Noise Technical Report

Dogwood Geothermal Energy Project

Heber 2 Solar Energy Project

Heber Field Company Geothermal Wells &Pipeline Project

Prepared for: Imperial County Planning & Development Services
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March 15, 2024

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SECTION 1 Introduction

Catalyst Environmental Solutions Corporation (Catalyst) has prepared this report to evaluate the potential for impacts related to noise resulting from implementation of the proposed Dogwood Geothermal Energy Project, Heber 2 Parasitic Solar Project, and the Heber Field Company Geothermal Wells and Pipeline Project (collectively, the Project) in the Imperial County, California. This report includes an evaluation of potential impacts associated with temporary and permanent increases in noise in the vicinity of the Project site and whether Project-induced noise is in excess of standards established by the applicable local jurisdiction (i.e., Imperial County). Site-specific construction and operations activity information used for noise models are based on information provided by ORMAT.

1.1 Project Overview

1.1.1 Project Location and Description

The Dogwood Project entails the development of a 25 MW (net generation) geothermal power plant that will include one ORMAT Energy Convertor (OEC), cooling towers, two isopentane tanks, a supplemental solar field, up to three production wells, a project substation, and ancillary facilities. The Project site includes the existing Heber 2, Heber South, and Goulds 2 geothermal power stations, on Assessor's Parcel No. (APN) 054-250-31-01, a 39.99-acre parcel that is approximately ¾ mile southwest of the town of Heber. The Dogwood geothermal facilities would be supplemented by an auxiliary solar field. The location for the supplemental solar photovoltaic field is still under consideration but will likely be near the Dogwood Project site. The solar photovoltaic field will provide behind-the-meter power used to offset the auxiliary load of the facility. Proposed facilities include:

- **Dogwood Project (OrHeber 3, LLC) – New CUP**
    - One (1) Integrated Two Level Unit (ITLU) Air Cooled ORMAT Energy Converter (OEC) generating unit
    - Two (2) 20,000-Gallon Isopentane Tanks for Motive Fluid Storage
    - One (1) Project substation for transmission to the grid
    - Ancillary and auxiliary facilities (including, compressed air system and fire prevention system)
    - A seven (7) megawatt (MW) solar photovoltaic field dedicated to the Dogwood geothermal plant
    - Interconnecting cable line from Dogwood solar facilities to Dogwood geothermal plant
- **Heber 2 Parasitic Solar Energy Facilities (Second Imperial Geothermal Company) – Amendment to CUP No. 19-0017**
    - A fifteen (15) MW solar photovoltaic field dedicated to the Heber 2 geothermal plant
    - Interconnecting cable line from Heber 2 solar facilities to Heber 2 geothermal plant

- **Wells and Pipeline (Heber Field Company, LLC) – Amendment to CUP No. 06-0028**
  - Up to six (6) new production wells (3 sited, 3 unsited)
  - One (1) new injection well
  - Brine pipelines

The Dogwood Project would rely on fluid from the existing wellfield and up to three (3) new production wells proposed by the Heber Field Company (HFC) which owns and operates the wells that service the Heber 2, Heber South, and Goulds 2 facilities. HFC also proposes to utilize the existing available injection capacity from an existing well on-site and one (1) new injection well that would be installed on-site adjacent to the Dogwood Project. The location of the new production and injection wells has not been finalized, but would be within 1-mile from the Dogwood Project site. HFC would install new on-site connections and pipelines segments to connect the Dogwood Project with the new and existing well system. The total project area of disturbance from the proposed development is approximately 124 acres as summarized in **Table 1**.

Table 1. Dogwood Project Area of Disturbance Estimates

Facility	Disturbance (Acres)
Geothermal Energy Facilities and Project Substation	5.0 acres
Solar Field and Connection Line	~95 acres
Production and Injection Wells and Connecting Pipeline	~24 acres
TOTAL	**124 acres**

1.1.2 Geothermal Production and Injection Wells

HFC will complete geothermal production wells in compliance with California Geologic Energy Management Division (CalGEM) Regulations (California Code of Regulations, Chapter 4, Subchapter 4) to depths between 1,000 and 4,000 feet, averaging approximately 3,500 feet. These wells are in the locating/siting process but are likely to be located within 1-mile of the proposed Dogwood Project. Casing depth will vary depending on the total depth of the well. After the well is completed, a well head will be installed and connected to a new transmission pipeline that will convey geothermal fluid to the Dogwood Project (as discussed below). An insulated electric conductor running from the OEC to the wellheads along the connecting pipelines will supply electricity to the wellhead pump motors. During normal well operations, total geothermal fluid production rates are expected to be approximately 8,000 gallons per minute (gpm) at 280°F.

One new injection well would be installed directly adjacent to the Dogwood plant. This well would also be owned and operated by HFC. This well is designed to provide direct service to the Dogwood Project, in addition to the available capacity in the existing HFC injection well/system. Injection will occur at the same approximate levels (i.e., 8,000 gpm) but at lower temperatures of approximately 170°F. Individual production well flow rates are expected to be approximately 4,000 gpm, with a wellhead pressure of about 100 pounds per square inch.

1.1.3 Geothermal Fluid Pipeline

Geothermal fluid and brine pipelines proposed by HFC will be used to transport geothermal fluid from the production wells to the Dogwood Project, the cooling unit, and the injection wells. Construction of the pipeline network will include auguring 24-inch diameter holes into the ground about three to five feet deep at approximately 30-foot intervals along the pipeline route. When complete, the top of the new geothermal pipelines will average three feet above the ground surface. Electrical power and instrumentation cables for the wells may also be installed in steel conduit constructed along the pipe.

1.1.4 ORMAT Energy Converter (OEC)

The proposed OEC unit is a two-turbine combined cycle binary unit, operating on a subcritical Rankine cycle, with isopentane as the motive fluid. The OEC system consists of a generator, turbines, a vaporizer, Air-Cooled condensers, preheaters and recuperators, and an evacuation skid/vapor recovery maintenance unit (VRMU) for purging and maintenance events. The design capacity for the unit is 25 MW (net).

1.1.5 Isopentane Storage Tanks

Two double-walled 20,000-gallon above-ground storage tank (AST) will be installed for the Project. Numerous safety and fire prevention measures will be installed on/near the isopentane tanks, including:

- Concrete foundations with blast walls separating the tank from the OEC
- An automated water suppression system.
- Concrete containment areas.
- Two flame detectors, which will immediately detect any fire and immediately trigger the automatic fire suppression system.
- A gas detector, which will immediately detect any isopentane leak and notify the control room (manned by 24/7).

1.1.6 Cooling Tower

A cooling tower array will perform air-cooling operations of the geothermal fluid. The cooling tower will include a series of heat-absorbing evaporators and condensers to capture and transfer heat stored in the geothermal fluid.

