OPERATION @ 10 FT.	OUTDOOR @ 10 FT.
W18AB/W18LB	49.6	47.3	48.6	46.2	62.8
W24AB/W24LB	52.4	50.4	51.9	48.9	62.3
W30AB/W30LB	53.9	52.9	54.5	47.3	67.1
W36AB/W36LB	53.9	52.9	54.5	47.3	67.1
W42AC	56.1	51.7	56.3	51.1	68.6
W48AC	57	52.7	57.8	52.8	69
W60AC	56.5	53.3	56	52.7	66.8
W72AC	61.2	56.6	60.8	57.1	77.1

Integrated values calculated per ANSI/ASA S12.60-2009/Part 2, Section 5.2.2.1.

blueplanet 150 TL3

Transformerless, three-phase string inverter.

The trendsetter among inverters.

Optimized for solar power plants with 1500 volt modules

Extensive grid management functions

Special properties for extreme climatic conditions

Farsighted technical features for future requirements

Lean commissioning and maintenance via remote services

DE 5001283-01-190130

Technical Data

DC input data	150 TL3
Max. recommended PV generator power	225 000 W
MPP range	960 – 1 300 V
Operating range	960 – 1 450 V
Rated DC voltage / start voltage	1 000 V / 1 100 V
Max. no-load voltage	1 500 V
Max. input current	160 A
Max. short circuit current $I_{sc\ max}$	300 A
Number of MPP tracker	1
Connection per tracker	1 - 2
AC output data	
Rated output	150 000 VA
Max. power	150 000 VA
Line voltage	660 V (3P+PE)
Voltage range (Ph-Ph)	480 – 760 V
Rated frequency (range)	50 Hz / 60 Hz (45 – 65 Hz)
Rated current	3 x 131,2 A
Max. current	3 x 132,3 A
Reactive power / cos phi	0 – 100 % Snom / 0,30 ind. – 0,30 cap.
Max. total harmonic distortion (THD)	≤ 3 %
Number of grid phases	3
General data	
Max. efficiency	99.2 %
Europ. efficiency	99.1 %
CEC efficiency	99.0 %
Standby consumption	< 10 W
Circuitry topology	transformerless
Mechanical data	
Display	LEDs
Control units	webserver, supports mobile devices
Interfaces	Ethernet (Modbus TCP, Sunspec) RS485 (Modbus RTU, Sunspec, KACO-protocol) USB, optional: 4-DI, WIFI
Fault signalling relay	potential-free NOC max. 30 V / 1 A
DC connection	cable lug, max. 240 mm² (0.372 in²) Cu or Al
AC connection	cable lug, max. 240 mm² (0.372 in²) Cu or Al
Ambient temperature	-25 °C – +60 °C [1)]
Humidity	0 – 100 %
Max. installation elevation (above MSL)	3 000 m
Min. distance from coast	500 m
Cooling	temperature controlled fan
Protection class	IP66 / NEMA 4X
Noise emission	59.2 db (A)
H x W x D	719 x 699 x 450 mm
Weight	78.2 kg
Certifications	
Safety	UL62109-1, UL1741, CSA-C22.2 No. 62109-1, CSA-C22.2 No. 62109-2, CSA-C22.2 No. 107.1 IEC 62109-1/-2, EN 61000-6-1/-2/-3, EN 61000-3-11/-12
Grid connection rule	overview see homepage / download area

[1)] Power derating at high ambient temperatures

Versions	S	XL
Number of DC inputs	1 - 2	1 - 2
DC switch	-	✓
DC SPD	Type 1 + 2	Type 1 + 2
AC SPD	○	○
RS485 interface SPD	○	○
Ethernet interface SPD	○	○
PID Set	○	○

standard = ✓ upgradeable = ○

Acoustic Test Center, Qingdao Branch, Institute of Acoustics, Chinese Academy of Sciences
Test Report

