Exhibit N
Sound Survey

Hankard Environmental, Inc.

November 9, 2020

DICKINSON WRIGHT PLLC

Pre-Construction Noise Analysis

for the proposed

Pleasant Prairie Solar Energy Center

November 9, 2020

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Executive Summary

This report describes the results of an analysis of the noise levels that are expected to be generated from the construction and operation of the Pleasant Prairie Solar Energy Center (Project or Facility). The Project is a photovoltaic solar electrical generation facility to be located in Franklin County, Ohio, approximately 10 miles west of Columbus. The Project has a maximum generating capacity of up to 250 megawatts. During construction, the Project will generate noise from the operation of typical equipment such as bulldozers and pile drivers. Sources of noise from the operation of the Facility include inverters, transformers, and cooling systems.

Noise emissions from the Project are subject to the provisions of the Ohio Administrative Code, Chapter 4906-4, which requires the Project to (1) measure existing ambient (background) noise levels prior to construction, and (2) predict noise levels from the construction and operation of the Project at sensitive receptor locations. The maximum noise level from Facility operations at noise-sensitive receptors (e.g., residences) located within one mile of the Facility is limited to the measured ambient noise level plus five A-weighted decibels (dBA).

Ambient noise levels were measured in September and October 2020 at eight locations near the proposed Facility. The average daytime and nighttime noise levels were 47 dBA and 39 dBA, respectively. This results in daytime and nighttime noise level limits of 52 dBA and 44 dBA, respectively (ambient plus 5 dBA).

Noise levels from the operation of the Facility were predicted at each of the 1,099 noise-sensitive receptors identified within one-half mile of the Project. Noise levels at more distant receptors will be lower than those reported herein, and well below the established limits. The primary sources of noise from the operation of the Facility would be the solar inverters located throughout the Facility and the primary step-up transformers located at the substation. The loudest operational noise level among non-participating residences is predicted to be 43 dBA at two residences in the northern portion of the Project. All predicted levels are below the 52 dBA daytime standard. Nighttime noise levels for all receptors were modeled with the substation step-up transformers as the only noise source, as inverters and their cooling systems do not operate at night. The loudest predicted level among non-participating residences under this condition is 41 dBA, which is below the 44 dBA nighttime limit.

Noise levels from the construction of the Facility were predicted at each of the 1,099 noise-sensitive receptors identified within one-half mile of the Project and also at one worst-case location along the Project boundary. During construction predicted noise levels at noise-sensitive receptors range from 32 to 87 dBA, with the loudest levels predicted for pile driving. At the Project boundary, construction noise levels are predicted to be as high as 115 dBA during pile driving. Much of the time construction noise levels will be lower than the predicted range. These levels are below standards typically applied to construction noise by agencies such as the U.S. Federal Highway Administration. Construction will be limited to daytime hours to the extent practicable, will take place for approximately 12 to 18 months, and will occur near any one receptor location for only a few weeks at a time.

1. Introduction

This report describes the results of a pre-construction noise analysis conducted by Hankard Environmental for the proposed Pleasant Prairie Solar Energy Center (Facility or Project). The general location of the Project is shown in Figure 1-1. The Project's maximum generating capacity is up to 250 megawatts. This analysis demonstrates that the Project satisfies the requirements of Chapter 4906-4 of the Ohio Administrative Code, *Certificate Applications for Electric Generation Facilities*, which requires the Project to provide a study of pre-construction (existing) noise levels, a description of construction and operational noise levels at the nearest property boundary and at all noise-sensitive receptors located within approximately one mile of the Project boundary, and the measures that will be taken by the Project to mitigate noise emissions.

The following sections describe in more detail the noise regulation applicable to the Project, the Project site and the location of noise sensitive receptors, the results of the pre-construction ambient noise study, the methods and data used to predict construction and operational noise emissions, the predicted construction and operational noise levels, and the mitigative measures to be employed.

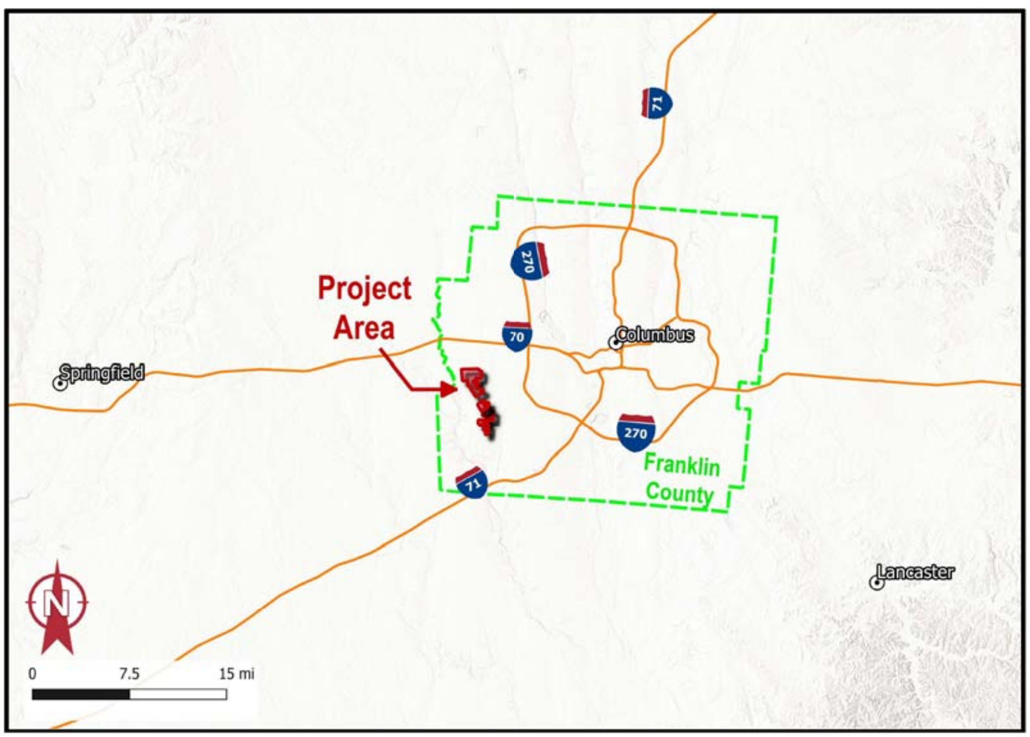

Figure 1-1. General Location of the Proposed Pleasant Prairie Solar Energy Center

2. Applicable Noise Regulation

Chapter 4906-4 of the Ohio Administrative Code, *Certificate Applications for Electric Generation Facilities,* sets forth the rules governing standard certificate applications for electrical generation facilities. Section 4906-4-08, *Health and Safety, Land Use and Ecological Information*, describes the noise-related information required as part of a certificate application. Specifically, Paragraph (A)(3) requires:

(3) The applicant shall provide information on noise from the construction and operation of the facility.

(a) Describe the construction noise levels expected at the nearest property boundary. The description shall address:
   (i) Blasting activities. (there is no blasting anticipating on this Project)
   (ii) Operation of earth moving equipment.
   (iii) Driving of piles, rock breaking or hammering, and horizontal directional drilling.
   (iv) Erection of structures.
   (v) Truck traffic.
   (vi) Installation of equipment.

(b) Describe the operational noise levels expected at the nearest property boundary. The description shall address:
   (i) Operational noise from generation equipment. In addition, for a wind facility, cumulative operational noise levels at the property boundary for each non-participating property adjacent to or within the project area, under both day and nighttime operations. The applicant shall use generally accepted computer modeling software (developed for wind turbine noise measurement) or similar wind turbine noise methodology, including consideration of broadband, tonal, and low-frequency noise levels.
   (ii) Processing equipment.
   (iii) Associated road traffic

(c) Indicate the location of any noise-sensitive areas within one mile of the proposed facility, and the operational noise level at each habitable residence, school, church, and other noise-sensitive receptors, under both day and nighttime operations. Sensitive receptor, for the purposes of this rule, refers to any occupied building.

(d) Describe equipment and procedures to mitigate the effects of noise emissions from the proposed facility during construction and operation, including limits on the time of day at which construction activities may occur.

(e) Submit a preconstruction background noise study of the project area that includes measurements taken under both day and nighttime conditions.

While there are no specific noise limits for solar farms in the Ohio Administrative Code, the Project has chosen to adhere to the limits outlined in Chapter 4906-4-09 *Regulations Associated with Wind Farms* Section F, Part 2, which states:

> *The facility shall be operated so that the facility noise contribution does not result in noise levels at any non-participating sensitive receptor within one mile of the project boundary that exceed the project area ambient nighttime average sound level (L_{eq}) by five A-weighted decibels (dBA). During daytime operation only (seven a.m. to ten p.m.), the facility may operate at the greater of: the project area ambient nighttime L_{eq} plus five dBA; or the validly measured ambient L_{eq} plus five dBA at the location of the sensitive receptor.*

As described in Section 4, ambient noise levels were measured for approximately two weeks at four representative locations within the Project area. From this data an average daytime and nighttime L_{eq} were determined. As described in Section 7, predicted noise levels from the operation of the Facility at all nearby noise-sensitive receptors were compared to limits of the measured daytime noise level plus five decibels and the measured nighttime noise level plus five decibels.

3. Project Site

The Project is located in Franklin County, Ohio. Figure 3-1 shows the Project site, including the locations of the solar panels and inverters, the substation, and the Project boundary. The site is bordered to the north by Interstate 70, to the south by Kropp Road, to the east by Alton Road, and to the west by Pleasant Prairie Drive. Figure 3-1 also shows the location of the 1,099 noise-sensitive receptors identified within approximately one-half mile of the Project. The noise-sensitive receptors include 1,079 residences, three schools, four churches, two golf courses, seven parks, three cemeteries/office, and one public building. The land use immediately surrounding the Project is a mix of agricultural, rural residential, and suburban residential. Noise levels at receptors located beyond one-half mile will be less than those reported herein.