1.1.7 Supplemental Solar Energy Plant

An approximately 7 MW (net) solar photovoltaic field would provide power directly to the Dogwood Project to offset auxiliary/parasitic loads during operations. The solar arrays will effectively reduce the margin between gross and net geothermal energy generation, allowing for the more efficient generation of geothermal energy.

The solar facility will not connect to the substation or generate power that will enter the transmission grid; rather, the solar facility will be entirely behind-the-meter and would serve as an integrated part of the operation of the geothermal power plant.

1.1.8 Project Substation

The Project will require a new substation to step up the low voltage electrical energy generated at the Dogwood Project to the higher voltage required for transmission. No upgrades to the off-site transmission will occur, and the Dogwood substation will connect directly to the existing point of interconnection with the Imperial Irrigation District controlled grid. The substation will include a 13.8 kV circuit breaker to protect the electric generator, a minimum of 80 megavolt ampere 13.8 kV/115 kV transformer, and 115 kV potential and current transformers for metering and system protection.

1.1.9 Water Use and Source

Water required for well drilling would typically average 50,000 gpd. Water necessary for road grading, construction, and dust control would average approximately 4,000 gpd. Water necessary for these activities would be obtained from local irrigation canals in conformance with Imperial Irrigation District (IID) requirements. Alternatively, a temporary pipeline from the respective irrigation canal could be used for water delivery to well site. Any temporary pipeline would be lain on the surface immediately adjacent to the access road. The Project will not require additional water from the IID for operations and will be covered under the existing contract.

1.2 Construction Activities

The Project is anticipated to take 16 to 24 months to install, test, and become fully operational as summarized in **Table 2.**

Table 2. Project Construction Process/Phasing

Construction Phase	Tentative Schedule	Total Duration
Site Preparation (Plant and Solar Fields)	2 Months	35 Months
Project Construction	16 Months	
Well Drilling and Pipe Interconnection	12 Months	
Substation Development and Interconnection	4 Months	
Testing	1 Month	

The estimated construction equipment and vehicle and truck trip counts associated with construction activities are detailed **Table 3** and **Table 4**, respectively.

Table 3. Project Construction Equipment List by Project Activity

Construction Phase	Equipment	Quantity	No. Days Used	Daytime Operating Hours	Nighttime Operating Hours	Typical L_{max} (dBA) at 50 feet from Source[1]
Site Preparation (Plant Site and Solar Fields) (2 Months)	Heavy Duty Trucks	3	30	5	0	76
	Excavator	1	30	8	0	81
	Roller	2	30	8	0	80
	Light-Duty Truck	8	30	4	0	75
Project Construction (16 Months)	Aerial Man Lifts	8	160	6	0	75
	Excavator	1	40	8	0	81
	Crane	2	160	6	0	81

Construction Phase	Equipment	Quantity	No. Days Used	Daytime Operating Hours	Nighttime Operating Hours	Typical L_{max} (dBA) at 50 feet from Source[1]
	Forklift	1	40	8	0	75
	Forklift	6	245	8	0	75
	Generator Set	1	320	8	0	81
	Grader	1	30	8	0	85
	Heavy Duty Trucks	2	90	8	0	76
	Rubber Tired Loader	1	30	8	0	84
	Backhoe	1	30	8	0	78
	Welders	15	245	6	0	74
	Light Duty Truck	1	40	4	0	75
	Light Duty Truck	15	245	4	0	75
Well Drilling and Pipe Interconnection (12 Months)	Light Tower	2	90	0	9	73
	Drill Rig	1	180	15	9	84
	Rig Mud Pump	1	180	15	9	81
	Rig Generator	1	180	15	9	81
	Heavy Duty Trucks (Mob/Demob)	8	24	8	0	76
	Crane	2	24	2.5	2.5	81
	Backhoe	1	24	6	0	78
	Forklift	1	24	6	0	75
	Vacuum Truck	1	24	10	0	85
	Concrete Truck	1	3	4	0	79
	Concrete Pumper	1	3	4	0	81
	Light Duty Truck	4	24	4	0	75
Substation Development and Interconnection (4 Months)	Crane	1	80	8	0	81
	Bore/Drill Rig	1	80	8	0	84
	Aerial Lift	2	80	8	0	81
	Heavy Duty Trucks (Delivery)	2	20	4	0	76
	Backhoe	1	14	8	0	78
	Forklift	1	80	8	0	75
	Ditch Digger	1	20	8	0	78
	Generator Set	2	80	8	0	73
	Light Duty Truck	5	80	4	0	75
Testing (1 Months)	Generator	1	30	15	9	81
	Light Tower (27 hp)	2	30	3	9	73
	Light Tower (9 hp)	2	30	3	9	73
	Pump (115 hp)	1	30	15	9	81
	Pump (415 hp)	1	30	15	9	81
	Light Duty Truck	1	30	4	0	75

Notes:

Adapted from FHWA Roadway Construction Noise Model User's Guide (FHWA 2006)

Table 4. Construction Vehicle Trips

Construction Phase	Trip Type	Number of One-Way Trips per Day	One-Way Trip Length (miles)[2]
Site Preparation	Workers[1]	46	10.2
	Vendor	10	11.9
	Haul	8	20
Project Construction	Workers[1]	46	10.2
	Vendor	40	225
	Haul	2	20
Well Drilling and Pipe Interconnection	Workers[1]	46	10.2
	Vendor	10	11.9
	Haul	0	20
Substation Development and Interconnection	Workers[1]	46	10.2
	Vendor	10	11.9
	Haul[3]	0	20
Testing	Workers[1]	46	10.2
	Vendor	4	11.9
	Haul	0	20

Notes:

1 Trip generation rate is calculated at roughly 3 trips/worker (assumed 50 percent of 15 workers leave/return once during the day) for a total of 46 trips, and 2 trips/vehicle (in/out) for vendor and haul trips.

2 Trip lengths consist of default CalEEMod values with exception of vendors for delivery of Project equipment during construction, with deliveries of solar panels, geothermal equipment, etc. assumed to originate at Port of Long Beach, approximately 225 miles from Project site.

3 All truck trips are assigned to vendor deliveries.

1.3 Operation Activities

Once the proposed Project is complete, the site will be staffed with 1-2 onsite employees. The proposed Project would require routine maintenance and unscheduled maintenance as needed. The parasitic solar facilities will be monitored remotely with visitation on an as-needed basis, and security personnel will perform periodic site visits. Any required planned maintenance activities would generally consist of equipment inspection and replacement and would be scheduled to avoid peak load periods. Any unplanned maintenance would be responded to as needed, depending on the event.

SECTION 2 Fundamental of Noise and Vibration

2.1 Fundamentals of Sound and Environmental Noise

Sound is mechanical energy transmitted by pressure waves in a compressible medium such as air. When sound becomes excessive or unwanted, it is referred to as noise. Although exposure to high noise levels has been demonstrated to cause hearing loss, the principal human response to environmental noise is annoyance. The response of individuals to similar noise events is diverse and influenced by the type of noise, the perceived importance of the noise and its appropriateness in the setting, the time of day and the type of activity during which the noise occurs, and the sensitivity of the individual.

