Noise and Traffic Assessment

Rhudes Creek Solar Project

December 17, 2021

Prepared for:

Kentucky Siting and Licensing Board
Kentucky Public Service Commission

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1. Introduction

1.1. Project Description

The proposed Rhudes Creek Project (Project) is located on 11 individual tax parcels (1,072 acres) in Hardin County, approximately 1-mile west of the unincorporated community of Cecilia, Kentucky (Figure 1). The Project has three (3) adjacent roadways: Kentucky State Route 86 (Hardinsburg Road), Hansborough Road, and S Black Branch Road. Federal highway access to US Route 62 and Interstate 65 are approximately 2.5 miles and 9.5 miles, respectively. Areas within and surrounding the Project are predominately agricultural with intermixed low-density residential.

The proposed Project would occur on approximately 1,072 acres and would feature the latest technology in utility-scale solar and includes bifacial solar modules that produce energy on the front- and backside of the panels, central type medium voltage inverter stations with integrated transformers, and single-axis mounting structure to track from east to west. The planned capacity of the Project is 100-megawatt alternating current (MWac). The Project would be enclosed by a security fence meeting the National Electrical Safety Code requirements, which would be generally located 100 feet inside of any property boundary. Strategic placement of vegetated buffers and 300-foot setbacks are proposed where visual impacts would be created by the Project.

The anticipated construction timeline for this Project is approximately 10-12 months. Once complete, the Rhudes Creek Project would be interconnected with Louisville Gas & Electric and Kentucky Utilities transmission network. The point of interconnection would be at a new switchyard with a three-breaker ring bus configuration on the existing Black Branch-Hardinsburg transmission line.

1.2. Existing Land Use and Project Conditions

According to the National Land Cover Database for Hardin County, the existing land use on the proposed Project is predominantly cultivated crops with sparsely scattered deciduous forests and hay fields throughout (Figure 2). Hardin County property appraiser classifies the properties within the Project as Farm or Residential. The Project is located within the rural residential zone (R-2). Aerial imagery shows isolated patches of forested and wooded corridors along streams, fence rows, and property boundaries throughout the Project (Figure 3). Additionally, there appear to be six farm ponds, numerous farm buildings (e.g., barns, silos, and sheds), and four residences within the proposed Project. Hardin County Property Valuation Administration assesses and values the surrounding land use as largely identical to that of the Project, with most properties being classified as farmland with residential parcels scattered throughout. A convenience store and a Fire Department Building are present north of the Project along Hardinsburg Road. Additional commercial properties (i.e. banks, gas stations, and a post office) are located further east on Hardinsburg Road near the unincorporated community of Cecilia, KY.

2. Noise Study

2.1. Nearest Receptor Sites

The nearest noise receptors (i.e., homes, businesses, schools, etc.) consist of scattered, low-density, residences interspersed in the vicinity of the Project (Figure 4). Four (4) residences are located within the project boundary (Participating Residences). The nearest Participating Residence is 137 feet from the planned structural components of the Project. All non-Participating Residences are located outside of the Project boundary and at least 300-feet from the nearest planned structural components of the Project. The nearest noise-sensitive facility (i.e., schools and libraries) is Cecilia Valley Elementary School approximately one-mile east of the proposed Project.

2.1.1. Existing Noise Conditions

According to Environmental Protection Agency (EPA) community noise reports, small towns and lightly used residential areas with interspersed agricultural activities are anticipated to have an ambient noise level around 50-60 A-weighted decibels (dBA). Based upon reasonable scientific judgment and practical experience in the Project area, the EPA-reported ambient noise levels are appropriate for use in this context. Contributors to this ambient noise level include:

- Major roadways including Hardinsburg Road, Hansborough Road, and S Black Branch Road which traverse along the northern, western, and within the eastern boundary of the Project. All are two-lane, rural highways that receive local traffic noise typical of rural farming areas (i.e., cars, trucks, and tractor trucks with trailering equipment). Existing traffic contributes to noise within the assessment area
- Active farmland, which contributes to noise typical of active hay production, crop planting and harvesting, and transportation of agricultural products and equipment. Noises associated with active farming typically range from 80 to 120 dBA and peak during normal business hours.

2.2. Construction Noise

2.2.1. Equipment and Machinery

The U.S. Department of Transportation Federal Highway Administration (FHWA) publishes noise levels for typical construction equipment as shown in the table below.