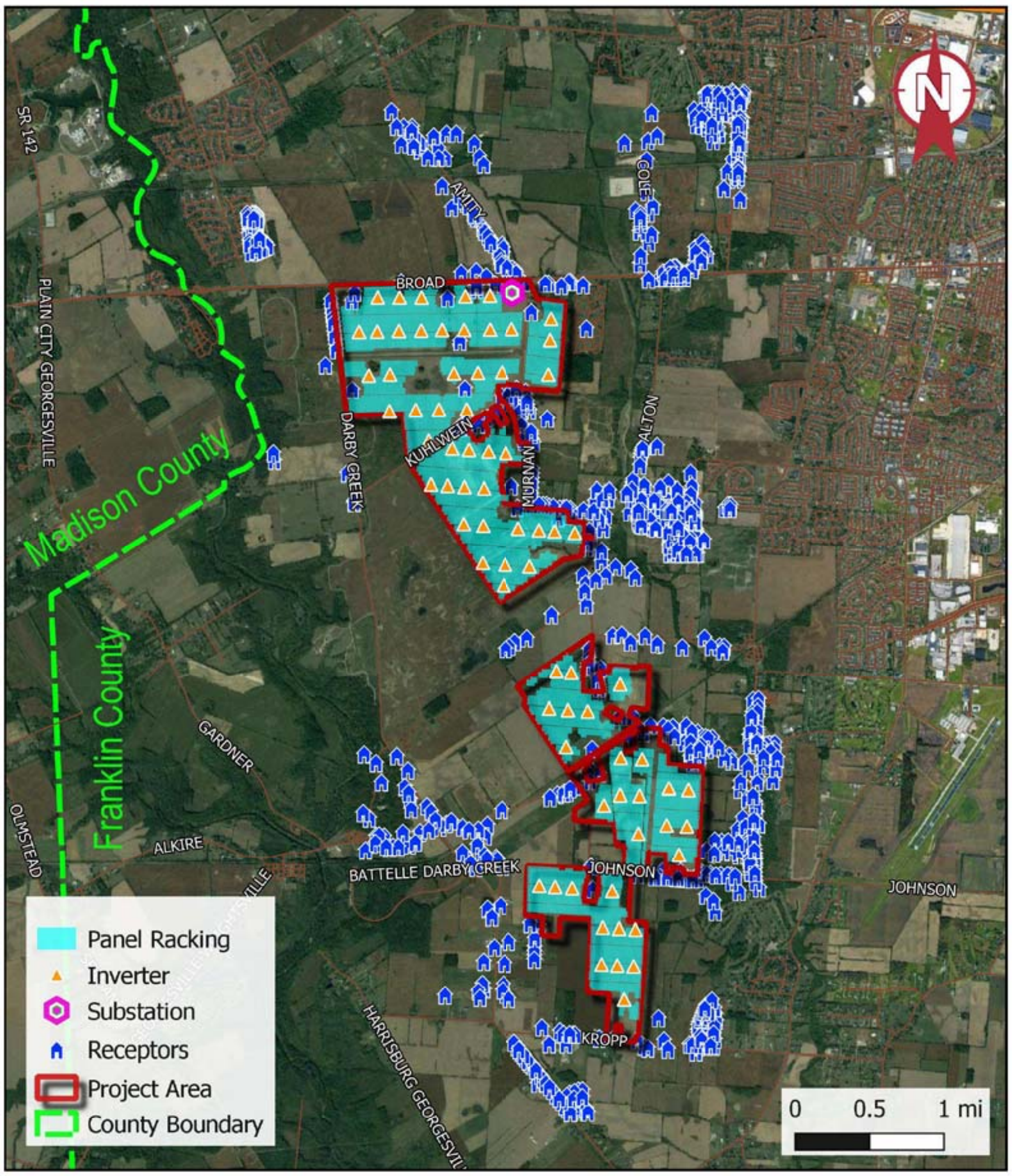

Figure 3-1. Proposed Pleasant Prairie Solar Energy Center Layout

4. Pre-Construction Background Noise Study

A pre-construction ambient sound (noise) level survey was conducted in the Project area in September and October 2020. The purposes of the survey were to measure and document existing sound levels, assess the character of the existing sound environment, and provide data for use in determining the applicable noise limits for the Project.

Measurement Locations

The Project area is roughly three miles outside of the beltway that surrounds Columbus, Ohio and includes open farmland, farmsteads, rolling hills, forested areas, paved rural and higher speed county roads, one state highway, two railways, and a small general aviation airport (Darby Dan Airfield). Note that there is a second airport, Bolton Field, in the area, but it is approximately 1.5 miles east of the Project Area. Sources of existing sound include natural sources such as wind, birds, and insects, as well as man-made sources such as traffic, farming equipment, and both commercial aircraft and general aviation overflights. Selection of monitoring locations considered several factors, including the range of sound environments in the Project area, proximity to the proposed location of Project noise sources and to roadways, farm and non-farm settings and their local activities and sources, and equipment security. Another factor in the site selection process was to achieve a relatively even geographical distribution of the measurement locations across the Project area. Photographs from each long-term and short-term location are shown in Appendix A.

LT1 is located at a residence in the northeast portion of the Project area about 100 feet east of Murnan Road and about 1,150 feet south of West Broad Street (U.S. Route 40). This area is mostly farmland, some scattered residences and residential areas, with the airfield about 1,500 feet to the southwest and a railroad about one mile to the north. The immediate area around the measurement location is exposed to the west and south with mature trees to the north and east. Meteorological measurements at this location included wind speed, wind direction, and precipitation.

LT2 is located at a residence in the northwest portion of the Project area about 280 feet east of Pleasant Prairie Drive and about 1,150 feet south of West Broad Street (U.S. Route 40). The site is surrounded by farmlands with the airfield about 1,000 feet to the north. Pleasant Prairie Drive is a primary connector road for the area with one lane in each direction. The immediate area around the measurement location is exposed on all sides with farmland to the north, south, and east with a few mature trees on the property. Meteorological measurements at this location included wind speed, wind direction, precipitation, temperature, relative humidity, and barometric pressure.

LT3 is located at a residence in the central portion of the Project area about 150 feet south of Murnan Road with no major roads in the area. The site is surrounded by a turf farm with several residences across the street and in the surrounding area. The airfield is just over one mile to the northwest. The immediate area around the measurement location is mostly exposed with mature trees on the property to the south and at the residences across the street to the north. Meteorological measurements at this location included wind speed, wind direction, and precipitation.

LT4 is located at a residence near a group of outbuildings in the south-central portion of the Project area about 120 feet south of the Alkire Road and Alton Road intersection. Both roadways are primarily for local traffic. The Camp Chase Railway about 400 feet to the northwest. The site is surrounded scattered residences with farmland to the south and a power transmission line to the east. Meteorological measurements at this location included wind speed, wind direction, and precipitation.

ST1 is located northeast of the Project across the street from an existing transformer substation and 400 feet south of a railroad crossing. This area was selected to represent residences along Cole Road. Land use in the area includes a mix of crop farming and residences. This site is exposed and on flat terrain.

ST2 is located near the east-central portion of the Project at the intersection of Alton Road and Hall Road. This site was selected to represent the numerous residences in the area as well as Alton Hall Elementary School. Land use in the area is mainly residential with interspersed farm lands. There are several trees in this area, but not in large groves.

ST3 is located near the west-central portion of the Project near the entrance to Battelle Darby Creek Metro Park about 220 feet west of Pleasant Prairie Drive. This site was selected for its general western location. The park has many visitors with people and pets using park amenities and the large trail system. There are some residences to the south of this site with farmland on the east side of Pleasant Prairie Drive. The park itself is heavily wooded.

ST4 is located at the southernmost portion of the Project area at the Pleasant View Intermediate School about 100 feet south of Kropp Road. This area was selected for its southern location. The primary land use in the area includes residential, public school outdoor use areas, and farmland.

Long-term data was collected for approximately two weeks (September 22 through October 5, 2020). Figure 4-2 shows an example plot of the measured noise levels over one week at LT1. After filtering for biogenic noise, periods of high ground winds, and removing all times when it was precipitating or stormy, the daytime (7:00 am to 7:00 pm) and nighttime (7:00 pm to 7:00 am) average noise levels at all sites were calculated to be 47 dBA and 39 dBA, respectively.