Sound (noise) levels are measured and quantified with several metrics. All of them use the logarithmic decibel (dB) scale with 0 dB roughly equal to the threshold of human hearing. A property of the decibel scale is that the sound pressure levels of two separate sounds are not directly additive. For example, if a 50 dB sound is added to another 50 dB sound, the total is only a 3 dB increase (to 53 dB). Thus, every 3 dB change in sound levels represents a doubling or halving of sound energy. Related to this is the fact that a less-than-3 dB change in sound levels is imperceptible to the human ear. Sound power level is the acoustic energy emitted by a source which produces a sound pressure level at some distance. While the sound power level of a source is fixed, the sound pressure level depends upon the distance from the source and the acoustic characteristics of the area in which it is located.

The frequency of sound is a measure of the pressure fluctuations per second, measured in hertz (Hz). Most sounds do not consist of a single frequency but consist of a broad band of frequencies differing in level. The characterization of sound level magnitude with respect to frequency is the sound spectrum. Many rating methods exist to analyze sound of different spectra. The method used for this analysis is A-weighting (there are also B- and C-weighting filters). The A-weighted scale (dBA) most closely approximates how the human ear responds to sound at various frequencies by progressively deemphasizing frequency components below 1,000 Hz and above 6,300 Hz and reflects the relative decreased sensitivity of humans to both low and extremely high frequencies (Federal Highway Administration [FHWA] 2018). **Table 5** lists typical sound levels from representative sources.

Table 5. Typical Noise Levels (Measured at a Distance a Person Would Typically be From the Source)

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	— 110 —	Rock band
Jet fly-over at 1,000 feet	— 100 —	
Gas lawn mower at 3 feet	— 90 —	
Diesel truck at 50 feet at 50 miles per hour	— 80 —	Food blender at 3 feet, Garbage disposal at 3 feet
Noisy urban area, daytime, Gas lawn mower at 100 feet	— 70 —	Vacuum cleaner at 10 feet, Normal speech at 3 feet
Commercial area, Heavy traffic at 300 feet	— 60 —	
Quiet urban daytime	— 50 —	Large business office, Dishwasher next room

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
Quiet urban nighttime	— 40 —	Theater, large conference room (background)
Quiet suburban nighttime	— 30 —	Library, Bedroom at night
Quiet rural nighttime	— 20 —	
	— 10 —	Broadcast/recording studio
Lowest threshold of human hearing	— 0 —	Lowest threshold of human hearing

Source: California Department of Transportation (CalTrans) 2013

The duration of noise and the time period at which it occurs are important factors in determining the impact of noise. Several methods are used for describing variable sounds including the equivalent level (L_{eq}), the maximum level (L_{max}), and the percent-exceeded levels. These metrics are derived from a large number of moment-to-moment A-weighted sound level measurements. Some common metrics reported in community noise monitoring studies are described below:

- L_{eq}, the equivalent level, can describe any series of noise events of arbitrary duration, although the most common averaging period is hourly. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events, and L_{eq} is the common energy-equivalent sound/noise descriptor.
- L_{max} is the maximum sound level during a given time. L_{max} is typically due to discrete, identifiable events such as an airplane overflight, car or truck passing by, or a dog barking.
- L_{90} is the sound level in dBA exceeded 90 percent of the time during the measurement period. L_{90} is close to the lowest sound level observed. It is essentially the same as the residual sound level, which is the sound level observed when no obvious nearby intermittent noise sources occur.
- L_{50} is the median sound level in dBA exceeded 50 percent of the time during the measurement period.
- L_{10} is the sound level in dBA exceeded only 10 percent of the time. It is close to the maximum level observed during the measurement period. L_{10} is sometimes called the intrusive sound level because it is caused by occasional louder noises like those from passing motor vehicles.

In determining the daily measure of community noise, it is important to account for the difference in human response to daytime and nighttime noise. Noise is more disturbing at night than during the day, and noise indices have been developed to account for the varying duration of noise events over time as well as community response to them. The Day-Night Average Level (L_{dn}) is such an index. L_{dn} represents the 24-hour A-weighted equivalent sound level with a 10 dBA penalty added to the “nighttime” hourly noise levels between 10:00 p.m. and 7:00 a.m. Because of the time-of-day penalties associated with the L_{dn} index, the L_{eq} for a continuously operating sound source during a 24-hour period will be numerically less. The Community Noise Equivalent Level (CNEL), similar to L_{dn}, applies a 10 dBA penalty for noise levels occurring during the nighttime hours between 10:00 p.m. and 7:00 a.m., and a 5 dBA penalty for noise levels the sound levels occurring during evening hours between 7:00 p.m. and 10:00 p.m. CNEL has been adopted by the State of California to define the community noise environment for development of the community noise element of a General Plan. Noise is also more disturbing the closer a receptor is to the source; noise levels decrease by 6 dB as the distance from its source doubles (FHWA 2011).

2.2 Fundamentals of Vibration

Ground-borne vibration consists of waves transmitted through solid material. Several types of wave motions exist in solids, unlike air, including compressional, shear, torsional, and bending. The solid medium can be excited by forces, moments, or pressure fields. Ground-borne vibration propagates from the source through the ground to adjacent buildings by surface waves. Vibration may be composed of a single pulse, a series of pulses, or a continuous oscillatory motion. The frequency of a vibrating object describes how rapidly it is oscillating, measured in Hz. Most environmental vibrations consist of a composite or “spectrum” of many frequencies and are generally classified as broadband or random vibrations. The normal frequency range of most ground-borne vibration that can be felt generally starts from a low frequency of less than 1 Hz to a high of about 200 Hz.

Vibration may be defined in terms of the displacement, velocity, or acceleration of the particles in the medium material. In environmental assessments, where human response is the primary concern, velocity is commonly used as the descriptor of vibration level, typically expressed in inches per second (in/sec) or millimeters per second (mm/s). The amplitude of vibration can be expressed in terms of the wave peaks or as an average, called the root mean square. The root mean square level is generally used to assess the effect of vibration on humans. Like noise, vibration can be expressed in terms of decibels with a reference velocity of $1x10^{-6}$ in/sec. The abbreviation “VdB” is often used for vibration decibels to reduce the potential for confusion with sound decibels.

Vibration can produce several types of wave motion in solids including compression, shear, and torsion, so the direction in which vibration is measured is significant and should generally be stated as vertical or horizontal. Human perception also depends to some extent on the direction of the vibration energy relative to the axes of the body. In whole-body vibration analysis, the direction parallel to the spine is usually denoted as the z-axis, while the axes perpendicular and parallel to the shoulders are denoted as the x- and y-axes, respectively.