Equipment	Typical Noise Level (dBA) 50 feet from Sources
Air Compressor	81
Backhoe	80
Ballast Equalizer	82
Ballast Tamper	83
Chainsaw	85
Compactor	82
Crane Derrick	88
Crane Mobile	83

Equipment	Typical Noise Level (dBA) 50 feet from Sources
Dozer	85
Generator	81
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	85
Pickup Truck	55
Pile Driver (Impact)	101
Pile Driver (Sonic)	96
Pneumatic Tool	85
Pump	76
Rail Saw	90
Rock Drill	98
Roller	74
Saw	76
Scarifier	83
Scraper	89
Shovel	82
Spike Driver	77
Tie Cutter	84
Tie Handler	80
Tie Inserter	85
Tractor	84
Truck	88
Welder/Torch	73

Source: FHWA Construction Noise Handbook, 2009. Table based on EPA Report and measured data. Exact noise levels may vary depending on manufacturer and model.

2.2.2. Noise Associated with Project Preparation

Because the proposed Project is primarily open farmland, vegetation removal and land preparation noise would be equivalent to the current ongoing agricultural harvesting practices and the need for extensive tree removal and land clearing are not applicable. The construction of the Project would use equipment typical for Project development (i.e., graders, bulldozers, excavators, dozers, and dump trucks) with noises approximated in the table above.

2.2.3. Noise Associated with Installation

Assembly of the panel tracking system, the installation of solar panels, inverters, and other electrical equipment associated with the Project and substation would likely employ typical manual hand tools and power tools. These assembly

operations would occur 100 feet to thousands of feet inside the property boundary, would occur during normal business hours on weekdays, and any noise generated by power equipment would be short in duration.

2.2.4. Anticipated Noise Levels for Project Preparation and Installation

The table below presents temporary noise levels anticipated during the construction of the Project.

	Project Preparation	**Solar Array Installation**
Cumulative Noise Level at 50 feet (dBA)	85	90
Minimum Distance to non-Participating Residences (ft)	300	300
Noise Reduction at 300 feet (dBA)	-15.6	-15.6
Distance Attenuated Noise Level at non-Participating Residences	69.4	74.4

2.3. Operational Noise

2.3.1. Solar Array and Tracking System

The solar array includes single-axis mounting structures distributed evenly across the Project. Tracking systems involve the panels being driven by small, 24-volt brushless DC motors to track the arc of the sun to maximize each panel's potential for solar absorption. Panels would turn no more than five (5) degrees every 15 minutes and would operate no more than one (1) minute out of every 15-minute period. These tracking motors are a potential source of mechanical noise and are included in this assessment. The sound produced by typical panel tracking motors would be approximately 69.6 dBA at 3.3 feet from the source.

2.3.2. Inverters, Transformers, and Project Substation

The Project would employ approximately 27 small-scale, above ground inverter and transformer stations located throughout the solar arrays. According to the supplier's technical datasheet, the noise level of each inverter and transformer station will be 67 decibels at approximately 33 feet.

The Project substation would have a high voltage step up transformer. The high side voltage would be 138 kilovolts (kV) with a maximum power rating of 120 megavolt amperes (MVA). The noise levels specified by various suppliers range between 70 and 83 dBA at 5 feet from the source. The closest three adjoining residential dwellings are at 1765, 1801, and 2010 feet away.

2.3.3. Anticipated Noise Levels for Project Operations

The table below presents anticipated tracking motor noise levels at Participating Residences within 300-feet and non-Participating Residences within 500-feet.

Residence ID	Category	Distance to Closest Panel (ft)	Estimated Noise Level (dBA) of Operation Equipment (tracking motors)
A	Participating Residence	137	33.8
B	Participating Residence	243	28.8
C	Participating Residence	262	28.2
D	Participating Residence	264	28.1
1	Non-Participating Residence	411	24.3
2	Non-Participating Residence	305	26.9
3	Non-Participating Residence	311	26.7
4	Non-Participating Residence	333	26.1
5	Non-Participating Residence	498	22.6
6	Non-Participating Residence	340	25.9
7	Non-Participating Residence	370	25.2
8	Non-Participating Residence	442	23.6

The table below presents noise levels anticipated for the inverter and transformer stations during the operation of the Project.

	Adjacent non-Participating Residence 1	Adjacent non-Participating Residence 2	Adjacent non-Participating Residence 3
Cumulative Noise Level at 33 feet (dBA)	67	67	67
Distance to non-Participating Residence (ft)	417	830	879
Noise Reduction at Distance to non-Participating Residence (dBA)	-22	-28	-28.5
Distance Attenuated Noise Level at non-Participating Residence	45	39	38.5

The table below presents noise levels anticipated for the substation during the operation of the Project.

	Adjacent non-Participating Residence 1	Adjacent non-Participating Residence 2	Adjacent non-Participating Residence 3
Cumulative Noise Level at 5 feet (dBA)	83	83	83
Distance to non-Participating Residence (ft)	1765	1801	2010
Noise Reduction at Distance to non-Participating Residence (dBA)	-51	-51.1	-52.1
Distance Attenuated Noise Level at non-Participating Residence	32	31.9	30.9

2.3.4. Project Operation and Maintenance

2.3.4.1. Vehicular traffic

The operation of the Project would not have permanent on-site employment. Vehicular traffic for the Project would be limited to periodic facility inspection and maintenance. While dispatches are not anticipated on weekends, they remain a possibility in the event of a component outage that would require timely repair in order to limit production impact from the Project. Employees would be in mid- or full-sized trucks and would contribute less to traffic noise than a typical residence and farming activities that are already occurring in the area. With the exception of the scenarios mentioned above, vehicular traffic on the Project would be limited to typical weekday work hours.