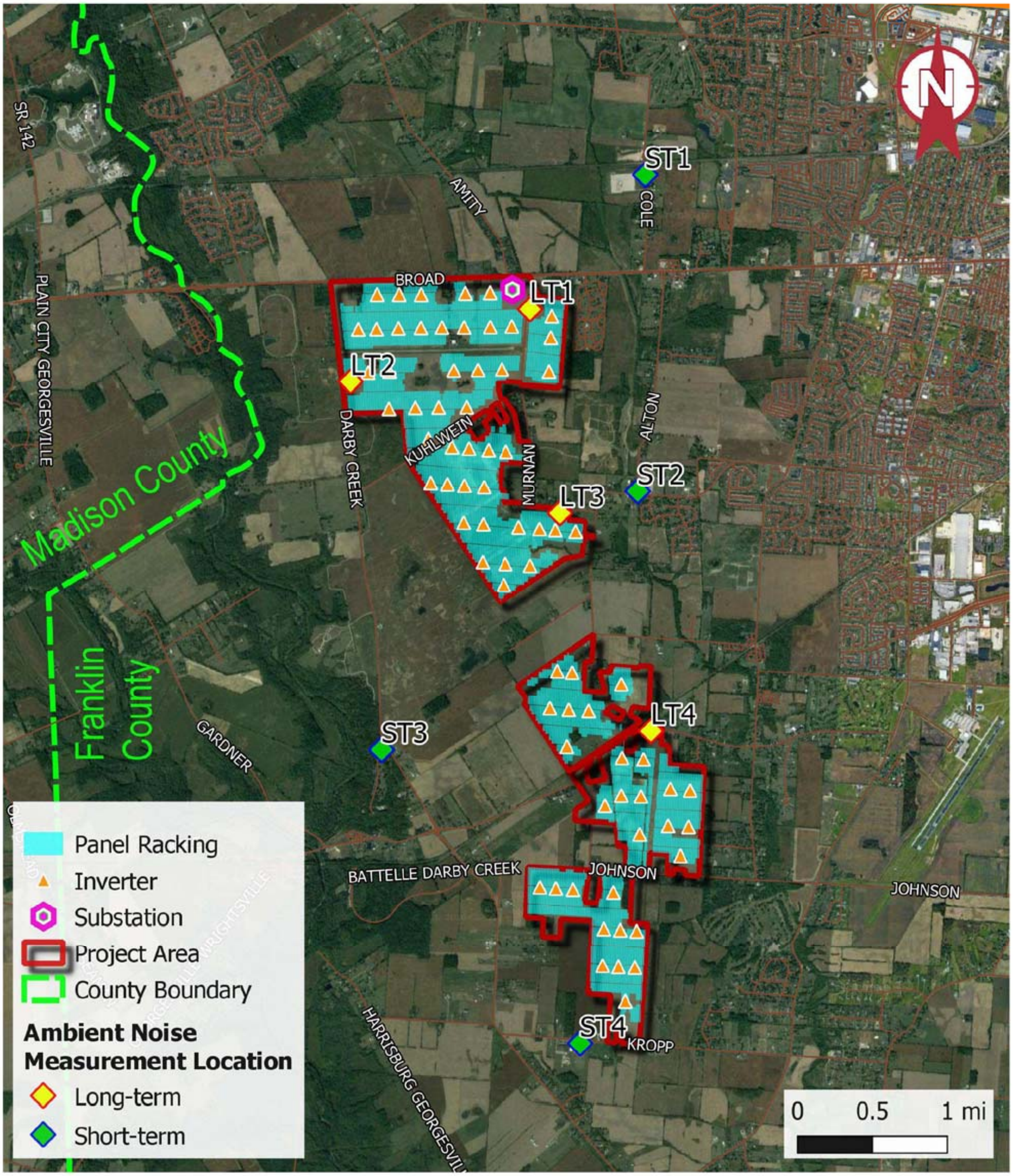

Figure 4-1. Background (Ambient) Noise Measurement Locations

Measurement Duration

Data were collected at the long-term sites for approximately two weeks (September 22 through October, 6 2020). Ten-minute measurements were conducted at each short-term site during the early morning and evening hours on two occasions between September 22 and 23, 2020. A total of 16 short-term measurements were made, four at each short-term site.

Measurement Equipment

Table 4-1 lists the instruments that were employed for the ambient sound survey. The acoustic instruments meet the Type 1 provisions of IEC 61672-1 Class 1, ANSI S1.4 Type 1, and/or ANSI S1.43. Vendor specifications for the sound level monitors indicate ambient conditions of -10°C to +50°C temperature and 10% to 90% relative humidity (non-condensing) and a measurement range of 25 dBA to 138 dBA with an inherent noise floor of 18 dBA.

The sound level monitors were field calibrated just prior to and directly following each series of measurements. The drift in the measured noise level was minimal (-0.1 to +0.2 dB) over the measurement period) and within accepted limits of ±0.5 dB per ANSI S12.9. In addition, the instruments were calibrated by an accredited laboratory within the 18 months prior to their use. Each microphone was covered with hydrophobically treated seven-inch diameter 80 pores-per-inch density windscreens (ACO Pacific model WS7-80T) to reduce the potential influence of wind-induced noise on the measured data. The microphones were mounted on a tripod and positioned five feet above the ground per ANSI S12.9 and at least 25 feet away from acoustically reflective surfaces.

Wind speed was measured at each long-term measurement location using either a Vaisala WXT536 or WMT52 sensor mounted at an elevation of six feet above the ground. The vendor specifications for the wind data logging system include: accuracies of ±2% from 0 to 10 mph and ±2.5% for 10 to 100 mph; and environmental conditions of -60°F to +140°F and 0% to 100% relative humidity. Wind speeds were measured at the short-term locations using a Kestrel 3000 anemometer.

Table 4-1. Noise Measurement Equipment

Measurement Location	Sound Level Monitor	Frequency Range (Hz)	Noise Floor (dBA)	Anemometer
LT1	Larson Davis 831C	6.3 - 20k	18	Vaisala WMT52
LT2	Larson Davis 831	6.3 - 20k	18	Vaisala WXT536
LT3	Larson Davis 831C	6.3 - 20k	18	Vaisala WMT52
LT4	Larson Davis 831	6.3 - 20k	18	Vaisala WMT52
ST1 - ST4	Larson Davis 831	6.3 - 20k	18	Kestrel 3000

Measurement Parameters

The sound level meters were configured to continuously measure and record both the 10-second and 10-minute averages of the overall L_{eq} and L_{90}, as well as one-third octave band L_{eq} and L_{90} levels (6.3 Hz to 20 kHz). One-third octave band levels were used to re-calculate ANS-weighted overall levels using the procedures outlined in ANSI S12.100. The ANS-weighting removes excess high frequency biogenic noise that would not be present in colder times of the year.

Short-term Measurement Results

The results of the attended short-term noise measurements are provided in Table 4-2 along with the audible sounds noted during each measurement. More specifically, this table lists both the actual A-weighted $L_{eq\text{-}10min}$ (dBA) levels as well as the noise sensitive A-weighted (ANS) $L_{eq\text{-}10min}$ (dBAi) levels. The purpose for reporting the ANS is that this data was measured during the fall months which contained some high frequency natural sounds (HFNS) such as crickets that do not occur year-round. Per ANSI S12.100-2014, *Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas*, to calculate the ANS, only the data in the one-third octave bands up through 1,250 Hz should be included. This process removes the HFNS and is more representative of all months that may not have insect activity. Table 4-2 shows how much quieter the measured levels were after removing insect noise. For the attended short-term measurements, it was minimal at all sites except ST4 where crickets were noted as being more prevalent than the other locations.

The morning noise level measurements were taken between 7:30am and 9:30am. It was noted that there were calm winds and clear skies each morning with an average temperature of 48°F and an average relative humidity at 75%, which are within the acceptable range for conducting noise measurements. It should be noted that there was a possible temperature inversion (i.e.: calm winds, low lying stable fog layer, clear sky) occurring on the second morning at the ST1 location in which distant (1.3 miles away) highway (I-70) traffic noise to the north was significant and dominated the measured levels. The first morning at ST1 was more dominated by local traffic which resulted in similar measured levels. The calculated overall morning ANS ranged from 46 to 59 dBAi which averaged approximately 1 dBA quieter than the dBA noise levels.

The evening noise level measurements were taken between 5:30pm and 7:00pm. It was noted that there were calm winds with an average temperature of 71°F and an average relative humidity at 47%, which are within the acceptable range for conducting noise measurements. The calculated evening ANS ranged from 48 to 59 dBAi which are approximately 1 dBA quieter than the dBA noise levels.

Table 4-2. Short-Term Noise Measurement and Calculated ANS Results

Location	Time	$L_{eq\text{-}10min}$ (dBA)	$L_{eq\text{-}10min}$ (dBAi)	Difference (dBA)	Audible Sounds
ST1	Morning 1	60	59	-1	distant and local traffic, diesel truck idling at substation, birds, distant dog barking, transformers not audible
	Morning 2	59	58	-1	distant highway traffic significant (temp inversion?), crickets, birds, backup alarms at substation
	Evening 1	53	52	-1	distant and local traffic, crickets, occasional bird, distant live music, commercial aircraft
	Evening 2	57	56	-1	crickets in background, distant traffic, minor local traffic, commercial aircraft, transformers not audible
ST2	Morning 1	57	56	-1	local traffic constant, distant dog barking, birds, trash truck, distant traffic audible with no local traffic
	Morning 2	52	51	-1	distant traffic, crickets slight, birds, local traffic light (no school), loud propeller airplane at airfield
	Evening 1	56	55	-1	local traffic, crickets constant, dog barking in distance, aircraft, residential talking and shop work
	Evening 2	60	59	-1	local traffic, barking dog in distance, aircraft, crickets
ST3	Morning 1	49	48	-1	birds, local and distant traffic
	Morning 2	47	46	-1	local and distant traffic, birds constant, no crickets
	Evening 1	52	51	-1	busy park, local traffic, people on park trails, crickets constant, birds, howling coyotes or dogs
	Evening 2	49	48	-1	local and distant traffic, people talking on trails, crickets slight
ST4	Morning 1	49	47	-2	distant traffic, birds, crickets, residential noise, local traffic
	Morning 2	50	48	-2	local traffic, distant traffic, crickets constant, birds, football practice in distance
	Evening 1	55	55	0	local and distant traffic, birds, no crickets
	Evening 2	51	48	-3	local and distant traffic, crickets in background, neighborhood noises, football practice in distance

Long-Term Measurement Results

Noise levels were measured continuously and unattended for approximately two weeks. Figure 4-2 shows a representative plot of one week of noise and wind speed data at LT1. Plots of all measured data at each site are provided in Appendix D. Note that while 10-minute L_{eq} samples were used to calculate overall ambient levels, figures in Appendix D plot one-hour L_{eq} noise levels for a cleaner visual representation. The data were analyzed as follows:

- Data samples were excluded for periods of rain as indicated in the plots provided in Appendix D.
- Data samples were excluded for periods when the measured ground wind speed exceeded 5 m/s.
- Data samples contaminated by anomalies such as levels greater than 70 dB were excluded as these are indicative of transient noise events.
- The effect of biogenic noise (insects, birds, frogs) was minimized by removing contributions from one-third octave band noise levels above 1,250 Hertz (these frequencies are where biogenic noise presents itself) and recalculating the overall ANS-weighted noise level (dBAi) per ANSI S12.1.
- The data were divided into daytime (7:00 am to 10:00 pm) and nighttime (10:00 pm to 7:00 am) periods.
- For each site the remaining noise level samples were used to determine the range and average L_{eq}. The results are listed in Table 4-3. Average levels were determined as the arithmetic average of all valid 10-minute samples after filtering. The average site-wide ambient noise levels are 47 dBAi during the daytime and 39 dBAi during the nighttime.

