

Appendix F

Construction Noise Analysis

October 2, 2025

02230.00016.001

Larry Thornburgh
Nasland Engineering
4740 Ruffner Street
San Diego, CA 92111

Subject: Construction Noise Analysis for the Avenida Encinas Coastal Rail Trail and Pedestrian Improvements Project

Dear Mr. Thornburgh:

HELIX Environmental Planning, Inc. (HELIX) was contracted by Nasland Engineering to provide a construction noise analysis for the Avenida Encinas Coastal Rail Trail and Pedestrian Improvements Project (project) in the City of Carlsbad, San Diego County, California. The project proposes to install improvements along Avenida Encinas, including a Class II bike lane along both sides of Avenida Encinas, roadway widening, new pavement, new sidewalks, curb ramps, center landscaped medians, landscaping, biofiltration swales, lighting, fencing, and retaining walls. This report details the methods and results of the noise analysis.

PROJECT DESCRIPTION

The City of Carlsbad (City) proposes to construct roadway, bikeway, and pedestrian improvements along an approximately one-mile segment of Avenida Encinas between Palomar Airport Road and a point just south of the Poinsettia Coaster Station Driveway in the western portion of the City. The project alignment is situated between Interstate 5 and the Los Angeles-San Diego-San Luis Obispo (LOSSAN) rail corridor and entirely within the Coastal Zone.

Proposed improvements would entail implementation of Reach 5 of the Coastal Rail Trail (CRT), a planned regional bicycle route that runs approximately 42 miles between Oceanside and Santa Fe Depot in Downtown San Diego, as well as roadway improvements along Avenida Encinas. Various segments of the CRT have been constructed in Oceanside, Carlsbad, and Encinitas, including Reach 1 (along Carlsbad Boulevard from State Street to the norther city boundary over Buena Vista Lagoon) and Reach 2 (between Tamarack Avenue and Oak Avenue) in Carlsbad. This portion of the CRT, Reach 5, would include a Class II bike lane along both sides of Avenida Encinas, consisting of a six-foot-wide striped bike lane within the roadway. Other improvements would include roadway widening, new pavement, new sidewalks, curb ramps, center landscaped medians, landscaping, biofiltration swales, lighting, fencing, and retaining walls.

The project alignment occurs within a developed area comprised of commercial, industrial, transportation, and residential land uses. Most of the project site is composed of developed land and disturbed habitat, with relatively small areas of wetland and native upland habitats. Surrounding land uses include Palomar Airport Road to the north; North County Transit District railroad right-of-way to the west; the Poinsettia Coaster Station to the south; and a gas station, business parks, car dealership, a wastewater treatment plant, and undeveloped land to the east. Figure 1 shows the regional location of the project, Figure 2 consists of an aerial photograph of the project site and surroundings along with the proposed alignment.

ENVIRONMENTAL SETTING

Noise and Sound Level Descriptors and Terminology

All noise level or sound level values presented herein are expressed in terms of decibels (dB), with A-weighting (dBA) to approximate the hearing sensitivity of humans. Time-averaged noise levels are expressed by the symbol L_{EQ} , with a specified duration. The Community Noise Equivalent Level (CNEL) is a 24-hour average, where noise levels during the evening hours of 7:00 p.m. to 10:00 p.m. have an added 5 dBA weighting, and sound levels during the nighttime hours of 10:00 p.m. to 7:00 a.m. have an added 10 dBA weighting. This is similar to the Day Night sound level (L_{DN}), which is a 24-hour average with an added 10 dBA weighting on the same nighttime hours but no added weighting on the evening hours. Sound levels expressed in CNEL are always based on dBA. These metrics are used to express noise levels for both measurement and municipal regulations, as well as for land use guidelines and enforcement of noise ordinances.

Sound can be described as the mechanical energy of a vibrating object transmitted by pressure waves through a liquid or gaseous medium (e.g., air) to a hearing organ, such as a human ear. Noise is defined as loud, unexpected, or annoying sound.