2.3.4.2. Maintenance activities

Typical maintenance activities on the solar facilities would be minor repair and maintenance on the solar panels, tracking systems, electrical wiring, or maintenance/inspections of the inverters. Grounds maintenance would be performed through an integrated land management approach, to include biological and mechanical control of vegetation, with herbicide applications as appropriate to control regulated noxious weeds per local, state, and federal regulations. Noise generated from these maintenance activities would contribute less than a typical residence and farming activities that are already occurring in the area.

2.4. Noise Impact Summary and Conclusions

Noise during the construction phase is expected to temporarily increase during daylight hours, and would be in the form of heavy equipment, passenger cars and trucks, and tool use during assembly of the solar facilities. Noise would be present on the Project during construction; however, due to the size of the Project, construction timing, and the distance to the nearest receptors, construction would not contribute to a significant noise increase compared to noise currently occurring (i.e., the operation of farming equipment, hay production, crop harvesting). In addition, periodic noise associated with solar panel tracking system and the relatively constant noise of inverters and transformers, would occur during operation. The noise produced by the inverters is 67.0 dBA, which is slightly above that of a typical person-to-person conversation (i.e., 60.0). Inverters may be located as close as 137 feet from the nearest noise receptor (i.e., residences). However, this increase in noise would be negligible and would not be a major contributor of noise to the nearest receptor. Project site visits and maintenance activities, such as mowing, would take place during daylight hours and would not significantly contribute to noise.

Sound levels generated by construction activities used on the Project are anticipated to range from 70 to 114 dBA at the source. Construction activities are designed to be conducted in phases. Noise generating activities would be temporary, ending once construction has been completed and taking place during the hours of 6 AM to 9 PM from Monday to Friday. The largest contributor of construction noise is expected to be pile driving equipment (approximately 114 dBA at three feet from source) used in the construction of the solar panel racking system. The pile driving phase would be completed at each pile before moving to the adjacent workspace to drive the next pile in sequence. This method results in short-term noise impacts from the pile driving at each location.

The table below presents anticipated pile-driving noise levels at Participating Residences within 300-feet and non-Participating Residences within 500-feet.

Residence ID	Category	Distance to Closest Panel (ft)	Estimated Noise Level (dBA) of Loud Construction Equipment (pile driver)
A	Participating Residence	137	81.2
B	Participating Residence	243	76.3
C	Participating Residence	262	75.6
D	Participating Residence	264	75.5
1	Non-Participating Residence	411	71.7
2	Non-Participating Residence	305	74.3
3	Non-Participating Residence	311	74.1
4	Non-Participating Residence	333	73.5
5	Non-Participating Residence	498	70.0
6	Non-Participating Residence	340	73.3
7	Non-Participating Residence	370	72.6
8	Non-Participating Residence	442	71.1

Using data from similar solar projects, the anticipated ambient daytime sound level for the area surrounding the Project is anticipated to be 50 to 60 dBA. The minimum setback for non-Participating Residences would be 300-feet.

The Project will employ multiple mitigative measures to ensure noise levels are kept at a safe level for on-site employees and ensure minimal disruption for neighboring properties. Internal controls focus on the time of day when pile driving is allowed on site as well as limiting the continuous duration of driving activities to reduce exposure for on-site personnel. Pile driving can only occur from 8am to 5pm on site and each driver can only run for 1 hour at a time followed by a 15-minute safety stand down. Installation of vegetation buffers and plantings of trees on site are strategically planned for early-stage construction to reduce and muffle the potential for construction noise to make it off site. Rhudes Creek Solar has not estimated the additional cost for noise suppression methods.

It is anticipated that it will cost $500,000 to $750,000 for increased vegetative buffer as well as the cost multiplier for newer-age equipment that ibV requires our subcontractors to utilize as well as the decibel measuring devices that are deployed by the safety and quality team to monitor on site levels. ibV also requires their subcontractors to reduce the frequency of multiple pile drivers working in the same area during construction – this process reduces the production rate which causes ibV to incur additional man hours and labor costs.

Additional options ibV deploys on the Project is to design the arrays in such a way that keeps noise generating activities as far from neighboring homes as feasible. Building of permanent and stationary sound barriers are an option that ibV has opted not to deploy given the capital expense and noise levels not being significant enough to require such measures.