Table 4-3. Summary of Daytime 10-minute Noise Levels from Long-Term Monitoring

Monitor	Time	L_{eq} Overall (dBAi)	L_{eq} Minimum (dBAi)	L_{eq} Maximum (dBAi)
LT1	Day	47	36	67
LT2	Day	44	32	64
LT3	Day	44	31	67
LT4	Day	53	42	68
Average		**47**	**35**	**67**
LT1	Night	43	31	59
LT2	Night	38	23	56
LT3	Night	35	23	56
LT4	Night	42	25	60
Average		**39**	**26**	**58**

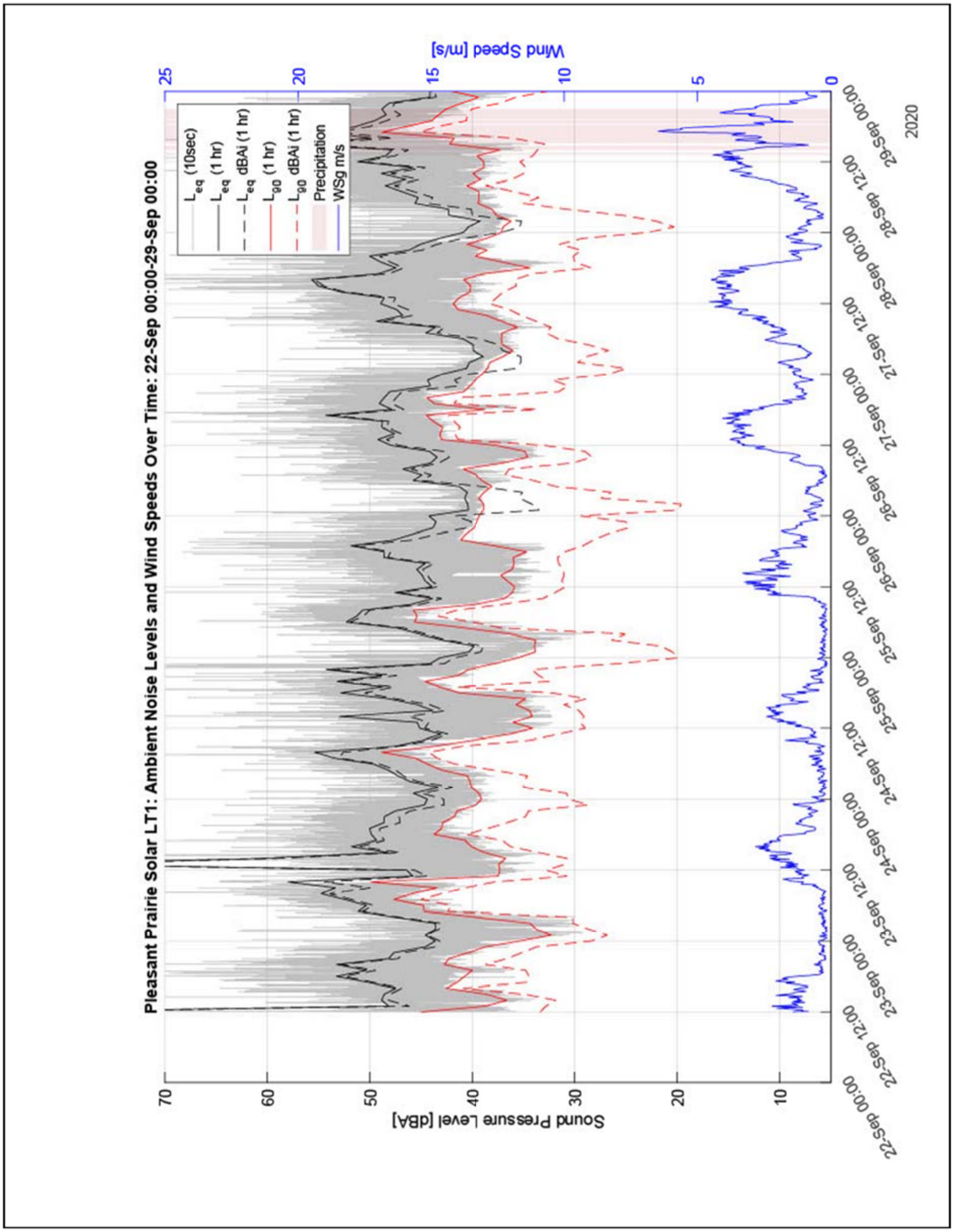

Figure 4-2. Measured Background Noise Levels at Location LT1 (September 22 – 29, 2020)

5. Noise Modeling Method

Noise levels from the operation of the proposed Project were predicted using the International Organization for Standardization (ISO) Standard 9613-2:1996, *Attenuation of Sound During Propagation Outdoors - Part 2: General method of calculation*. The calculations were implemented using the SoundPLAN v8.2 acoustical modeling software program. There are a number of parameters in the ISO 9613-2:1996 method, including the locations of the noise sources and receivers, noise source spectral characteristics, terrain and ground type, and atmospheric propagation conditions. The ISO method assumes optimal acoustic propagation in all directions, specifically that a "well-developed, moderate ground-based temperature inversion" is present or, equivalently, that all receptors are downwind of all noise sources at all times. The sections below describe the specific ISO 9613-2:1996 settings used in this analysis to predict noise from operations.

Terrain and Ground Effect

The terrain in the acoustic model was defined using Digital Elevation Model (DEM) data from the U.S. Geological Survey (USGS) National Elevation Dataset. The acoustical effect of the ground was modeled using the ISO 9613-2:1996 General Method. This method requires the selection of ground factors for the ground near the source, near the receiver, and in between. A ground factor of 0.0 represents a completely reflective surface such as pavement, which would result in a higher level of sound reaching a receiver. A ground factor of 1.0 represents absorptive ground such as thick grass or fresh snow, resulting in a lower level of sound reaching the receiver. Modeling for this Project used a ground factor of 0.5 because the site will be planted with native grasses after construction.

Atmospheric Conditions

The air temperature, relative humidity, and atmospheric pressure were set to standard-day conditions of 10°C, 70%, and 1 atmosphere, respectively. Per ISO 9613-2:1996, these values result in the least amount of atmospheric sound absorption and the highest levels of sound reaching the receivers.

Receptors

In the SoundPLAN model, prediction points (receptors) were located at the 1,099 noise-sensitive receptors within approximately one-half mile of the Project boundary. Of these receptors, 1,079 are residences, the rest includes three schools, four churches, two golf courses, seven parks, two cemeteries, and one public building. Prediction locations are shown in Figures 5-1 to 5-4. In accordance with ISO 9613-2:1996, the height above the ground for each receptor was set to five feet.