In the science of acoustics, the fundamental model consists of a sound (or noise) source, a receiver, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting the propagation path to the receiver contribute to the sound level and characteristics of the noise perceived by the receiver. The field of acoustics deals primarily with the propagation and control of sound.

Continuous sound can be described by frequency (pitch) and amplitude (loudness). A low-frequency sound is perceived as low in pitch. Frequency is expressed in terms of cycles per second, or Hertz (Hz) (e.g., a frequency of 250 cycles per second is referred to as 250 Hz). High frequencies are sometimes more conveniently expressed in kilohertz (kHz), or thousands of Hertz. The audible frequency range for humans is generally between 20 Hz and 20,000 Hz.

The amplitude of pressure waves generated by a sound source determines the loudness of that source. A logarithmic scale is used to describe sound pressure level (SPL) in terms of dBA units. The threshold of hearing for the human ear is about 0 dBA, which corresponds to 20 micro-Pascals (mPa).

Under controlled conditions in an acoustical laboratory, the trained, healthy human ear is able to discern 1 dBA changes in sound levels, when exposed to steady, single-frequency ("pure-tone") signals in the mid-frequency (1,000 Hz to 8,000 Hz) range. In typical noisy environments, changes in noise of

1 to 2 dBA are generally not perceptible. A 5 dBA increase is generally perceived as a distinctly noticeable increase, and a 10 dBA increase is generally perceived as a doubling of loudness.

Because decibels are logarithmic units, SPL cannot be added or subtracted through ordinary arithmetic. Under the decibel scale, a doubling of sound energy corresponds to a 3-dBA increase. In other words, when two identical sources are each producing sound of the same loudness, the resulting sound level at a given distance would be 3 dBA higher than one source under the same conditions.

Ground-borne Vibration Descriptors and Terminology

Ground-borne vibration consists of rapidly fluctuating motions or waves transmitted through the ground with an average motion of zero. Sources of ground-borne vibrations include natural phenomena and anthropogenic causes (e.g., explosions, machinery, traffic, trains, construction equipment). Vibration sources may be continuous (e.g., factory machinery) or transient (e.g., explosions). Several different methods are typically used to quantify vibration amplitude. One is the peak particle velocity (PPV); another is the root mean square velocity (RMS). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. For the purposes of this analysis, a PPV descriptor with units of inches per second (in/sec) is used to evaluate construction-generated vibration for building damage and human complaints.

Existing Setting and Surrounding Land Uses

The project site is the existing Avenida Encinas ROW between Palomar Airport Road and the Poinsettia Coaster Station Driveway. Surrounding land uses include: LOSSAN railroad tracks, a gas station, business parks, automotive dealerships, a water treatment plant, undeveloped parcels, a school, and the Poinsettia Coaster Station. Residential uses are located across the LOSSAN railroad tracks, and include a hotel, mobile homes, and single-family residences.

Noise and Vibration Sensitive Land Uses

Noise-sensitive land uses (NSLUs) are land uses that may be subject to stress and/or interference from excessive noise, such as residential dwellings, schools, transient lodging (hotels), hospitals, and educational facilities. Industrial and commercial land uses are generally not considered sensitive to noise. The closest NSLUs to the project site are a school and the aforementioned residences and hotel uses. The distances between the project site and NSLUs vary. Nearby residences are located as close as 150 feet from the Avenida Encinas ROW, and the Community Montessori Charter School is located approximately 60 feet from the centerline of the ROW.

REGULATORY FRAMEWORK

City of Carlsbad Municipal Code, Chapter 8.48, Noise

It shall be unlawful to operate equipment or perform any construction in the erection, demolition, alteration, or repair of any building or structure or the grading or excavation of land during the following hours, except as hereinafter provided:

After 6:00 p.m. on any day, and before 7:00 a.m., Monday through Friday, and before 8:00 a.m. on Saturday; all day on Sunday; and on any federal holiday.