Sample Name	PV Grid-Connected Inverter	**Test Kind**	on-site sample test
Sample Quantity	2	**Model/Type**	SG3600UD-MV
Sample Description	good, without broken	**Receipt Date**	2021-01-27
Sample Number	ATC210014(1-2)	**Test Date**	2021-01-27
Name of Client	Sungrow Power Supply Co., ltd		
Address of Client	No.1699 Xiyou Rd. New & High Technology Industrial Development Zone, Hefei, P.R. China		
Environment for Test	ATC210014(1) Temperature: 18.5℃; Humidity:48.0%RH; Atmosphere pressure: 1020.9hPa ATC210014(2) Temperature: 11.6℃; Humidity:71.0%RH; Atmosphere pressure: 1022.8hPa		
Test Standard	ISO 3746:2010 Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane		
Test Item	Sound power level		
Location of Test	ATC210014(1) No. 3318, Lianhua Road, Hefei Economic and Technological Development Zone, Anhui Province P.R. China ATC210014(2) No.1699 Xiyou Rd. New & High Technology Industrial Development Zone, Hefei, P.R. China		
Test Conclusion	See Test Result （test seal）		
Note	\		

Approval: **Verification：** **Chief tester：**

Date： **Date：** **Date：**

Acoustic Test Center, Qingdao Branch, Institute of Acoustics, Chinese Academy of Sciences
Test Report (Continuation Sheet)

Test Condition

1. The PV Grid-Connected Inverter (SG3600UD-MV) is combined by inverter and transformer, sample ATC210014(1) is the transformer， and sample ATC210014(2) is the inverter, they are measured separately;
2. Reference box of the transformer: l_1=2000, l_2=1940mm, l_3=2600mm, and the measurement distance d=1300mm, 12 microphone positions are used as shown in Fig.1 according to Annex C in the ISO 3746-2010, and the measurement surface area S_1 = 92.2m^2;
3. The Transformer is test in a silent room, and its low voltage side was connected to 660V-60Hz power supply(transformer is in no-load state);
4. Reference box of the inverter: l_1=2200mm, l_2=1500mm, l_3=2400mm, the measurement distance d=1300mm, 12 microphone positions are used as shown in Fig.2 according to Annex C in the ISO 3746-2010, and the measurement surface area S_2 = 85.5m^2;
5. The inverter is test in a industrial room and is set to the full load state ;
6. Each microphone position is tested for 30s;
7. The main equipment for testing is shown in Table 1;
8. The microphone was field calibrated before and after the measurements to verify accuracy of the measurements.

Table 1 Main equipment for test

Name	Type\Serial Number	Validity
Sound Calibrator	B&K Type 4231\2725159	2021-09-01
Data Acquisition System	B&K Type 3050-A-060\3050-105837	2021-09-02
Microphone	GRAS 46AE\270180	2021-09-01
Microphone	GRAS 46AE\270292	2021-09-01
Microphone	GRAS 46AE\270293	2021-09-01
Microphone	GRAS 46AE\270299	2021-09-01

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Test Report (Continuation Sheet)

Test Result

Table 2 Calculated Transformer Sound Power Level for 1/1 Octave Bands

Item	Sound Levels at Octave Band Center Frequencies (dB)									Overall Sound Power	
	31.5	63	125	250	500	1000	2000	4000	8000	(dBA)	(dB)
Transformer	67.8	60.5	70.3	72.4	63.5	55.8	43.1	34.1	29.3	65.8	74.5

Table 3: Calculated Transformer Sound Power Level for 1/3 Octave Bands

1/3 Octave Band Center Frequencies/Hz	Sound Power level/dB	1/3 Octave Band Center Frequencies/Hz	Sound Power level/dB
20	62.4	**500**	58.9
25	66.7	**630**	55.7
31.5	60.3	**800**	54.2
40	55.9	**1000**	48.8
50	57.4	**1250**	45.2
63	55.3	**1600**	41.5
80	53.7	**2000**	37.6
100	58.1	**2500**	33.7
125	70.3	**3150**	30.9
160	55.3	**4000**	28.8
200	57.1	**5000**	27.6
250	72.1	**6300**	26.3
315	56.7	**8000**	23.9
400	59.6	**10000**	22.6

Note: The underlined data represent upper bounds to the sound power level of the noise source under test.