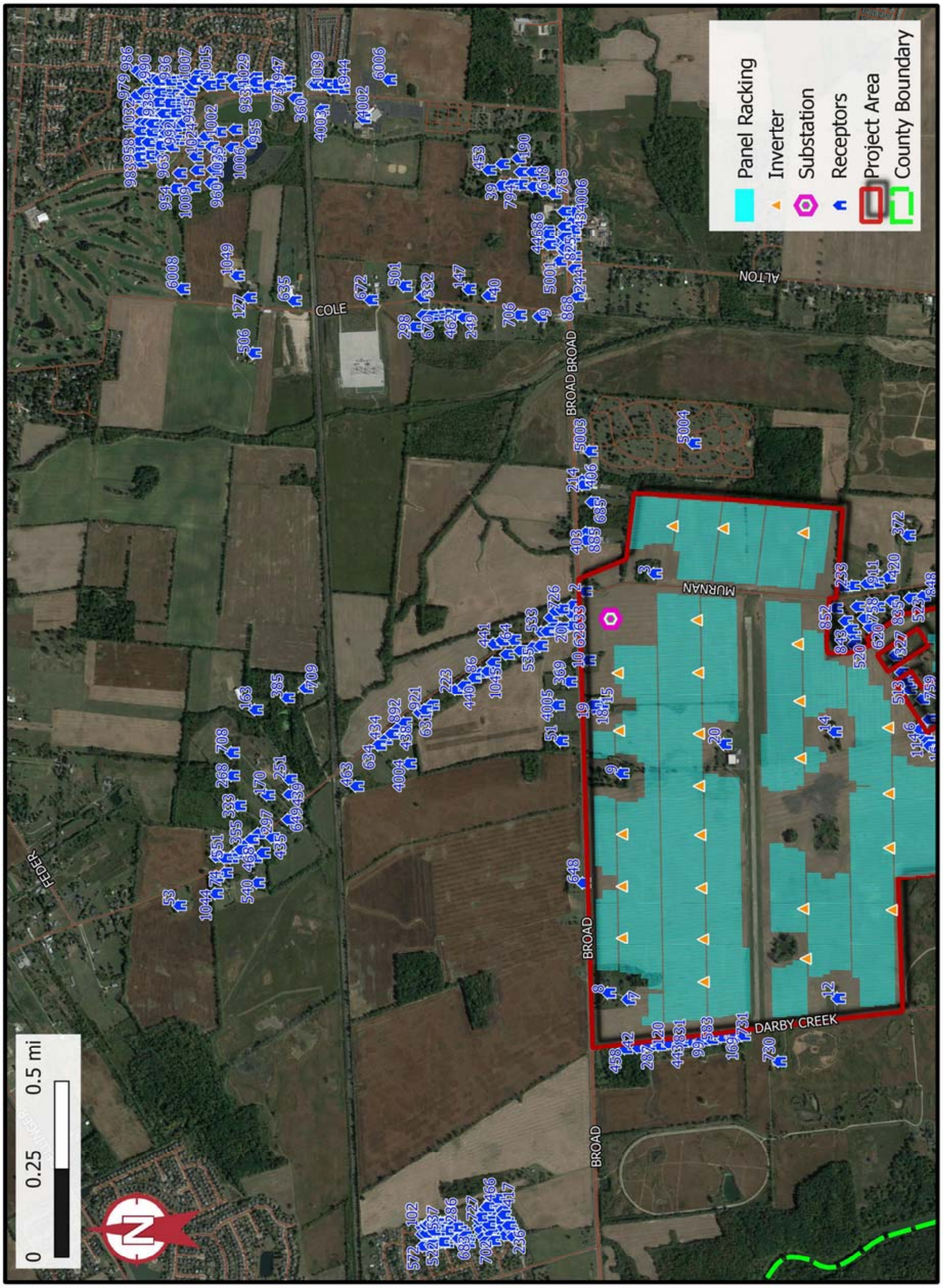

Figure 5-1. Noise-Sensitive Receptors – Northern Area

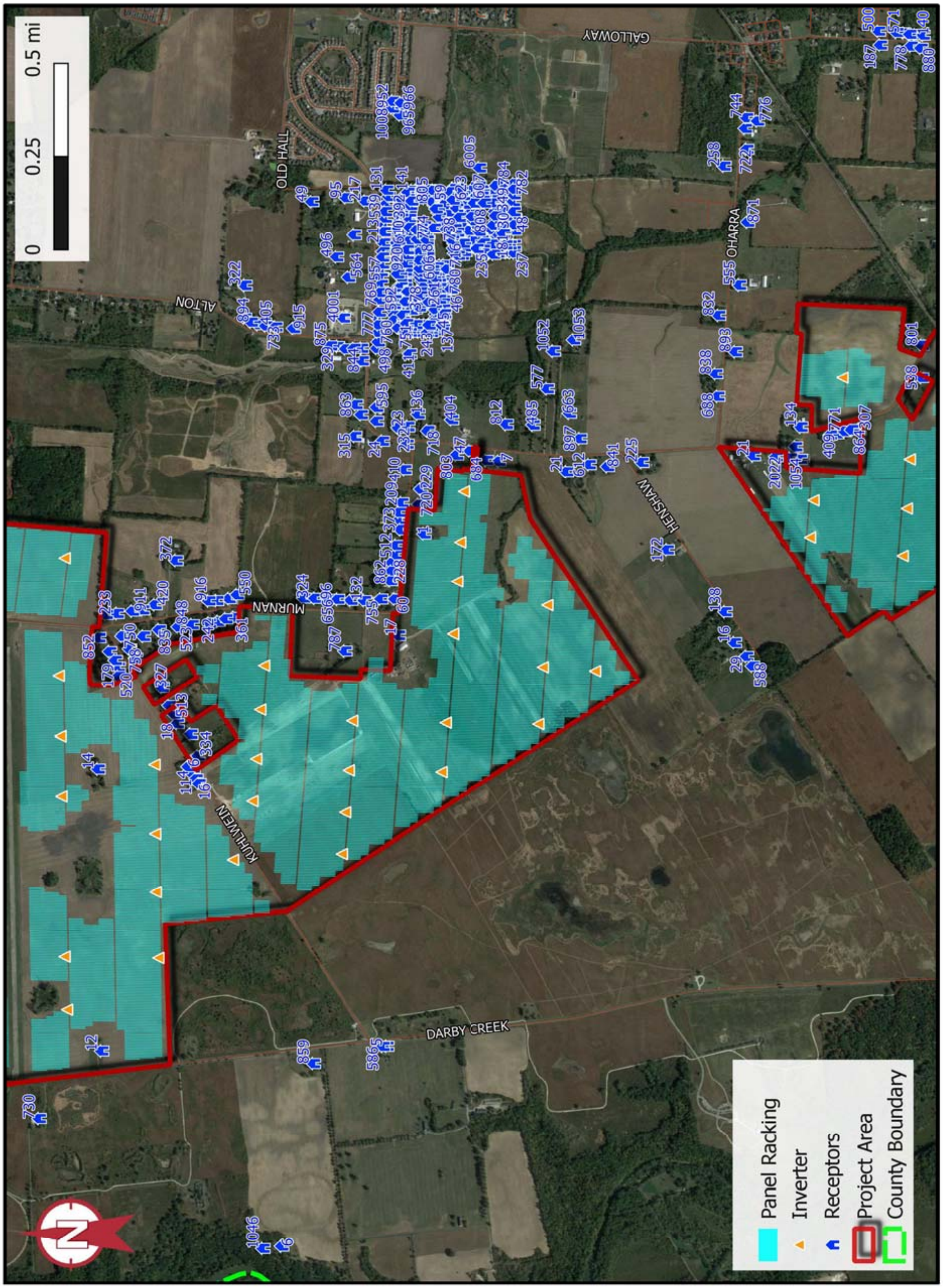

Figure 5-2. Noise-Sensitive Receptors – North-Central Area

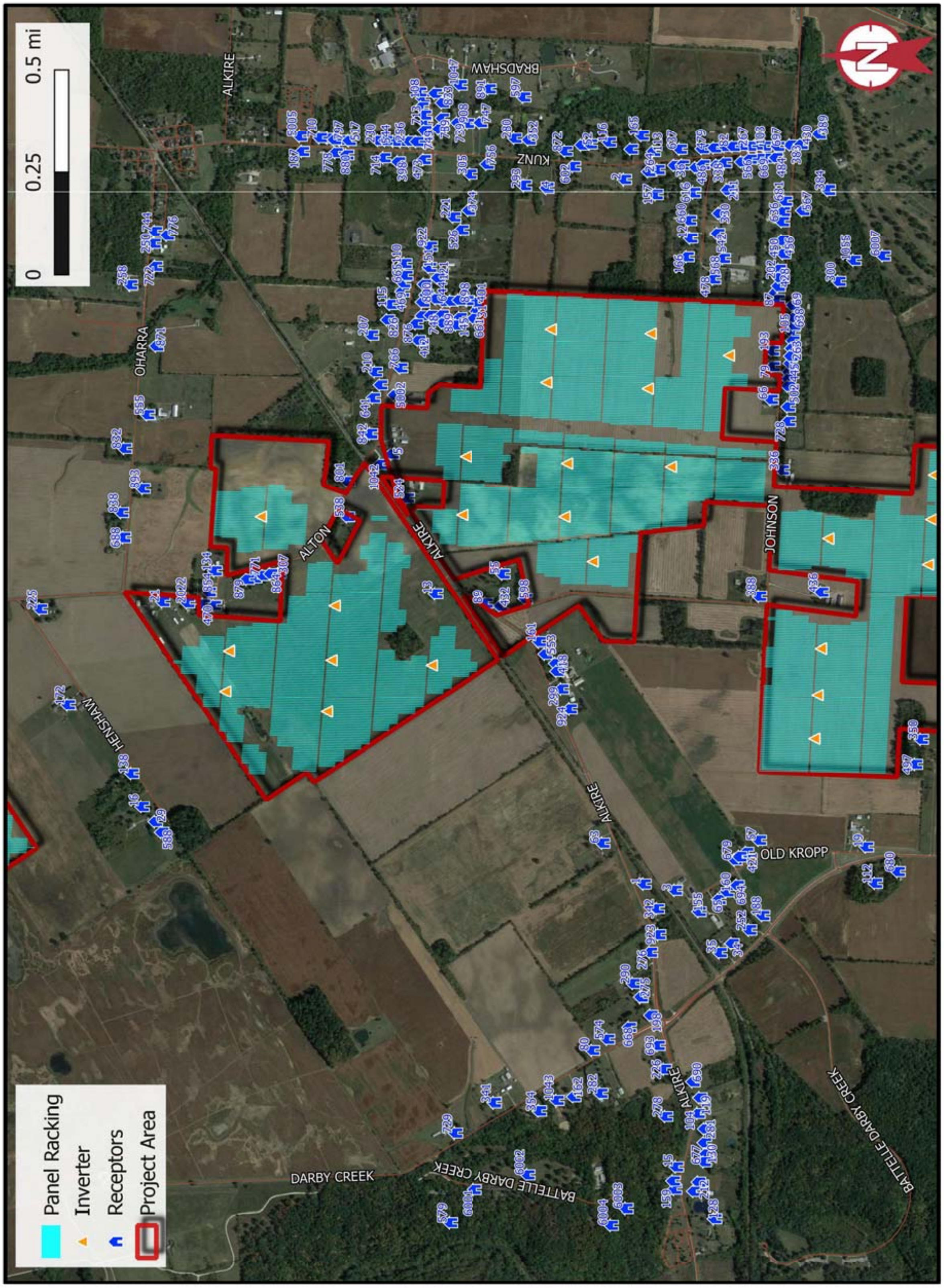

Figure 5-3. Noise-Sensitive Receptors – South-Central Area

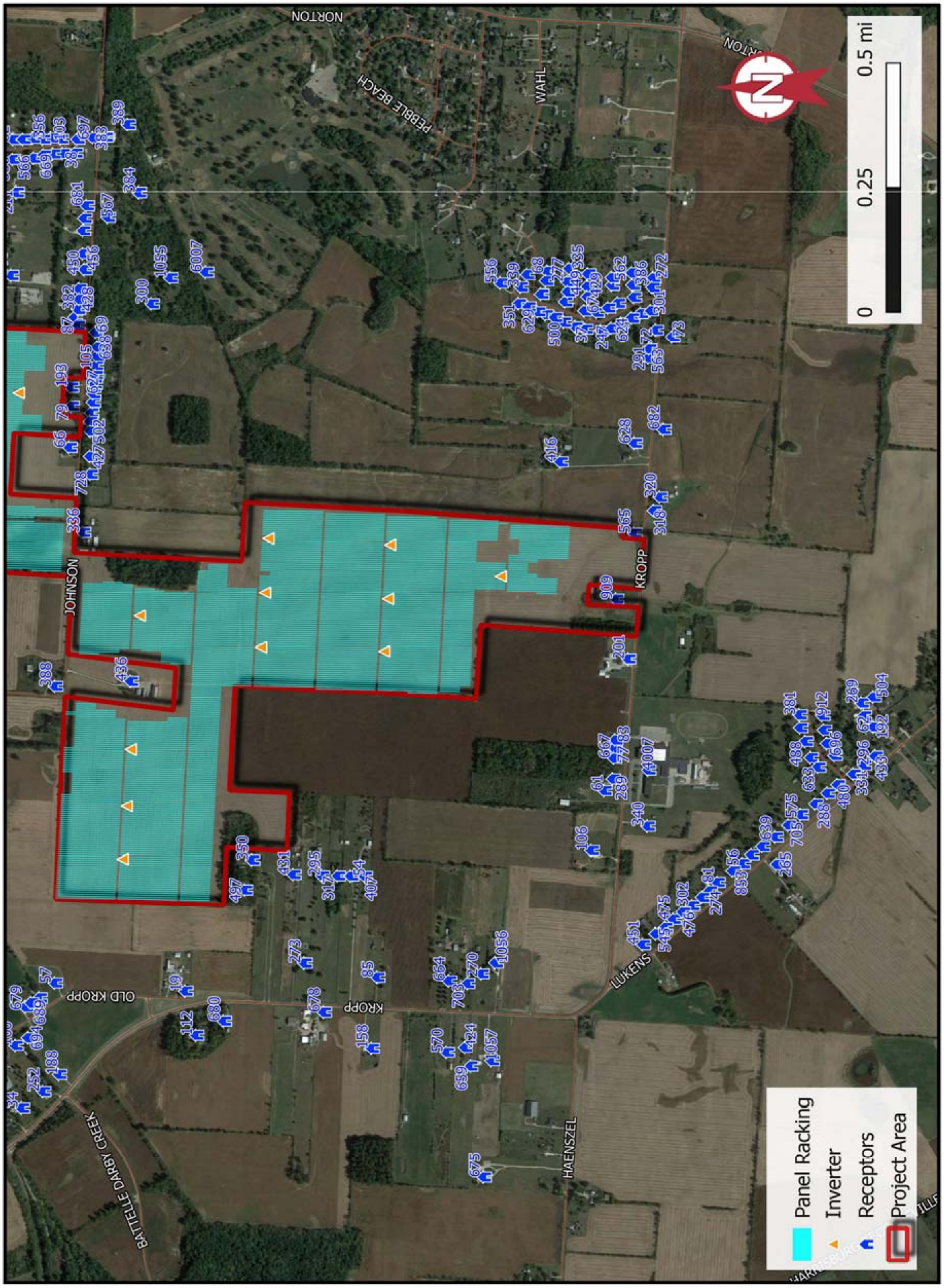

Figure 5-4. Noise-Sensitive Receptors – Southern- Area

Construction Noise Sources

Noise levels were predicted using the Federal Highway Administration's (FHWA) Roadway Construction Noise Model (RCNM) v1.1 for the five phases of construction: site preparation, civil work, pile driving, mechanical assembly, and electrical work. Table 5-1 lists the equipment associated with each phase, as well as the number of units to be employed, the sound power level of each unit, and the percentage of time that each piece of equipment is expected to be used at full capacity (the usage factor). Construction noise source levels were generally based on measurements of construction equipment made by Hankard Environmental on previous projects. The usage factors were taken from the RCNM. All construction noise sources were modeled at 10 feet above the ground.

Table 5-1. Noise Source Characteristics of Construction Equipment

Phase	Equipment Type (quantity)	Usage Factor (%)	Octave Band Sound Power Level (dB)									Overall Sound Power Level (dBA)
			31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz	8,000 Hz	
1 Site Preparation	Bulldozer (1)	40%	116	111	116	116	105	107	104	95	85	112
	Excavator (2)	40%	103	112	112	107	99	97	95	92	85	104
	Motor Grader (2)	40%	100	99	110	104	101	110	103	94	89	112
	Water Truck (1)	40%	103	107	112	103	106	104	98	94	85	108
	Dump Truck (1)	40%	98	112	105	103	97	98	96	90	82	103
2 Civil Work	Roller (1)	40%	--	138	128	115	101	98	97	94	90	116
	Dump Truck (1)	40%	98	112	105	103	97	98	96	90	82	103
	Excavator (2)	40%	103	112	112	107	99	97	95	92	85	104
	Trencher (1)	50%	109	114	114	108	105	102	101	95	87	108
	Motor Grader (2)	40%	100	99	110	104	101	110	103	94	89	112
	Water Truck (1)	40%	103	107	112	103	106	104	98	94	85	108
3 Pile Driving	Pile Driving (1)	20%	128	130	132	121	125	126	124	119	111	130
	Pickup Truck (2)	40%	100	114	107	105	99	101	98	92	84	105
	Man Lift (2)	20%	102	108	101	92	92	93	94	87	81	99
	Crane (1)	16%	---	139	117	104	102	100	96	90	85	114
	Backhoe/Loader (1)	40%	105	102	111	101	99	101	99	96	91	106
4 Mechanical Assembly	Pickup Truck (2)	40%	100	114	107	105	99	101	98	92	84	105
	Man Lift (2)	20%	102	108	101	92	92	93	94	87	81	99
	Crane (1)	16%	---	139	117	104	102	100	96	90	85	114
	Backhoe/Loader (1)	40%	105	102	111	101	99	101	99	96	91	106
5 Electrical Work	Pickup Truck (2)	40%	100	114	107	105	99	101	98	92	84	105
	Flatbed Truck (1)	40%	100	114	107	105	99	101	98	92	84	105
	Man Lift (1)	20%	102	108	101	92	92	93	94	87	81	99
	Small Generator (1)	50%	103	110	108	108	105	104	103	102	98	110
	Compressor (1)	40%	106	113	111	111	108	107	106	105	101	113

Operational Noise Sources