The two primary concerns with project-induced vibration, the potential to damage a structure and the potential to annoy people, are evaluated against different vibration limits. Studies have shown that the threshold of perception for the average person is a peak particle velocity (PPV) in the range of 0.2 to 0.3 mm/s (0.008 to 0.012 in/sec). Human perception to vibration varies with the individual and is a function of physical setting and the type of vibration. Persons exposed to elevated ambient vibration levels, such as people in an urban environment, may tolerate a higher vibration level. Vibration levels for typical construction-related sources of ground-borne vibration are shown in **Table 6** below.

Table 6. Vibration Source Amplitudes for Construction Equipment

Equipment	PPV at 25 feet (in/sec)		Approximate Vibration Velocity Level (Velocity Level in Decibels [VdB])	
	25 feet	50 feet	25 feet	50 feet
Large Bulldozer	0.089	0.031	87	78
Caisson Drilling	0.089	0.031	87	78
Loaded Trucks	0.076	0.027	86	77
Jackhammer	0.035	0.012	79	70
Small Bulldozer	0.003	0.001	58	49

Source: Adapted from CalTrans 2020 and Federal Transit Administration (FTA) 2018

SECTION 3 Regulatory Framework

Federal, state, and local noise regulations and policies that may apply to the proposed Project are described below.

3.1 Federal

3.1.1 Noise Control Act of 1972

USEPA, pursuant to the Noise Control Act of 1972, established guidelines for acceptable noise levels for sensitive receptors such as residential areas, schools, and hospitals. The levels set forth are 55 dBA L_{dn} for outdoor use areas and 45 dBA L_{dn} for indoor use areas, and a maximum level of 70 dBA L_{dn} is identified for all areas to prevent hearing loss (USEPA 1974). These levels provide guidance for local jurisdictions but do not have regulatory enforceability. In the absence of applicable noise limits, the USEPA levels can be used to assess the acceptability of project-related noise.

3.1.2 U.S. Department of Housing and Urban Development

The U.S. Department of Housing and Urban Development (HUD) has also established guidelines for acceptable noise levels for sensitive receivers such as residential areas, schools, and hospitals (24 CFR 51). HUD's noise levels include a two-pronged guidance, one for the desirable noise level and the other for the maximum acceptable noise level. The desirable noise level established by HUD conforms to the USEPA guidance of 55 dBA L_{dn} for outdoor use areas of residential land uses and 45 dBA L_{dn} for indoor areas of residential land uses. The secondary HUD standard establishes a maximum acceptable noise level of 65 dBA L_{dn} for outdoor use areas of residential areas.

3.1.3 Federal Transit Authority

The FTA has published guidance relevant to assessing ground-borne vibration associated with construction activities, which have been applied by other jurisdictions to other types of projects (FTA 2018). For example, engineered concrete and masonry (no plaster) buildings can be exposed to ground-borne vibration levels of 0.3 inches per second without experiencing structural damage. Buildings extremely susceptible to vibration damage (e.g., historic buildings) can be exposed to ground-borne vibration levels of 0.12 in/sec without experiencing structural damage.

3.2 State

The California Code of Regulations (CCR) has guidelines for evaluating the compatibility of various land uses as a function of community noise exposure, as shown in **Table 7** below.

The extensive state regulations pertaining to worker noise exposure are applicable to the proposed project (for example California Occupational Safety and Health Administration Occupational Noise Exposure Regulations [8 CCR General Industrial Safety Orders, Article 105, Control of Noise Exposure, Section 5095, et seq.]), for workers in a "central plant" and/or maintenance facility, or for those involved in the use of maintenance equipment or heavy machinery.

Table 7. Estimated Existing Noise Exposure for General Assessment

Land Use Category	Noise Exposure Ranges (dB CNEL) Normally Acceptable[1]	Noise Exposure Ranges (dB CNEL) Conditionally Acceptable[2]	Noise Exposure Ranges (dB CNEL) Normally Unacceptable[3]	Noise Exposure Ranges (dB CNEL) Clearly Unacceptable[4]
Residential: Low-density Single Family, Duplex, Mobile Homes	<60	55-70	70-75	>75
Residential: Multiple Family	<65	60-70	70-75	>75
Transient Lodging: Motels, Hotels	<65	60-70	70-80	>80
Schools, Libraries, Churches, Hospitals, Nursing Homes	<70	60-70	70-80	>80
Auditoriums, Concert Halls, Amphitheaters	Undefined	<70	>65	Undefined
Sports Arena, Outdoor Spectator Sports	Undefined	<75	>70	Undefined
Playgrounds, Neighborhood Parks	<70	67-75	>73	Undefined
Golf Courses, Riding Stables, Water Recreation, Cemeteries	<75	Undefined	70-80	>80
Office Buildings, Business Commercial and Professional	<70	67-77	>75	Undefined
Industrial, Manufacturing, Utilities, Agriculture	<75	70-80	>75	Undefined

Source: California Office of Planning and Research (OPR) 2017

Notes:

1. Normally Acceptable: specified land use is satisfactory, based upon the assumption that any buildings involved are of normal construction without any special noise insulation requirements.
2. Conditionally Acceptable: New construction or development should only be undertaken after a detailed analysis of the noise reduction requirements is made and the needed insulation features included in the design.
3. Normally Unacceptable: New construction or development should generally be discouraged. If new development is to proceed, a detailed analysis of the noise reduction requirements is made, and the needed insulation features are included in the design.
4. Clearly Unacceptable: New development or construction should not be undertaken.

3.3 Local

Imperial County is the agency responsible for regulating and controlling noise through the Noise Element of the County General Plan and the Noise Ordinance of the County's Codified Ordinances. The Noise Element of the Imperial County General Plan provides a program for incorporating noise issues into the land use planning process with a goal of minimizing adverse noise impacts to noise-sensitive receptors. The Noise Element specifies construction hours and noise limits and the acceptable property line operational noise levels at various land uses for day, evening, and night periods for the County Noise Ordinance.

3.3.1 Imperial County General Plan Noise Element

The Noise Element of the Imperial County General Plan examines noise sources and provides information to be used in setting land use policies to protect noise-sensitive land uses and for developing and enforcing a local noise ordinance. The Noise Element (2015) provides a program for incorporating noise issues into the land use planning process with a goal of minimizing adverse noise impacts to receptors such as residences, schools, and hospitals, which are sensitive to noise. The County identifies Noise Impact Zones for sensitive receptors likely to be exposed to significant noise (greater than 60 dB CNEL or 75 dBA L_{eq}) from roadways, railroads, airports, and agricultural activities. The purpose of the Noise Impact Zone is to define areas and properties where an acoustical analysis of a proposed project is required to demonstrate project compliance with land use compatibility requirements and other applicable environmental noise standards. Any property within 1,500 feet of an interstate highway or 1,100 feet of a State highway is within a Noise Impact Zone, as is any property within 0.25 mile (1,320 feet) of existing farmland that is in an agricultural zone.