METHODOLOGY AND ASSUMPTIONS

Modeling Software

Project construction noise was analyzed using the Roadway Construction Noise Model (RCNM; USDOT 2008), which incorporates estimates of sound levels from standard construction equipment based on manufacturers' specifications and measured reference noise levels. The RCNM noise modeling outputs are included in Attachment A, *RCNM Output*, to this report.

Assumptions

Construction Equipment Noise Levels

Project construction activities would include grubbing and land clearing, grading and excavation, drainage, utilities installation, and paving. Construction would require the use of heavy off-road equipment. Construction equipment was estimated as part of the project's air quality analysis (HELIX 2025), and would include backhoes, excavators, dozers, loaders, pavers, and rollers.

NOISE IMPACTS

Thresholds of Significance

Impacts from construction noise would be significant if noise is generated outside the hours specified in the City's Municipal Code Chapter 8.48 for construction.

In the absence of a numerical decibel threshold, this analysis will consider construction noise exceeding 10 dBA above ambient noise levels at nearby sensitive receptors to be a significant increase. This is based on the general perception that a 10 dBA increase is considered a doubling of loudness.

Excessive ground-borne vibration would occur if construction-related ground-borne vibration exceeds the "strongly perceptible" vibration annoyance potential criteria for human receptors of 0.1 inch per second PPV or the damage potential criteria to relatively old residential structures 0.5 inch per second PPV for continuous/frequent intermittent construction sources (such as impact pile drivers, vibratory pile drivers, and vibratory compaction equipment), as specific by Caltrans (2020).

Construction Noise Analysis

The magnitude of a construction noise impact would depend on the type of construction activity, equipment, duration of each construction phase, distance between the noise source and receiver, and any intervening structures. Construction would generate elevated noise levels that may disrupt nearby residences and other NSLUs. Although the nearest residences are located approximately 150 feet west of the project site, the nearest NSLU, a school, is located approximately 60 feet south of the roadway centerline. Construction equipment would not all operate at the same time or location and would not be in constant use during a typical 8-hour operating day. Furthermore, due to the linear nature of the project, equipment is not anticipated to be stationary at a given location for long periods. Therefore, average distances between the nearest off-site residences and construction is estimated would likely exceed 60 feet. As a conservative estimate however, 60 feet was used in this analysis.

Multiple construction equipment types would be in use throughout the day. For example, a dozer and an excavator may be working on the site simultaneously but would not be working in close proximity one another at a given time due to the nature of their respective operations. An excavator and loader, were analyzed together for construction noise impacts due to their likelihood of being used in conjunction with one another. Table 1, *Anticipated Construction Equipment*, presents a summary of the heavy equipment anticipated to be used for project construction, the typical operating time percentage, and the average noise level at a distance of 60 feet reported by the RCNM.

Table 1
ANTICIPATED CONSTRUCTION EQUIPMENT

Construction Equipment	Percent Operating Time	Distance to NSLU (feet)	Noise Level at 60 feet (dBA L _{EQ})
Grubbing and Land Clearing			
Backhoe	40	60	72.0
Excavator	40	60	75.1
Dozer	40	60	76.1
Grading and Excavation			
Excavator	40	60	75.1
Backhoe	40	60	72.0
Loader	40	60	73.5
Dozer	40	60	76.1
Scraper	40	60	78.0
Excavator/Loader	40	60	77.4
Utilities Installation			
Backhoe	40	60	72.0
Dozer	40	60	76.1
Grader	40	60	79.4
Loader	40	60	73.5
Excavator	40	60	75.1
Paving			
Loader	40	60	73.5
Pavers	50	60	72.6
Rollers	20	60	71.4

Source: Roadway Construction Noise Model (U.S. Department of Transportation 2008); HELIX 2025
dBA = A-weighted decibels; L_{EQ} = time averaged sound level.

Based on these assumptions, the loudest construction operations involve the use of a grader, which would generate noise levels of 79.4 dBA L_{EQ} at nearby NSLUs (see Appendix A, *Construction Noise Modeling Outputs*). This represents a conservative estimate, because due to the linear nature of the project, a grader is not anticipated to be stationary in a single location near an NSLU.