3. Traffic Study

3.1. Existing Road Network and Traffic Conditions

The Project would be directly adjacent to a state highway route (KY 86 – Hardinsburg Road) and two county roads (Hansborough Road and S Black Branch Road). These roadways are two-lane rural highways that provide access to unincorporated Cecilia, Kentucky which is located approximately 1-mile east of the Project and its surrounding areas. Hardinsburg Road would provide the primary access to the Project for the construction and subsequent operation. The main driveway access would improve an existing driveway located on the southside of Hardinsburg Road at 37°39'46.94"N, 85°59'49.43"W. A secondary driveway access to the transmission easement and point of interconnection would be a newly constructed road on the northside of Hardinsburg Road at 37°39'55.47"N, 86° 0'9.35"W. Upon a field visit and review in April 2021, the Kentucky Transportation Cabinet District 4 Engineer confirmed that neither the existing nor the newly proposed driveways would have sight distance issues or present a safety hazard for roadway users.

The Average Daily Traffic (ADT) is defined as the total volume of traffic passing a point, or segment, of a road, in both directions, during a period of time, divided by the number of days in the period and factored to represent an estimate of traffic volume for an average day of the year. There are two ADT monitoring stations in the project vicinity; both along Hardinsburg Road (KY 86). The ADT information in the project vicinity is summarized in the table below.

Station ID	Roadway	Location and Distance (miles) and Direction from the Property Access Drives	ADT (average number of vehicles / 24-period)	Year Assessed
047753	KY 86	0.17 Miles west of the primary Project access driveway	9.5	2018
047263	KY 86	3.1 miles east of the primary Project access driveway	10.5	2018

3.2. Construction Traffic

During the approximately 10-12 month construction period, a temporary increase in traffic volume associated with travel of construction laborers, delivery of construction equipment and material, delivery of solar panel components and equipment is anticipated during the hours of 6 AM and 9 PM from Monday to Friday. There would be up to 150 construction employees and parking would be onsite. Employees' transportation to the site will be a mix of modes, with most entry-level workers and temporary laborers carpooling each day via the subcontractor-provided vanpool. The remaining contractors will arrive via personal vehicle or contractor assigned work truck. Personal cars and work trucks will also

consistently carpool a full vehicle's worth of employees. Contractors are incentivized to have their employees carpooled to the site by only being permitted a limited number of on-site parking spots. Laborer commutes with passenger vehicles and trucks would occur daily with two traffic peaks (i.e., morning peak and afternoon peak), whereas deliveries of equipment would occur on trailers, flatbeds, or other large vehicles peaking during the first three months of construction. The number and approximate weight classes of the trucks anticipated on site per day during the construction phase are as follows: five class 2 trucks, four class 4 trucks, four class 6 trucks, two class 7 trucks and ten class 8 tractor trailers per day only during the two-month delivery phase. The estimate weight of the Project's required substation transformer is approximately 140 tons and will be delivered using a Grove GRT9165 Rough Terrain Crane.

With a heavy vehicle adjustment, the construction of the facility could add up to 200 passenger car equivalent vehicles per day. Due to the low traffic volumes that exist near the Project, the increase in 200 vehicles per day during construction are not expected to adversely impact traffic and would be temporary. The temporary increase in traffic volumes is not anticipated to have adverse impacts on the surrounding area. Traffic impacts during operations would be negligible as the facility would not have any permanent employment and would only generate a minor volume of vehicle trips for periodic facility inspection and maintenance.

3.2.1. Traffic Safety Precautions

Lane closures are not anticipated along Hardinsburg Road, Hansborough Road, or S Black Branch Road for the construction of the Project. However, the presence of signage, signaling, flagmen, and temporary lane closures may be employed to reduce risk of collision on the roadway. For instance, the presence of a flagman to temporarily stop traffic to allow for a delivery truck and trailer to safely turn into the Project may be necessary at times of equipment deliveries. Appropriate signage of trucks entering the highway or slow-moving vehicles would be used to notify oncoming traffic.

3.2.2. Impact on Road Infrastructure

Significant degradation to the existing roadways is not anticipated for the proposed project. The increase in localized traffic and the continued entry and exit of heavy trucks or equipment has potential to result in additional wear of the existing roadway or shoulders of S Black Branch Road, Hansborough Road, and Hardinsburg Road. The contractor would be accountable for documenting conditions of roadways prior to the start of work in accordance with applicable permits and local authorities and would be responsible for restoring impacted roads to preconstruction conditions as necessary.

Access drives and internal roads would be constructed or improved as needed to accommodate appropriate vehicles and equipment to construct the proposed Project.

3.3. Operational and Maintenance Traffic

The operation of the Project would not provide permanent on-site employment. Personnel would be limited to facility inspection to ensure proper equipment operation and note any maintenance needs. Maintenance would occur periodically with more frequent landscape maintenance occurring during the vegetative growing season. Employees would be in

mid- or full-sized trucks and would contribute less to vehicle traffic than a typical residence. Vehicular traffic on the Project would be limited to typical weekday work hours and would not significantly contribute to additional traffic in the project vicinity.