An acoustical analysis is required for any action that would be located, all or in part, in a Noise Impact Zone. According to the Noise Element, if the future noise levels from the action are within the normally acceptable noise level guidelines but result in an increase of 5 dBA CNEL or greater, the action would have a potentially significant noise impact; and mitigation measures must be considered. If the future noise level after the action is completed is greater than the normally acceptable noise level, a noise increase of 3 dBA CNEL or greater should be considered a potentially significant noise impact; and mitigation measures must be considered.

Land use compatibility defines the acceptability of a land use in a specified noise environment. Noise/Land Use Compatibility Guidelines are provided in the Noise Element to evaluate potential noise impacts and provide criteria for environmental impact findings and conditions for project approval. An acoustical analysis is required to demonstrate conformance of a proposed project with Noise/Land Use Compatibility Guidelines. These guidelines categorize noise levels at residential land uses as "normally acceptable" up to 60 dBA day-night average sound level (L_{dn}) or CNEL and as "conditionally acceptable" up to 70 dBA L_{dn} or CNEL.

Construction noise standards included in the Noise Element restrict construction equipment noise levels to 75 dBA L_{eq} when averaged over an eight-hour period and measured at the nearest sensitive receptor. This standard assumes a construction period, relative to an individual sensitive receptor of days or weeks. In cases of extended length construction times, the standard may be tightened so as not to exceed 75 dB L_{eq} when averaged over a one-hour period. In addition, construction equipment operation is limited to the hours of 7:00 a.m. to 7:00 p.m., Monday through Friday, and 9:00 a.m. to 5:00 p.m. on Saturday. Further, no commercial construction operations are permitted on Sunday or holidays.

3.3.2 Imperial County Noise Ordinance

The County enforces construction and operation noise standards specified in the Noise Element through the Noise Ordinance. Noise-generating sources in Imperial County are regulated under the County of Imperial Codified Ordinances, Title 9, Division 7 (Noise Abatement and Control). The noise standards of the Ordinance limit the hours of construction and the level of noise emitted by the construction, as well as the operational noise levels at various land uses for day, evening, and night. Noise limits are established in Chapter 2 of this ordinance and shown in **Table 8**.

Table 8. Imperial County Property Line Noise Limits.

Zone	Time	Average Hourly Sound (L_{eq})
Residential Zones	7 a.m. to 10 p.m.	50
	10 p.m. to 7 a.m.	45
Multi-Residential Zones	7 a.m. to 10 p.m.	55
	10 p.m. to 7 a.m.	50
Commercial Zones	7 a.m. to 10 p.m.	60
	10 p.m. to 7 a.m.	55
Light Industrial/Industrial Park Zones	Anytime	70
General Industrial Zones	Anytime	75

Source: Imperial County Ordinance - Title 9, Division 7 (Noise Abatement and Control)

When the noise-generating property and the receiving property have different uses, the more restrictive standard shall apply. When the ambient noise level is equal to or exceeds the Property Line noise standard, the increase of the existing or proposed noise shall not exceed 3 dB L_{eq}.

Property line noise limits apply to noise generation from one property to an adjacent property. The standards imply the existence of a sensitive receptor on the adjacent, or receiving, property. In the absence of a sensitive receptor, an exception or variance to the standards may be appropriate. These standards do not apply to construction noise. These standards are enforced through the County's code enforcement program on the basis of complaints received from persons impacted by excessive noise. The County may act to restrict disturbing, excessive, or offensive noise which causes discomfort or annoyance to reasonable persons of normal sensitivity residing in an area. Noise received at the property line of a residence is limited to 50 dBA L_{eq} in the daytime and 45 dBA L_{eq} at night.

Under Section 90702.00 of the County’s Codified Ordinances, sound level limits for industrial noise are set at 75 dBA L_{eq} on or beyond the boundary of the property line at any time. Average hourly noise in residential areas is limited to 50 to 55 dBA from 7:00 a.m. to 10:00 p.m. and to 45 to 50 dBA from 10:00 p.m. to 7:00 a.m.

SECTION 4 Existing Conditions

4.1 Noise Sensitive Receptors

Noise-sensitive land uses are generally considered to include those uses where noise exposure could result in health-related risks to individuals, as well as places where quiet is an essential element of their intended purpose. Residential dwellings are of primary concern because of the potential for increased and prolonged exposure of individuals to both interior and exterior noise levels, and because of the potential for nighttime noise to result in sleep disruption. Additional land uses such as schools, transient lodging, historic sites, cemeteries, and places of worship are also generally considered sensitive to increases in noise levels. These land use types are also considered vibration-sensitive land uses, as are commercial and industrial buildings where vibration would interfere with operations within the building, including levels that may be well below those associated with human annoyance.

There are numerous sensitive receptors in proximity to Project components including residences, Mt. View Cemetery, and Heber Elementary School. **Table 9** summarizes the sensitive receptors in the Project area and distance to the nearest Project components.

Table 9. Sensitive Receptors in Proximity to Project Components

Sensitive Receptor	Nearest Project Component	Distance to Nearest Project Component
Residence (104 E. Jasper Rd.)	Heber 2 Parasitic Solar Facility	540
Residence (600 Dogwood Rd.)	Dogwood Parasitic Facility	2,900
Residential Area (E. Fawcett Rd.)	Production Well	2,985
Heber Elementary School	Production Well	3,400
Residences (153, 185, 195 E. Cole Blvd.)	Dogwood Parasitic Facility	3,825
Mt. View Cemetery	Production Well	6,890

4.2 Existing Noise Sources and Ambient Noise Levels

Existing ambient noise in the vicinity of the Project sites is consistent with a rural agricultural landscape with the dominant noise sources consisting of vehicular traffic on local roads, the existing Heber 2 Complex, and the operation of agricultural equipment. The major source of vehicular noise is traffic along State Route (SR) 86 and SR 111 and the Regional Arterials Dogwood Road and Jasper Road. SR 86 is a principal farm-to-market route for Imperial County agricultural products and carries a high percentage of heavy trucks. SR 86 also carries heavy recreational traffic on weekends (Imperial County 2015). The Noise Element of the Imperial County General Plan provides calculated noise contours for the area's highways based on vehicle volumes, speed, and vehicle mix. Calculated noise levels for SR 86 south of Interstate 8 indicate that the 60 dBA (CNEL) noise contour would be met at 1,600 feet from the travel corridor under 2015/future conditions (i.e., with consideration to increases in traffic volumes in the years following the preparation of the Noise Element in 2015).

The existing geothermal facilities adjacent to the Project site also contribute to the existing noise environment. Typical sound power levels for the existing power plants and geothermal well pads are in the range of 113 dBA at the loudest noise source of the power plant and 92 dBA directly adjacent to each well. Noise from these stationary sources lessens at a rate of approximately 6 dB per doubling of distance, depending on such environmental conditions as topography, vegetation, and weather. Specifically, operational noise levels of an existing geothermal facility in Imperial County were recorded at 70 dBA L_{eq} at approximately 100 feet (Chambers Group, Inc. 2015).