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Test Report (Continuation Sheet)

Test Result

Table 4 Calculated Inverter Sound Power Level for 1/1 Octave Bands

Item	Sound Levels at Octave Band Center Frequencies (dB)									Overall Sound Power	
	31.5	63	125	250	500	1000	2000	4000	8000	(dBA)	(dB)
Inverter	85.5	85.3	86.6	85.9	90.1	81.0	80.3	88.1	80.6	91.9	95.7

Table 5 Calculated Inverter Sound Power Level for 1/3 Octave Bands

1/3 Octave Band Center Frequencies/Hz	Sound Power level/dB	1/3 Octave Band Center Frequencies/Hz	Sound Power level/dB
20	70.2	**500**	85.6
25	76.2	**630**	80.6
31.5	81.3	**800**	78.2
40	82.4	**1000**	76.0
50	81.6	**1250**	74.2
63	80.4	**1600**	74.5
80	79.2	**2000**	75.0
100	80.2	**2500**	76.4
125	84.0	**3150**	74.9
160	79.6	**4000**	70.7
200	77.5	**5000**	87.6
250	80.8	**6300**	80.2
315	83.4	**8000**	73.9
400	87.0	**10000**	73.1

Note: Because the sound power of inverter is much larger than the value of the transformer, so the total noise of the transformer and the inverter in the test state is the value of the inverter.

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Test Report (Continuation Sheet)