The model of noise emissions from the Project included 73 inverters and two primary step-up transformers located at the Facility's substation. Note that noise from solar tracking motors was not included as it has been found to be inaudible off-site based on measurements made at existing solar facilities. The inverters were modeled at a height of six feet above ground. The substation step-up transformers were modeled at a height of ten feet above ground. The inverters and substation transformers were all assumed to operate at full acoustic output during the daytime. Only the transformers were assumed to operate at night (at full acoustic output).

Table 5-2 lists the sound power levels for each source. The Project proposes to use the TMEIC Ninja 4.2 kW model inverter or a similar substitute. The solar inverter levels shown in the table are based on field measurements of a TMEIC 3.3 kW model inverter in operation at an existing solar farm. The model to be employed at the Project is expected to have a substantially similar noise profile to the one presented in the table, particularly since the majority of noise created by inverters is attributable to cooling systems that will be the same or similar between inverter models. The sound power level of the step-up transformers was estimated using the procedures outlined in the "Electric Power Plant Environmental Noise Guide" from the Edison Electric Institute (EEI, 1984). As discussed in more detail below, to meet the 44 dBA nighttime noise limit approximately 5 dBA of reduction is needed in transformer noise emissions versus that shown in Table 5-2. This can be accomplished in a number of feasible ways, such as the specification of low-noise transformers or the construction of barrier walls or enclosures. The modeling results presented herein assume this 5 dBA reduction.

Table 5-2. Noise Emission Levels of Operational Equipment

Equipment Type	Equipment Quantity	Octave Band Sound Power Level (dB)									Overall Sound Power Level (dBA)
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz	8,000 Hz	
Solar Inverter	73	99	95	99	98	95	86	79	73	69	95
Transformer (165 MVA)	2	93	99	101	96	96	90	85	80	73	96

6. Predicted Construction Noise Levels

The construction noise analysis was conducted using the Federal Highway Administration's Roadway Construction Noise Model (RCNM) v1.1. This computer software program includes construction noise source sound pressure levels and equipment usage factors. Noise levels from each of the five phases of construction of the Facility were predicted at each of the receptor locations identified within the Project Study Area and at one worst-case location along the Project boundary. These phases include site preparation (clearing); civil work (grading and the construction of access roads); pile driving (use of small specialty pile driving units); mechanical assembly of the solar panels, racks, and modules; and electrical work, which consists of connecting all the equipment. Some of this work will be conducted concurrently in different areas of the site. The total duration of construction is approximately 18 months.