4.3 Existing Vibration Environment

Similar to the environmental setting for noise, the vibration environment is dominated by traffic from nearby roadways. Heavy trucks can generate ground-borne vibrations that vary depending on vehicle type, weight, and pavement conditions. According to the FTA (2018), *Transit noise and Vibration Impacts Assessments*, “if the roadway is fairly smooth, the vibration from rubber-tired traffic is rarely perceptible.” Roads in the Project area are smooth asphalt and it is unlikely that traffic on the local roadway is perceptible.

SECTION 5 Project Noise Prediction

5.1 Methodology

The Project construction and operation noise levels were estimated using the computer noise propagation model SoundPLAN Essential (version 5.1), which calculates noise impacts taking into account terrain features including relative elevations of noise sources, receivers, and intervening objects, ground effects due to areas of pavement and unpaved ground, and atmospheric effects on sound propagation. The following assumptions and parameters are included in the SoundPLAN supported noise source assessment:

- Ground effect acoustical absorption coefficient equal to 0.0, which represents the acoustically reflective “hard” surface for the majority of the geothermal plant site. Vegetated fields surrounding the Project site were assigned a coefficient of 1.0, which represents the acoustically “soft” surface associated with the vegetated ground cover;
- Reflection order of 1, which allows for a single reflection of sound paths on encountered structural surfaces such as buildings and structures; and
- Calm meteorological conditions (i.e., no wind) with 70 degrees Fahrenheit and 83% relative humidity.

5.1.1 Operations

Project features were input as sound sources in the SoundPLAN Essential three-dimensional model space and defined with the following assumptions and available project design information.

Noise data from the ORMAT Tungsten Mountain facility, which is similar in design to the Proposed Project, was used to model noise associated with geothermal plant operations using SoundPLAN Essential methodology for industrial sites. Accordingly, operation of the power plant is assumed to generate an average noise level of 62 dBA at 450 feet (equivalent to approximately 105 dBA at the source) with continuous operation (i.e., 24-hours per day). Similarly, the proposed Project wells would generate an average noise level of 72 dBA at 25 feet (equivalent to approximately 90 dBA at the source) with continuous operation. In addition to these sound source inputs, potential sound-occluding terrain and proposed Project features that define the three-dimensional sound were included in the propagation model space.

Due to the low number of additional trips associated with operation of the proposed Project, vehicles traveling to/from the Project site are not expected to result in changes to noise levels in the surrounding area.

5.1.1.1 Vibration

Anticipated charging systems are designed and manufactured to feature rotating and reciprocating components (e.g., fans) that are well-balanced with isolated vibration within or external to the equipment casings. On this basis, potential vibration impacts due to operation of the stationary sources are not expected. The speed limit on the adjacent roadways is 55 miles per hour and the road surface is in good condition. As trucks enter and exit the site, they would traverse the asphalt drive at very low speeds. As noted in FTA (2018), rubber tires and suspension systems provide vibration isolation, and therefore, it is unusual for ground-borne vibration associated with on-road vehicle movement to be perceptible. As such, vibration impacts associated with Project operation are not expected to be significant and have not been evaluated herein.

5.1.2 Construction

5.1.2.1 Onsite Construction Noise

The potential construction noise levels onsite associated with proposed Project construction activities were estimated for each distinct construction phase. The noise model conservatively assumes that construction equipment presented in **Table 3** above for each respective construction activity will be operated simultaneously and in a concentrated area nearest to the closest sensitive receptors. In actual practice, however, the types and numbers of construction equipment near any specific receptor location will vary over time.

5.1.2.2 Offsite Noise (Construction Traffic)

Estimated vehicle trips associated with each phase of construction is presented above in **Table 4**. For the purpose of this analysis, the principals of logarithmic summation are applied to estimate the maximum noise increase associated with construction traffic along local surface streets. Specifically, noise levels increase by 3 dBA when the number of similar noise sources double. The increase in delivery/haul trucks and construction worker vehicle trips are not anticipated to double the amount of traffic that currently exist in the surrounding are. As such, the increase in delivery/haul trucks and worker vehicles in the surrounding roadways is not anticipated to incrementally increase noise levels in the surrounding area by 3 dBA or more and are not analyzed further herein.

5.2 Predicted Results

5.2.1.1 Operations

Predicted daytime/nighttime noise levels attributed to concurrent operation of the proposed Project onsite stationary sources (i.e., OEC, ITLU, substation transformers, auxiliary facilities, production wells, injection wells) are propagated to two nearest sensitive receptors shown in **Figure 1**. **Table 10** presents a summary of predicted Project operational noise levels at the two nearest sensitive receptors. **Figure 1** illustrates the predicted daytime and nighttime sound levels (which are equivalent since operations are 24-hours per day) associated with Project operations in the surrounding area. As summarized in **Table 10**, Project-related operational noise would be below, and thus in compliance with the Imperial County noise standards which limits the increase in future noise levels to 5 dBA CNEL as a result of the action within Noise Impact Zones that are currently within normally acceptable noise level guidelines (i.e., 60 dB CNEL). Specifically, the Project-related operation noise is estimated to be less than the assumed ambient daytime noise level of 50 dBA L_{eq} and nighttime noise level of 45 dBA L_{eq}. Thus, the Project would not result in an increase in the assumed ambient noise level of 60 dBA CNEL. Therefore, the proposed Project would also not result in noise levels exceeding the threshold of 65 dBA CNEL established by the Imperial County noise standards.

Table 10. Modeled Maximum Project Operations Sound Levels (dBA)

Modeled Receptors	Modeled 24-Hour Project Operation Noise Level[1] (L_{eq})	Presumed Ambient Noise Level (CNEL)	Calculated CNEL (Project + Ambient)	Noise Standard[2] (CNEL/L_{eq})	Exceed Standard?
S1 (Resident at 104 E. Jasper Road)	27.7	60	60	65/75	No
S2 (Residential Area off E. Fawcett Road)	14.3	60	60	65/75	No

Notes:

1. Modeled noise level is associated with construction equipment. Modeled construction noise levels less than ambient would not be expected to increase noise levels at the modeled receptors.
2. The noise standard for as provided in the Imperial County Noise Element specifies that noise levels shall not increase more than 5 dBA CNEL from measured ambient noise level in Noise Impact Zones that are currently within normally acceptable noise level guidelines. Per Section 90702.00 of the County's Codified Ordinances, sound level limits for industrial noise are set at 75 dBA L_{eq} on or beyond the boundary of the property line at any time.