Photos on Site

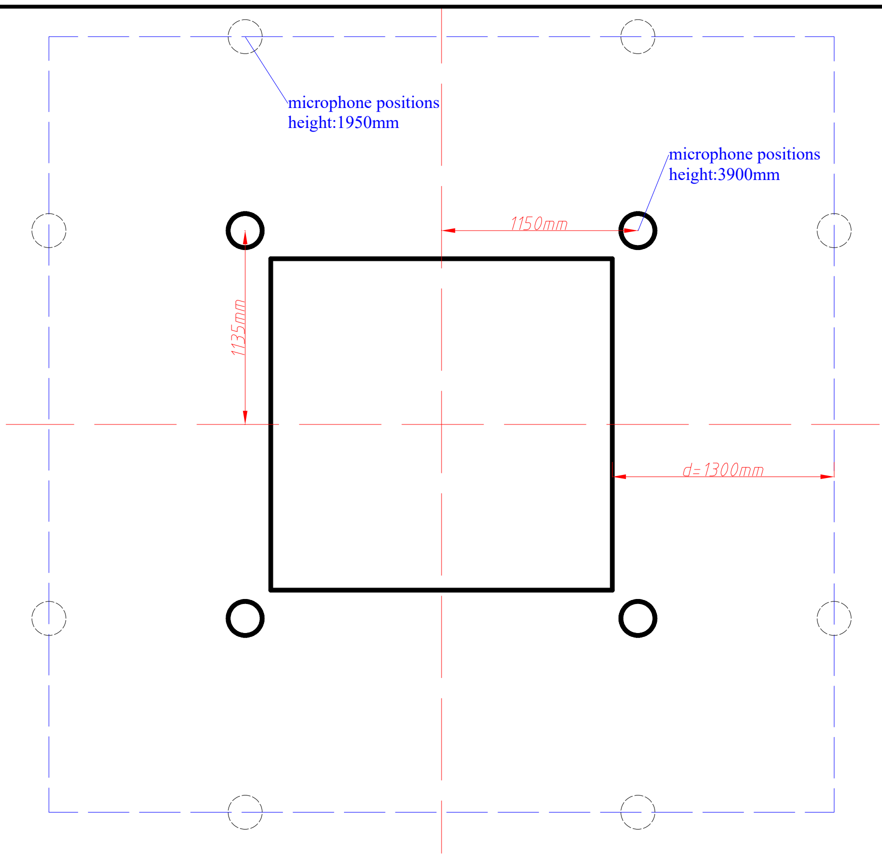

Figure 1 microphone positions of the transformer

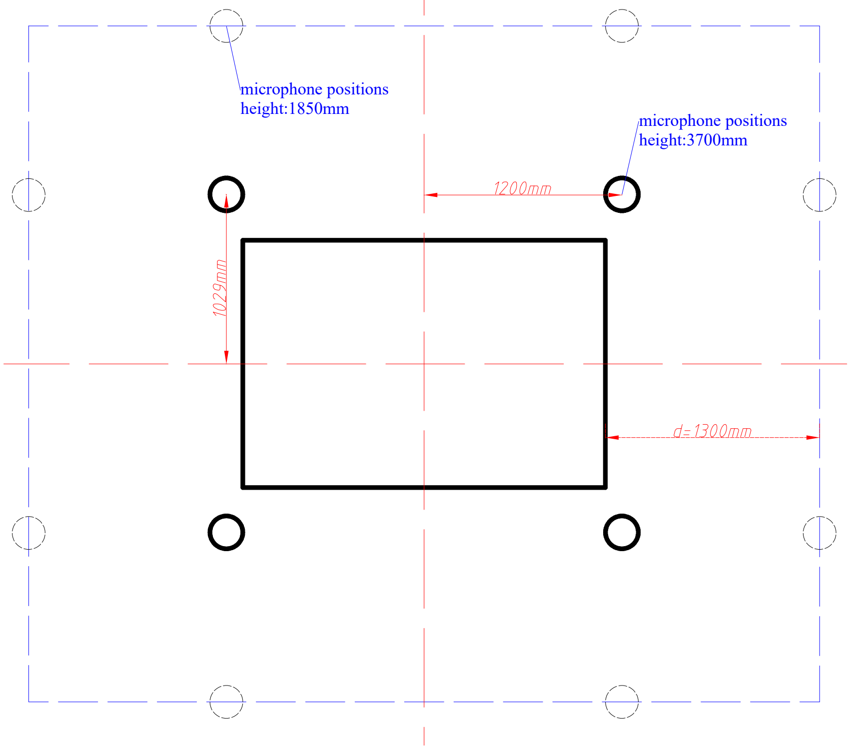

Figure 2 microphone positions of the inverter

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Test Report (Continuation Sheet)