3.4. Traffic Summary and Conclusions

Traffic in the project vicinity is predicted to increase temporarily during the 10-12 month construction phase of the project. This includes daily morning and evening peaks for construction laborers entering and exiting the Project and periodic delivery of construction materials and equipment. Appropriate signage and traffic directing would occur as necessary to increase driver safety and reduce risk of collisions for approaching traffic. There are no anticipated damages to the existing roadway infrastructure. For facility operation and maintenance, there is no significant increase in traffic (i.e., the expected traffic to be contributed to the area would be less than a typical residence home).

4. Fugitive Dust Impacts

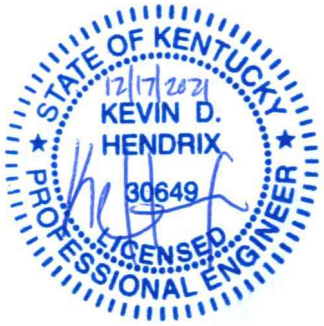
Land disturbing activities associated with the Project would have minor temporary fugitive dust impacts. To reduce wind erosion of recently disturbed areas, appropriate revegetation measures, application of water, or covering of spoil piles may occur. Existing gravel roads currently used for agricultural activities would be further improved to handle the construction and maintenance traffic. The Project design retains the majority of the existing topography. Excavation and earthwork would be minimal, and the ground disturbances would be completed in phases so that soil can be stabilized before starting work on other areas of the site. Additionally, mitigative measures include retaining natural windbreaks and barriers, frequent water applications to wet surfaces and prevent fugitive dust, reduced speed on site and control of vehicle access, washing equipment prior to leaving the site, covering open trucks, and using gravel compacted roads for construction and maintenance would be used to minimize impacts.

5. Impacts to Rail

There is one Class II railroad line owned and operated by Paducah & Louisville Railway and managed by Omega Rail Management that passes through the eastern portion of the Project. The railroad real estate and right-of-way is managed by Omega Rail Management, who administers the permitting process on behalf of the Railway. The line currently serves freight for commercial and industrial customers. An existing, at grade crossing (#925-621 C) is located within the Project. This crossing is permitted and utilized by landowner for agricultural activities. Omega Rail Management has provided clear instructions and requirements for safety and operating procedures during construction in the document titled *CE-8 REV 3-97 Specifications for Pipeline Occupancy of Railroad Property*. The impacts of the Project encroachments on the rail line are to be minimal leading up to and during construction. After construction is complete, crossing encroachments of the rail line would be limited to periodic inspections and maintenance activities.