5.2.1.2 Construction

Based on the types and number of equipment to be used, construction activities associated with Project site construction (solar fields and plant site) and well drilling and pipe interconnection are identified to have the greatest potential to increase noise levels in the Project area. For a conservative analysis, the cumulative noise for both phases of construction including drilling of all three production wells and injection well is assumed to occur simultaneously (although only one well would actually be drilled at any given time) and is propagated to the nearest sensitive receptors to estimate the maximum change in noise levels resulting from the proposed Project as summarized in **Table 11** and illustrated in **Figure 2** and **Figure 3**. As shown in **Table 11, Figure 2** and **Figure 3**, construction activities would not exceed the Imperial County daytime noise standard for construction activities of 75 dBA L_{eq} at the nearest sensitive receptor and nighttime well drilling activities would not result in perceptible noise levels at the nearest sensitive receptors.

Table 11. Modeled Maximum Project Construction Sound Levels (L_{eq}, dBA).

Modeled Receptors	Modeled Daytime Construction Noise Level[1]	Modeled Nighttime Construction Noise Level[1]	Presumed Ambient Noise Level (Day/Night)	Noise Standard[2] (Day/Night)	Exceed Standard ?
S1 (Resident at 104 E. Jasper Road)	30.2	25.8	50/45	75	No
S2 (Residential Area off E. Fawcett Road)	7.4	4.7	50/45	45	No

Notes:

1. Modeled noise level is associated with construction equipment. Modeled construction noise levels less than ambient would not be expected to increase noise levels at the modeled receptors.
2. The noise standard for construction activities as provided in the Imperial County General Plan Noise Element specifies that construction noise shall not exceed 75 dBA at the nearest sensitive receptor. This standard is applicable for daytime noise given the restrictions on construction hours per the Noise Element. Nighttime noise standards are presumed to be any perceptible noise at the nearest sensitive receptor (i.e., and increase in 3 dBA above presumed ambient nighttime noise level of 45 dBA).