Photos on Site

Figure 3 Image of the tansformer under test

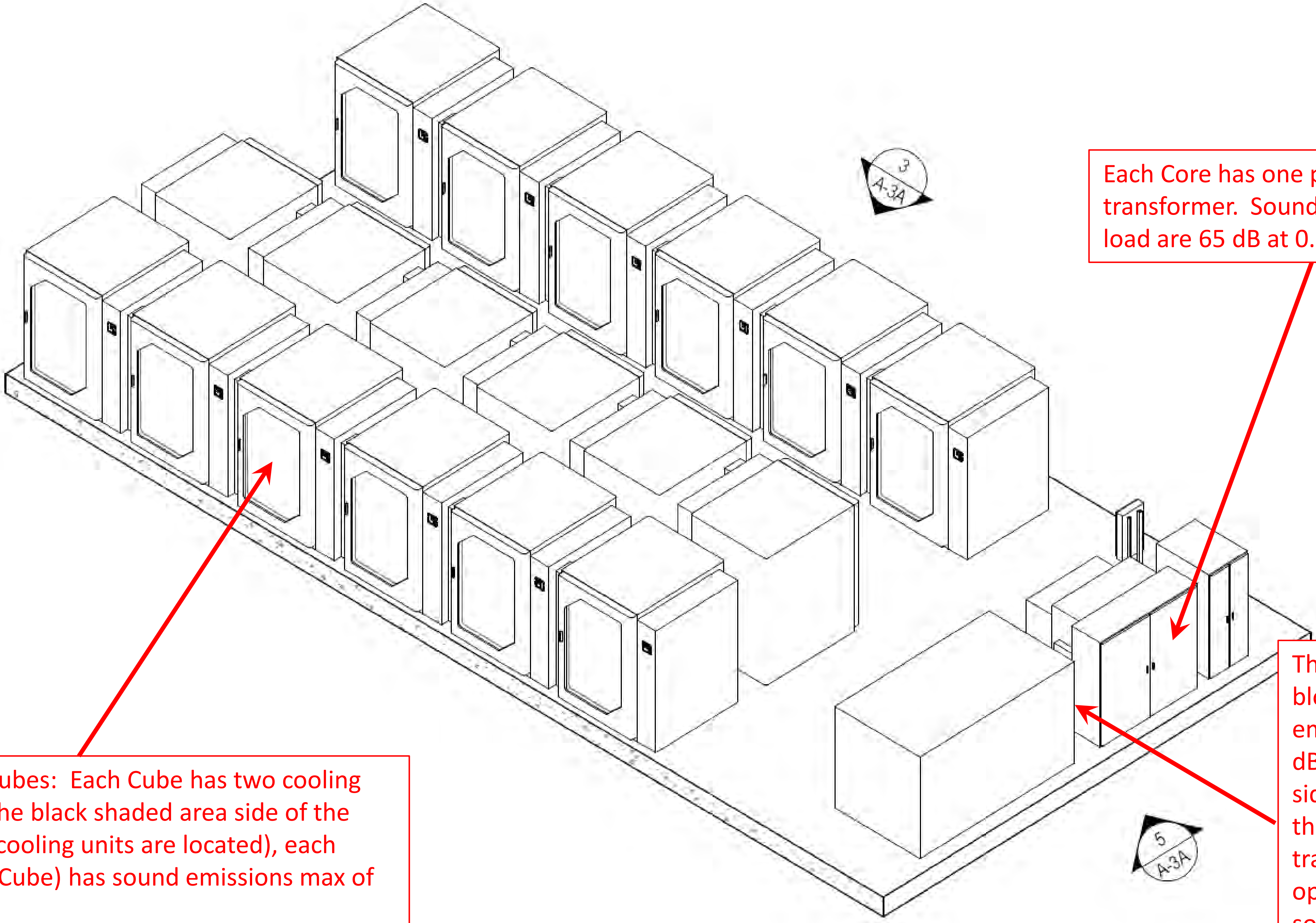
Figure 4 Image of the inverter under test