Signature of Professionals

Michael Savage
Environmental Services
Project Manager



Kevin Hendrix, PE, LEED AP
Civil Engineering
Discipline Director

Figures 1-4

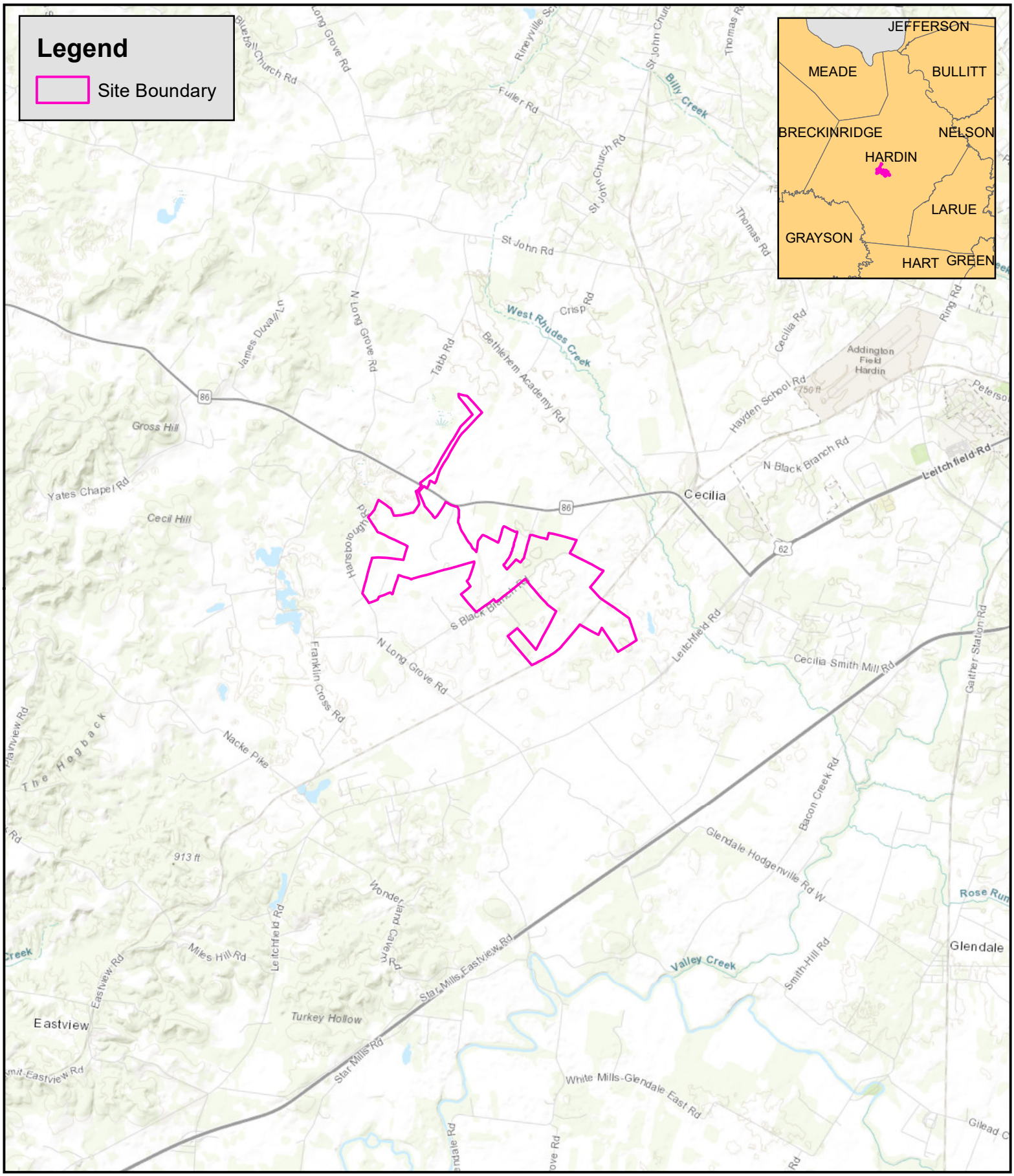


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Figure 1 - Project Location Map