The ranges of predicted construction noise levels ($L_{eq(1hr)}$) for each phase of construction at all of the receptors are provided in Table 6-1. For pile driving, the expected worst-case maximum levels (L_{max}) are presented because this activity can be the most noticeable when nearby, even though this source may not be operating continuously. These values assume that all of the equipment for each phase of work is operating at its expected hourly usage-factor. Predicted construction noise levels for all of the receptor and Project boundary locations are provided in Appendix B.

Table 6-1. Predicted Construction Noise Levels at Receptors

Construction Phase	Range of Noise Levels ($L_{eq\text{-}1hr}$ (dBA))	
	Minimum	Maximum
1 – Site Preparation	40	80
2 – Civil Work	39	80
3 – Pile driving	51(1)	87(1)
4 – Mechanical Assembly	34	74
5 – Electrical Work	32	73

(1) Maximum instantaneous noise level shown

Mitigation measures for construction noise, if necessary, include the use of ambient controlled broadband backup alarms versus tonal alarms, using well-maintained equipment (particularly with respect to mufflers), and maintaining communication with affected residents.

7. Predicted Operational Noise Levels

The primary noise sources associated with the operation of the Project include 73 pad-mounted inverters located throughout the Project area and the two 165 MVA step-up transformers located at the substation. This analysis assumed that all of the inverters and transformers would operate simultaneously at full acoustic output during the daytime, but only the substation step-up transformers would operate at night (at full acoustic output). The analysis assumes that approximately 5 dBA of step-up transformer noise reduction over a typical unit will be achieved by some means, as previously described in Section 5 above.

Operational noise levels were predicted at the 1,099 noise-sensitive receptors located within approximately one-half mile of the Project boundary. The predicted noise levels for daytime operation range from 18 to 44 dBA, with 97% of the receptors having levels of 40 dBA or less. All of the levels are less than the daytime limit of 52 dBA. The loudest levels among non-participants (43 dBA) are predicted at a residence near the intersection of Broad and Amity Road in the northeast portion of the Project area (R626) and at a residence along Kuhlwein Road in the northern portion of the Project area. The predicted noise levels for nighttime operation range from 1 to 41 dBA for non-participating residences, all of which are below the limit of 44 dBA established for the Project. See Appendix C for a list of predicted operational noise levels at all receptors.

The predicted noise levels for daytime operation of the Facility are depicted graphically in Figures 7-1 through 7-4. The contour around the substation for nighttime operation is shown in Figure 7-5. Shown are the 52 dBA and 44 dBA noise level contours which represent the daytime and nighttime noise level limits, respectively. From these figures it can be seen that operational noise levels do not exceed the daytime or nighttime limits at or outside of the Project boundary.

8. Noise Mitigation Measures

As currently designed, noise emissions from the operation of the Project are predicted to meet both the daytime and nighttime limits established for the Project based on ambient noise measurements. This is based on approximately 5 dBA of reduction in noise emissions of the substation step-up transformers from the level shown in Table 5-2. This can be achieved by specifying lower noise transformers or constructing a barrier around the transformers. The Project has otherwise minimized operational noise levels at nearby receptors through the appropriate siting of equipment. Should the Facility design, equipment selection, or other aspects of the Project change, this noise analysis should be updated accordingly.

All maintenance activities should be conducted using well-maintained and properly muffled vehicles and equipment.

Mitigation measures for construction noise, if necessary, include the use of ambient controlled broadband backup alarms versus tonal alarms, using well-maintained equipment (particularly with respect to mufflers), and maintaining communication with affected residents.