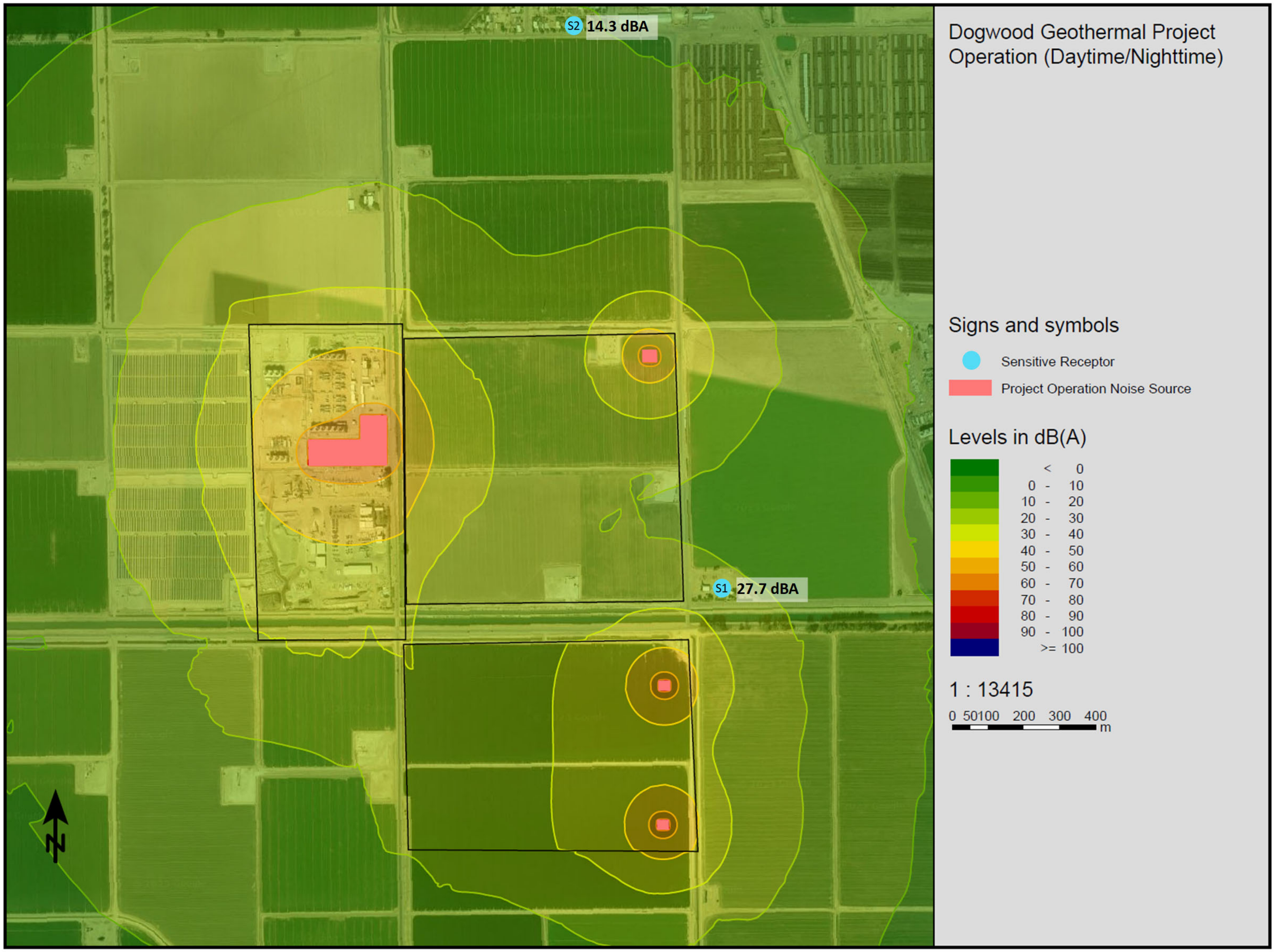

Figure 1. Modeled Operational Noise – Daytime/Nighttime

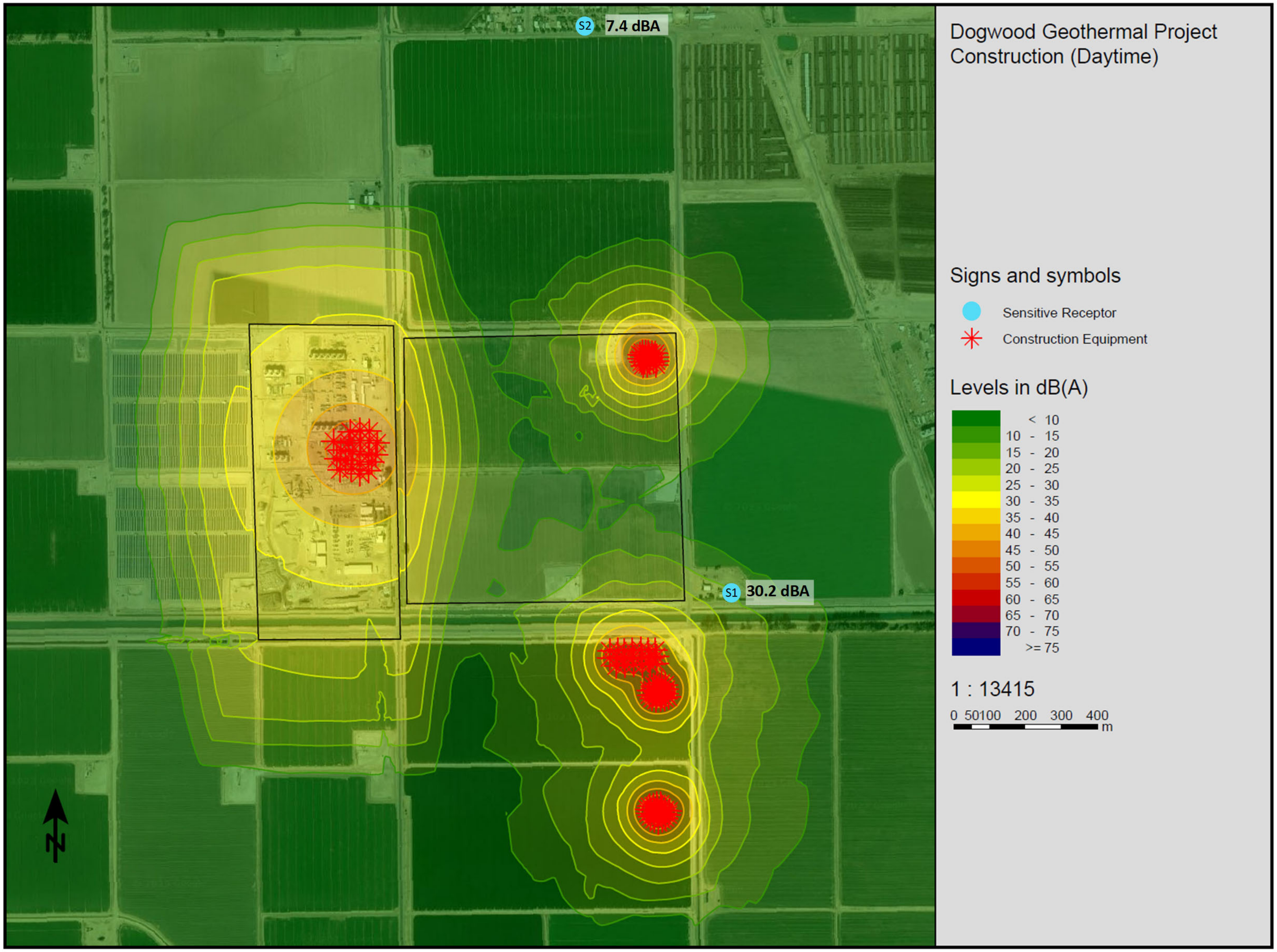

Figure 2. Modeled Project Construction Noise - Daytime

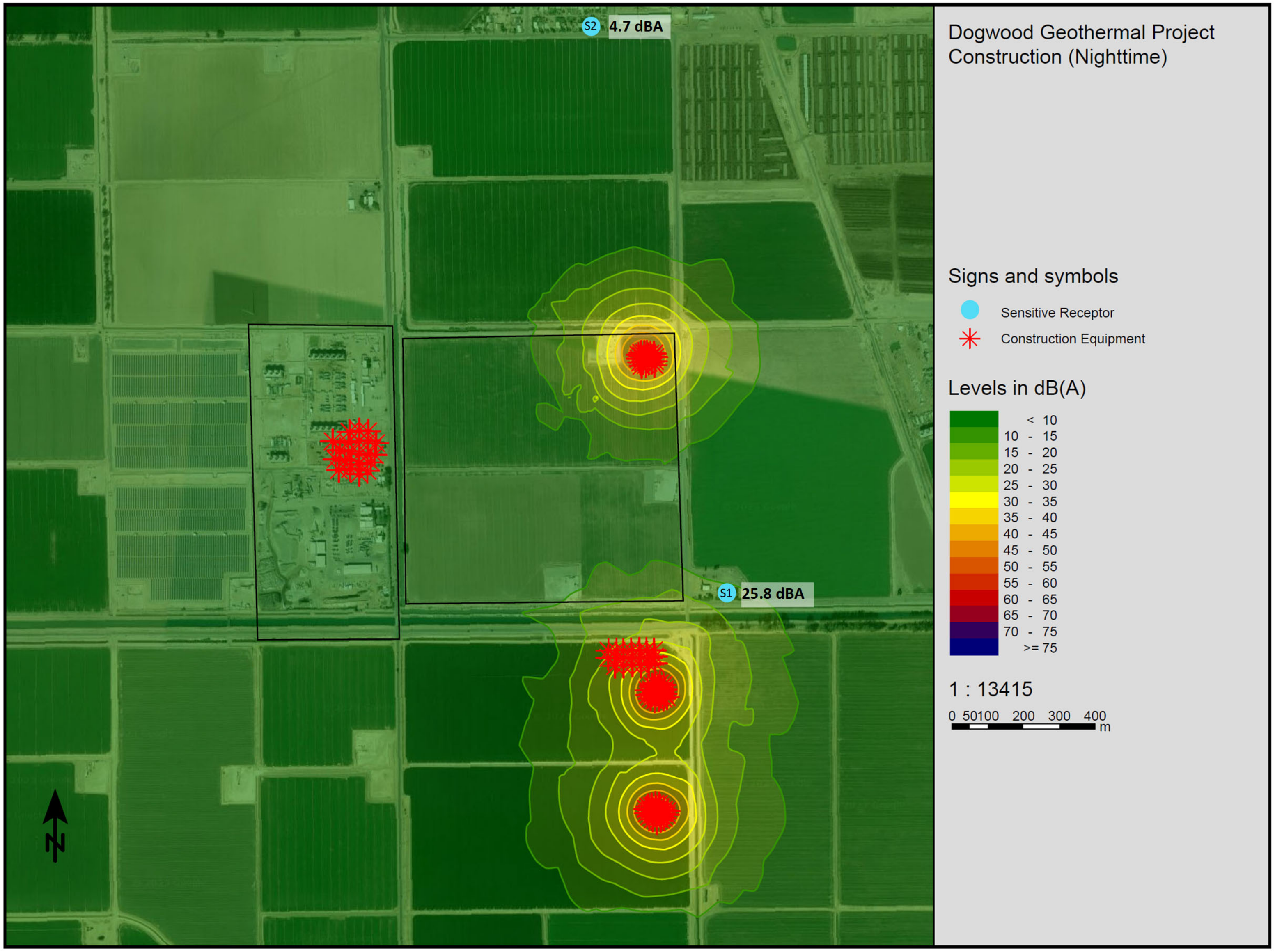

Figure 3. Modeled Project Construction Noise - Nighttime

SECTION 6 Conclusions

Based on the SoundPLAN modeling of the Project, anticipated operational and construction noise levels would not exceed local thresholds and would comply with local guidelines set forth in the County's Noise Element and Noise Ordinance. Therefore, the Project would not generate significant noise levels that would disturb noise-sensitive land uses (i.e., residential) in the vicinity.

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