Rhudes Creek Solar Project
Hardin County, Kentucky
December 2021

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0 0.5 1 2 Miles

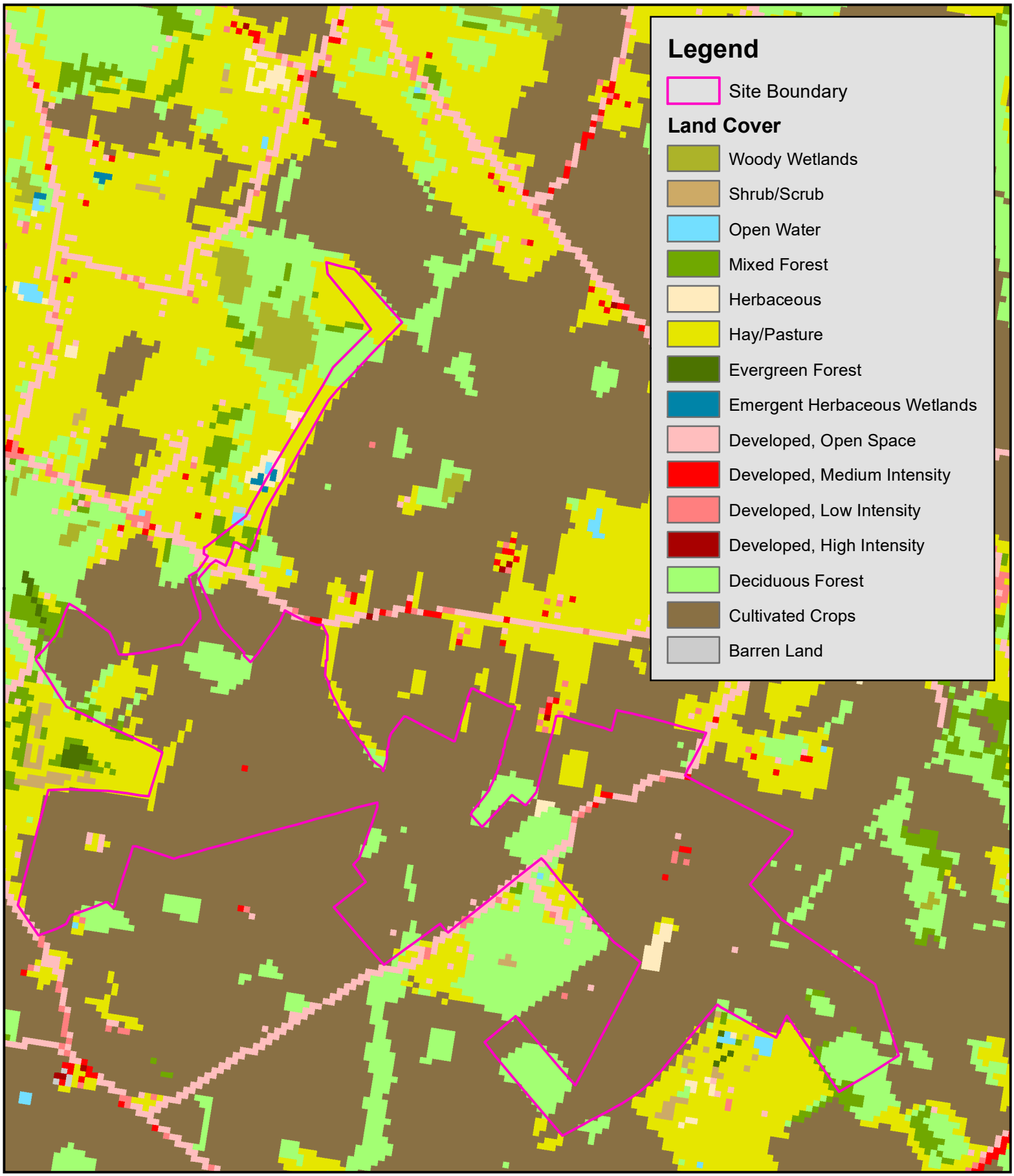

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Figure 2 - Land Use Map

Rhudes Creek Solar Project
Hardin County, Kentucky
December 2021

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0 0.25 0.5 1 Miles

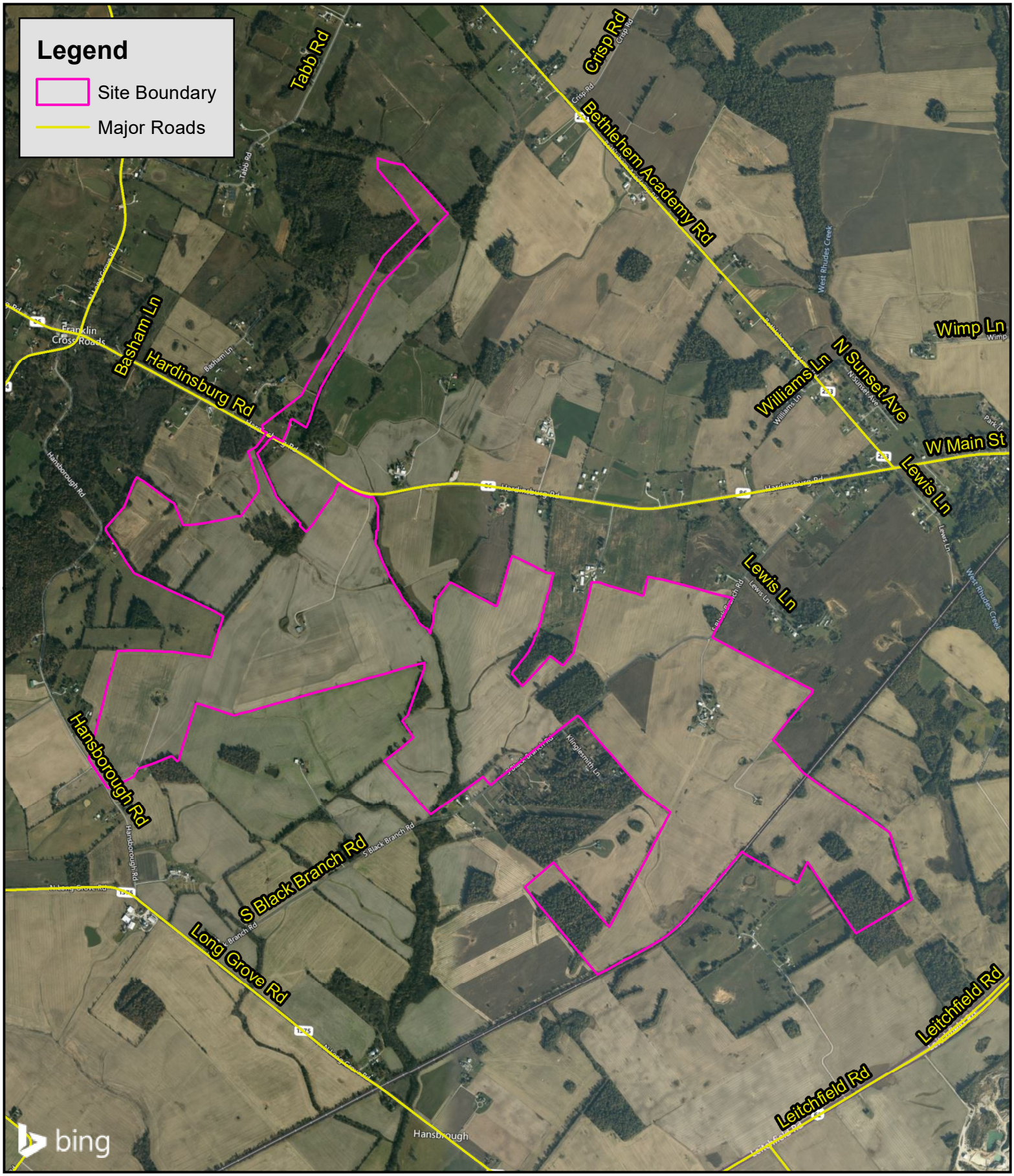