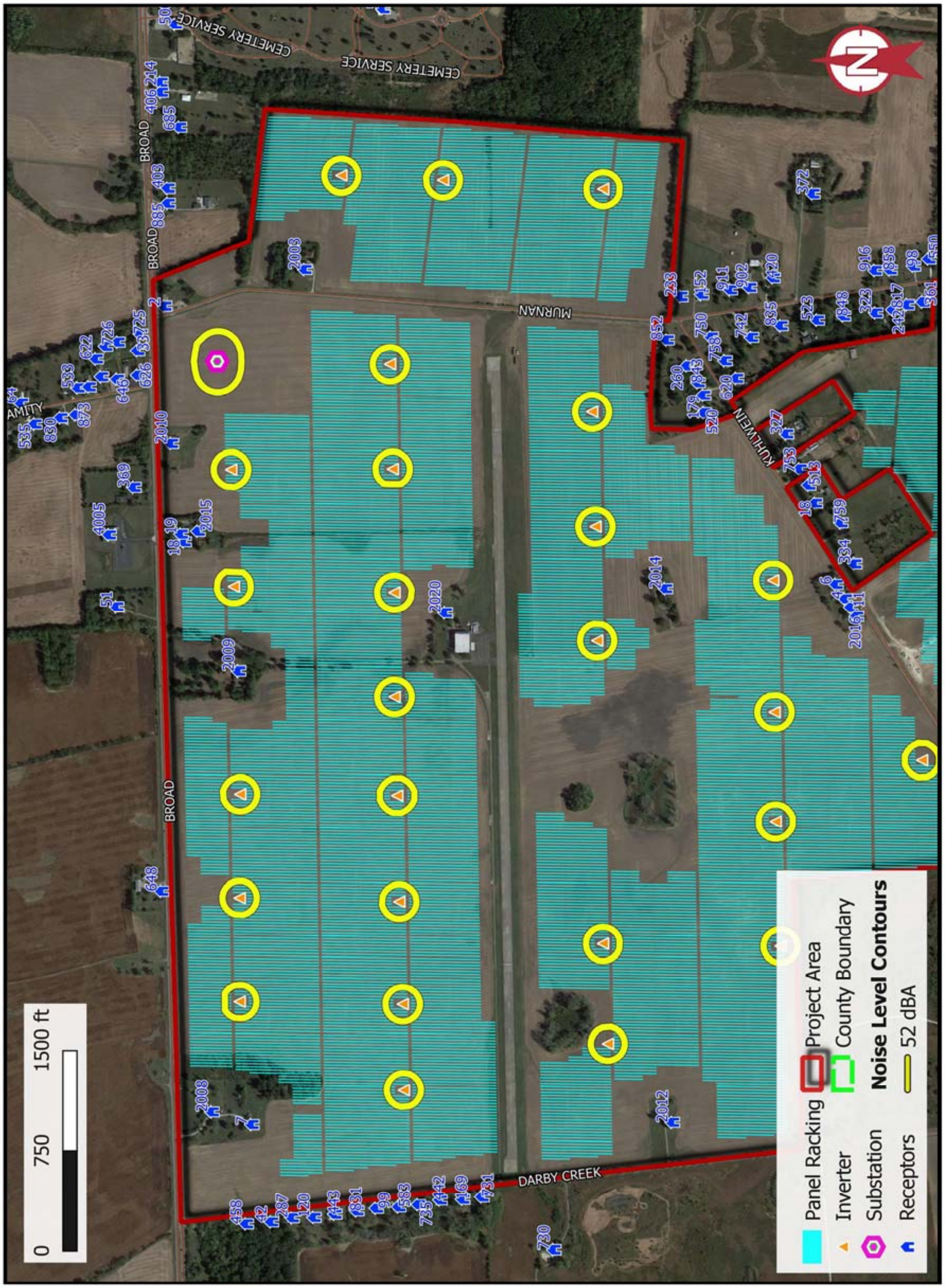

Figure 7-1. Predicted Daytime Operational Noise Level Contours – Northern Area

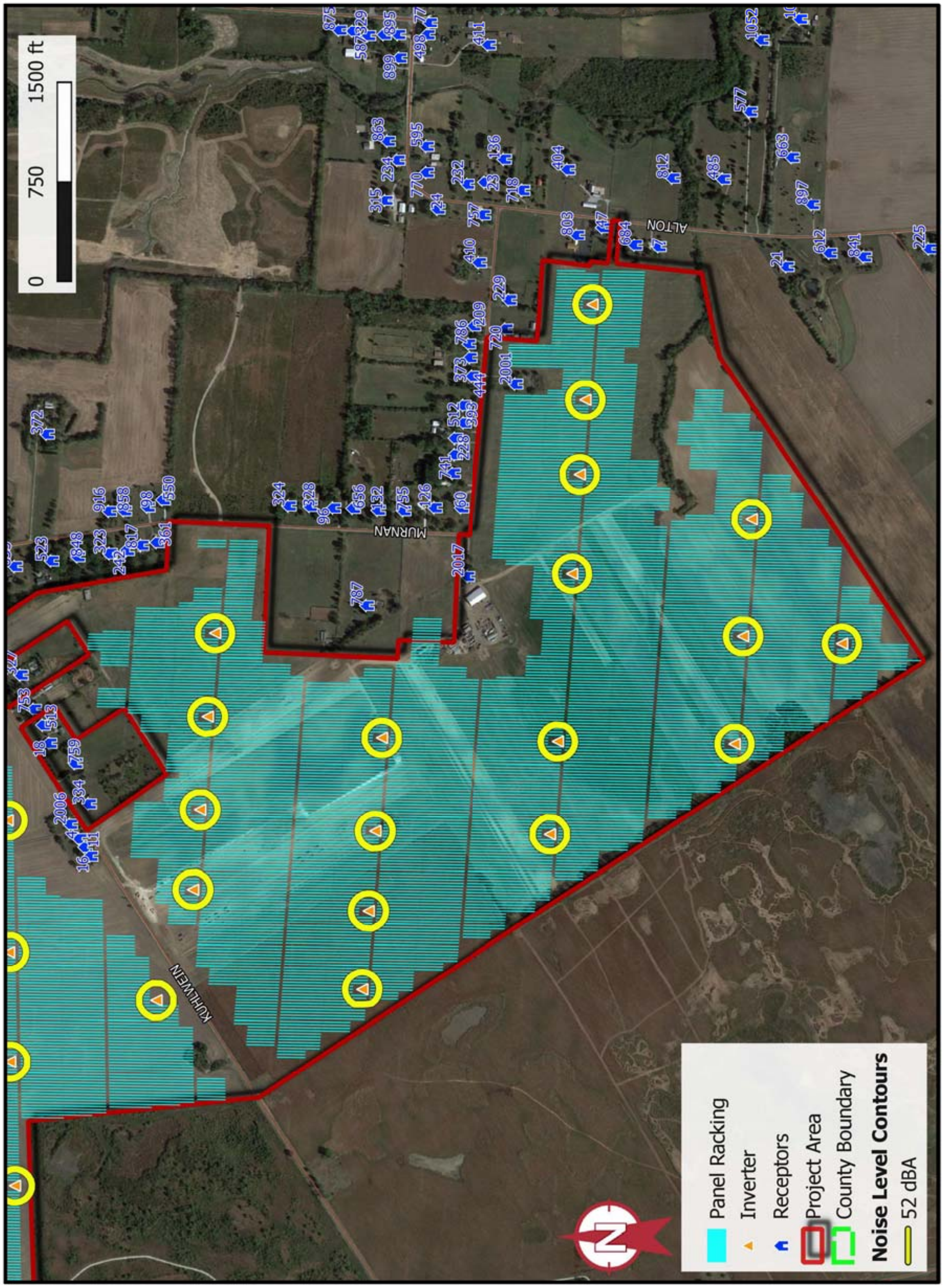

Figure 7-2. Predicted Daytime Operational Noise Level Contours – North-Central Area

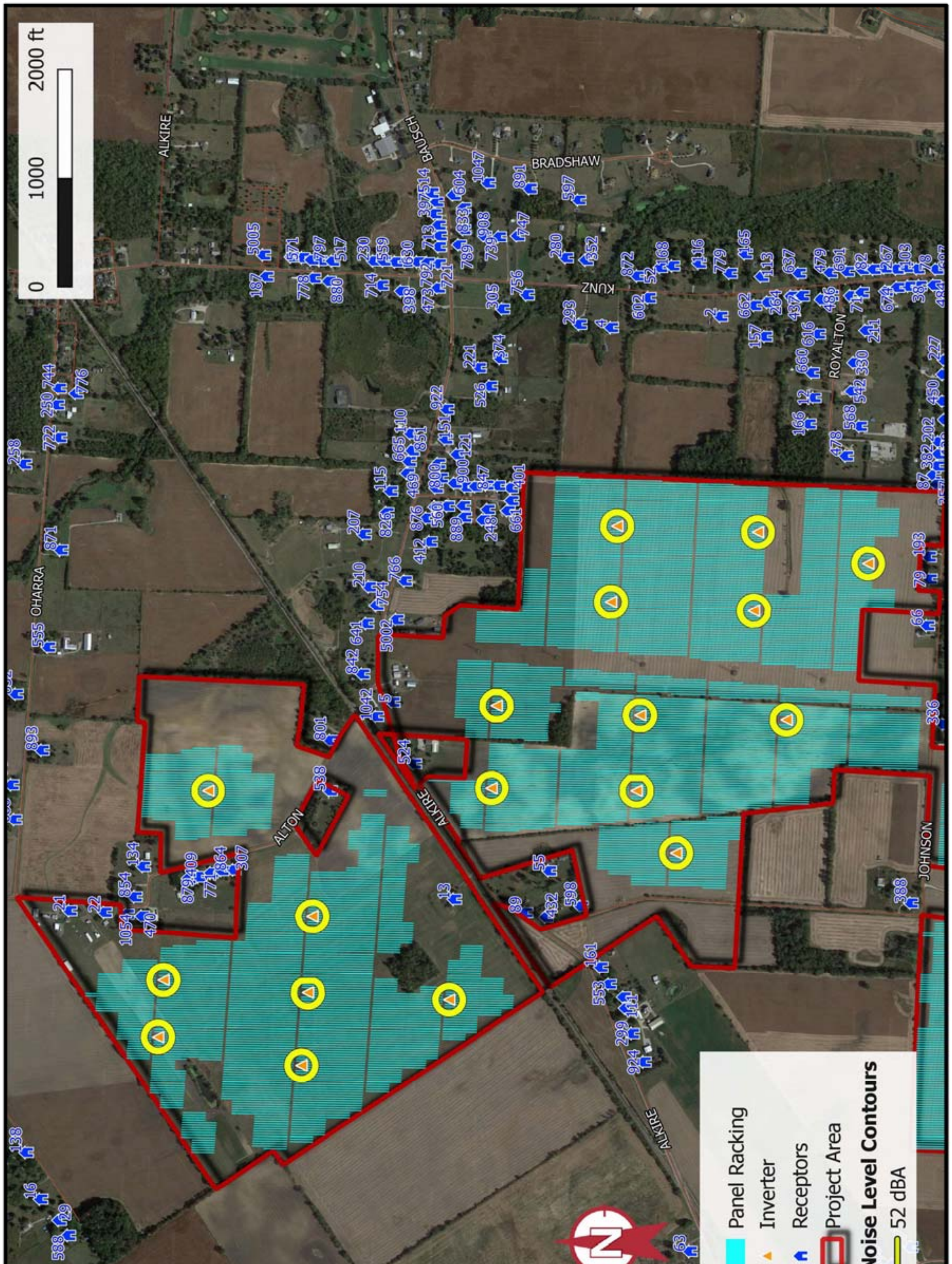

Figure 7-3. Predicted Daytime Operational Noise Level Contours –South-Central Area

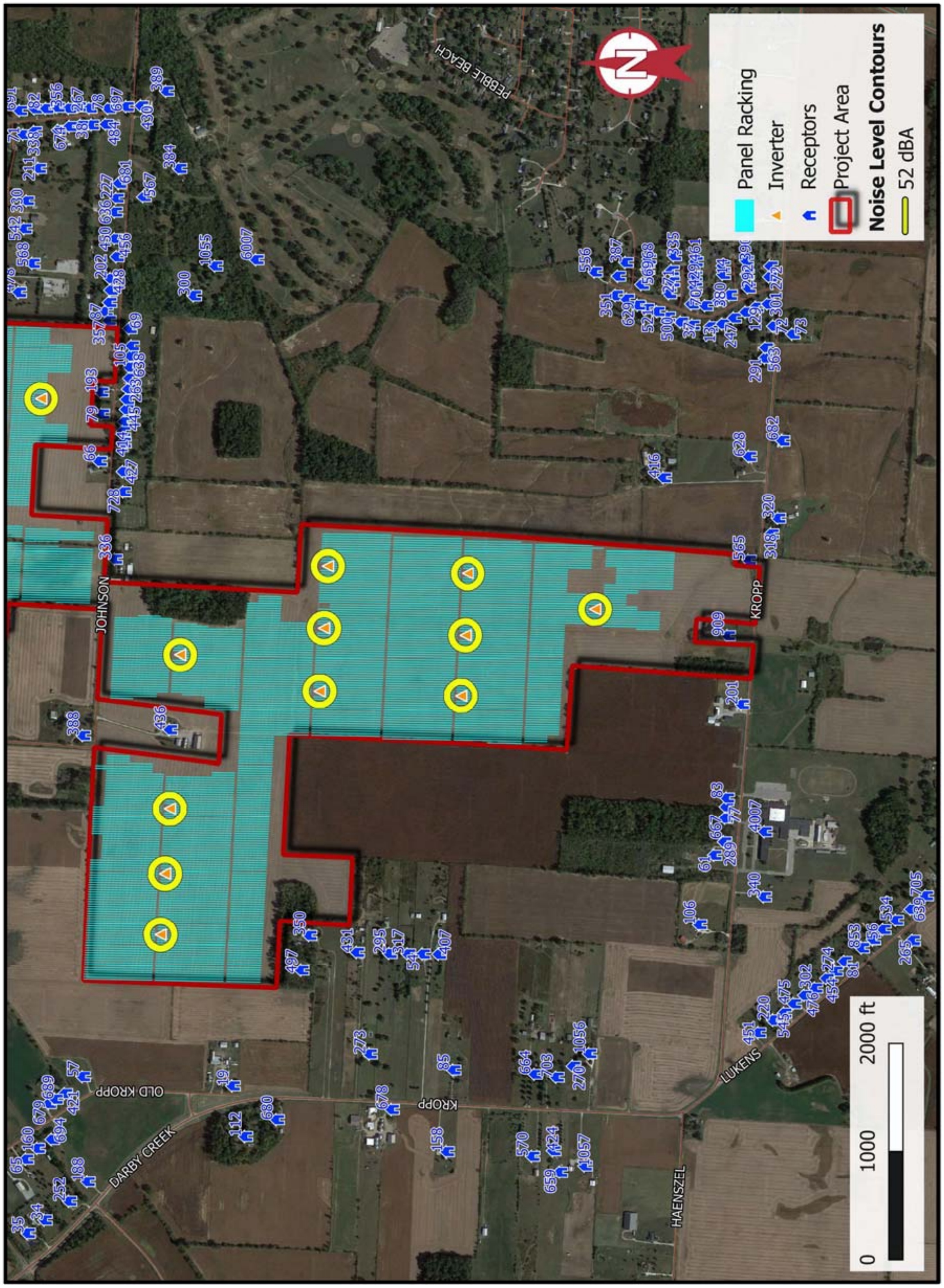

Figure 7-4. Predicted Daytime Operational Noise Level Contours – Southern Area