-Test Report End-

Sound power levels from SG3600UD-MV Inverter and Transformer noise report(1).pdf

INVERTER			TRANSFORMER			COMBINED		
Freq	dBZ	Tonality	Freq	dBZ	Tonality	Freq	dBZ	Tonality
20	70.2		20	62.4		20	70.9	
25	76.2	0.5	25	66.7	5.4	25	76.7	0.6
31.5	81.3	2.0	31.5	60.3	-1.0	31.5	81.3	1.8
40	82.4	1.0	40	55.9	-3.0	40	82.4	0.9
50	81.6	0.2	50	57.4	1.8	50	81.6	0.2
63	80.4	0.0	63	55.3	-0.3	63	80.4	0.0
80	79.2	-1.1	80	53.7	-3.0	80	79.2	-1.1
100	80.2	-1.4	100	58.1	-3.9	100	80.2	-1.5
125	84	4.1	125	70.3	13.6	125	84.2	4.3
160	79.6	-1.2	160	55.3	-8.4	160	79.6	-1.2
200	77.5	-2.7	200	57.1	-6.6	200	77.5	-2.9
250	80.8	0.3	250	72.1	15.2	250	81.3	0.9
315	83.4	-0.5	315	56.7	-9.2	315	83.4	-0.8
400	87	2.5	400	59.6	1.8	400	87.0	2.5
500	85.6	1.8	500	58.9	1.3	500	85.6	1.8
630	80.6	-1.3	630	55.7	-0.8	630	80.6	-1.3
800	78.2	-0.1	800	54.2	2.0	800	78.2	-0.1
1000	76	-0.2	1000	48.8	-0.9	1000	76.0	-0.2
1250	74.2	-1.1	1250	45.2	0.1	1250	74.2	-1.0
1600	74.5	-0.1	1600	41.5	0.1	1600	74.5	-0.1
2000	75	-0.5	2000	37.6	0.0	2000	75.0	-0.5
2500	76.4	1.5	2500	33.7	-0.5	2500	76.4	1.4
3150	74.9	1.4	3150	30.9	-0.4	3150	74.9	1.3
4000	70.7	-10.6	4000	28.8	-0.4	4000	70.7	-10.5
5000	87.6	12.2	5000	27.6	0.1	5000	87.6	12.1
6300	80.2	-0.5	6300	26.3	0.6	6300	80.2	-0.6
8000	73.9	-2.7	8000	23.9	-0.6	8000	73.9	-2.7
10000	73.1		10000	22.6		10000	73.1	

The sound pressure levels assumed in the South Ripley BESS models is a conservative assumption based on data for the Fluence Gridstack HVAC system. Fluence Gridstack containers feature two (2) HVAC units, each measured at 65db one (1) meter from the unit (see manufacturer diagram of “cubes” on next page). The South Ripley model assumes two (2) HVAC units per container, each modeled at 70 dBA one (1) meter from the units. This level of conservatism is applied to account for variations in HVAC unit size and location on different battery containers. Final procurement of battery containers will include ensuring that the battery as built will comply with permitted sound power levels and ORES requirements.



Each Core has one padmount transformer. Sound emissions at full load are 65 dB at 0.3m.

Each Core has 24 Cubes: Each Cube has two cooling units in the door (the black shaded area side of the Cube is where the cooling units are located), each cooling unit (2 per Cube) has sound emissions max of 65 dB at 1m.

There is one inverter block. The sound emissions are up to 79 dB at 1m on the back side of the inverter on the side that faces the transformer. We have options to reduce sound if needed.

Test Report

This is a report of sound tests conducted on a transformer following the IEEE C57.12.90-2010 standard. This test is used to assess the spectral distribution of sound from the substation and not the overall sound power level.

Test 1

Voltage: 345/115 kV
MVA: 202/269/336 MVA
Instrumentation: Cesva SC310 ANSI/IEC Class I
Testing Conditions: Fans on and Fans off

Sound Power Level (dBA)

	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	LwA
Fans Off	37.2	51.2	92.0	87.4	92.4	75.0	68.0	65.5	60.3	95.9
Fans On	45.3	61.2	89.9	88.2	93.6	92.6	89.9	83.7	73.6	97.9

Spectral weighting (dBA to dBA)

	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	LwA
Fans Off	-58.7	-44.7	-3.9	-8.5	-3.5	-20.9	-27.9	-30.4	-35.6	0.0
Fans On	-52.6	-36.7	-8.0	-9.7	-4.3	-5.3	-8.0	-14.2	-24.3	0.0

Sound Power Level (dBZ)

	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	LwZ
Fans Off	76.6	77.4	108.1	96.0	95.6	75.0	66.8	64.5	61.4	108.6
Fans On	84.7	87.4	106.0	96.8	96.8	92.6	88.7	82.7	74.7	107.2

Spectral weighting (dBZ to dBZ)

	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	LwZ
Fans Off	-31.9	-31.2	-0.5	-12.6	-12.9	-33.6	-41.7	-44.0	-47.2	0.0
Fans On	-22.5	-19.8	-1.3	-10.4	-10.4	-14.6	-18.5	-24.6	-32.5	0.0

Revised January 2022