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Figure 3 - Aerial Map

Rhudes Creek Solar Project
Hardin County, Kentucky
December 2021

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0 0.25 0.5 1 Miles

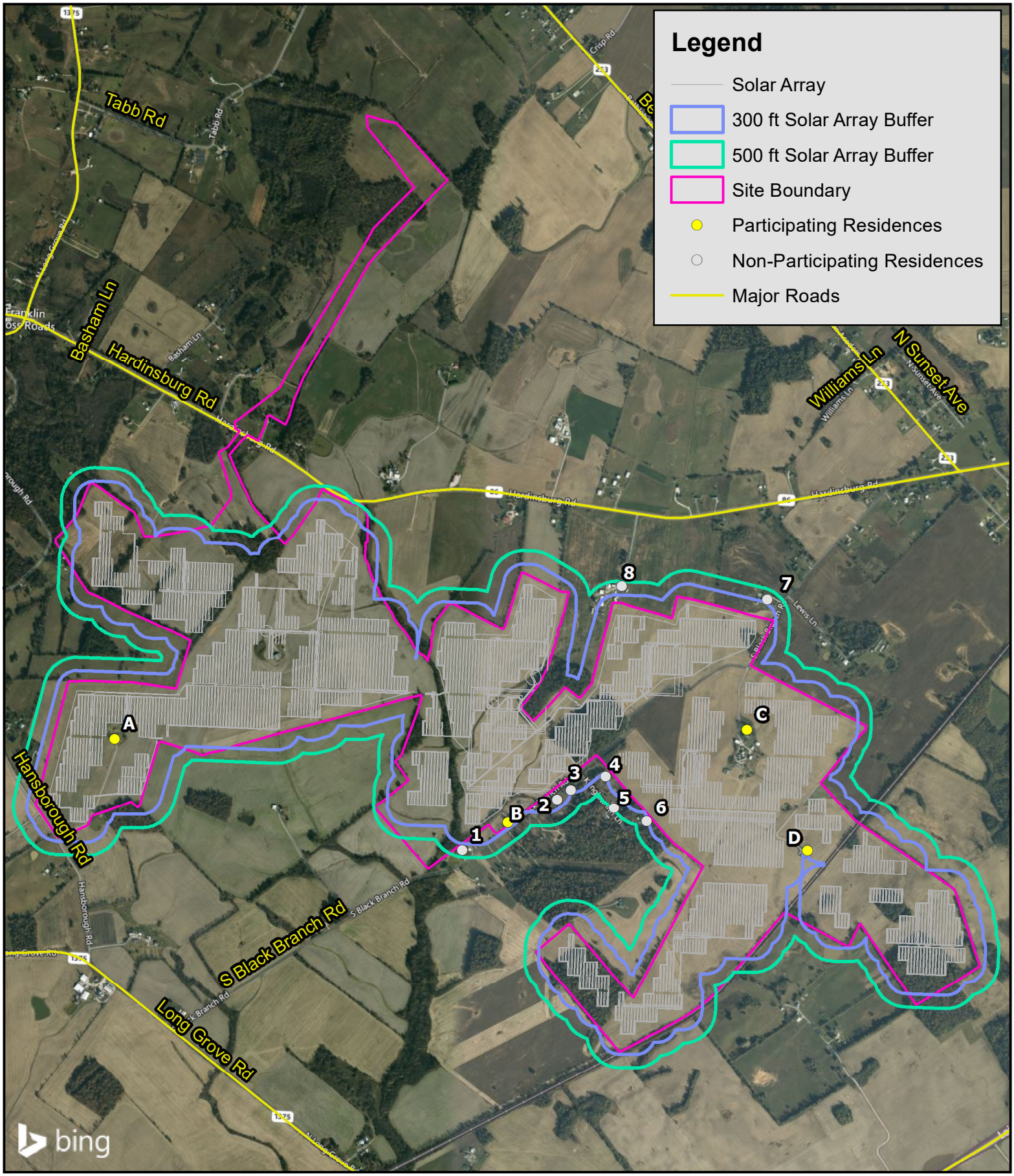

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Figure 4 - Noise Receptor Map

Rhudes Creek Solar Project
Hardin County, Kentucky
December 2021

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0 0.25 0.5 1 Miles