As noted above, the City does not provide a numerical threshold for construction noise levels, but construction would be required to occur within the hours allowed by the Municipal Code. Existing ambient noise levels are described in the City's General Plan. Ambient noise levels may fluctuate throughout a given day or time of year, but Figure 5-2 of the General Plan Noise Element indicates that noise levels in the vicinity of the project are estimated to be between 60 and 65 dBA CNEL (City 2015). Therefore, noise levels from construction equipment may exceed 10 dBA above existing conditions if a grader or scraper is in use. Noise levels from construction would be reduced through the implementation of a construction management plan, as described in NOI-1 below.

NOI-1 Construction Noise Management Plan. Noise levels from project-related construction activities shall not exceed 10 dBA above existing ambient noise levels, or 70 dBA, when measured at nearby noise-sensitive land uses or receptors. A Construction Management Plan that describes the measures included on the construction plans to ensure compliance with the noise limit shall be prepared by the project applicant and submitted to the City of Carlsbad Planning Division for approval prior to issuance of the grading permit. The following measures may be included to reduce construction noise generated by graders and scrapers:

- Construction equipment to be properly outfitted and maintained with manufacturer-recommended noise-reduction devices.
- Diesel equipment to be operated with closed engine doors and equipped with factory-recommended mufflers.
- Mobile or fixed “package” equipment (e.g., arc-welders and air compressors) to be equipped with shrouds and noise control features that are readily available for that type of equipment.
- Electrically powered equipment to be used instead of pneumatic or internal-combustion powered equipment, where feasible.
- Unnecessary idling of internal combustion engines (e.g., in excess of 5 minutes) to be prohibited.
- Material stockpiles and mobile equipment staging, parking, and maintenance areas to be located as far as practicable from noise sensitive receptors.
- The use of noise-producing signals, including horns, whistles, alarms, and bells, shall be for safety warning purposes only.
- No project-related public address or music system shall be audible at any adjacent sensitive receptor.
- Temporary sound barriers or sound blankets may be installed between construction operations and adjacent noise-sensitive receptors. Due to equipment exhaust pipes being approximately 7 to 8 feet above ground, a sound wall at least 10 feet in height above grade, to block the line-of-sight between project construction activities and residences along the northern, southern, and eastern property lines. These barriers would mitigate noise levels to within acceptable levels. To effectively reduce noise levels, the sound barrier should be constructed of a material with an STC rating of 22 or 23 with no gaps or perforations and remain in place until the conclusion of demolition, grading, and construction activities.
- General working hours are Monday through Friday, 7:00 am- 6:00 pm. Site mustering (i.e., gathering/assembly at the site) is not allowed prior to and after the allowable working hours.

Construction Vibration

Construction of the project would occur approximately 60 feet from nearby residences and a hotel. A possible source of vibration during general project construction activities would be a vibratory roller, which may be used for compaction of soil beneath the roadway. A vibratory roller would create approximately 0.210 inch per second PPV at a distance of 25 feet (Caltrans 2020). A 0.210 inch per second PPV vibration level would equal 0.08 inch per second PPV at a distance of 60 feet.¹ This would be lower than the “strongly perceptible” impact for humans of 0.1 inches per second PPV. Buildings located within this distance are newer structures that would not be susceptible to structural damage. Additionally, off-site exposure to such ground-borne vibration would be temporary. Therefore, temporary impacts associated with the roller (and other potential equipment) would be less than significant.

CONCLUSIONS

Construction of the proposed project would result in less than significant impacts related to vibration. Construction noise from the use of a scraper or grader may exceed existing ambient noise conditions by 10 dBA or more, which may be perceived as a doubling of loudness. Mitigation measure NOI-1 would require a construction management plan to reduce noise levels from a scraper or grader, if used.

Sincerely,



Jason Runyan
Senior Acoustic Analyst

Attachments:

Figure 1: Regional Location
Figure 2: Aerial Photograph

Appendix A Construction Noise Modeling Outputs

REFERENCES

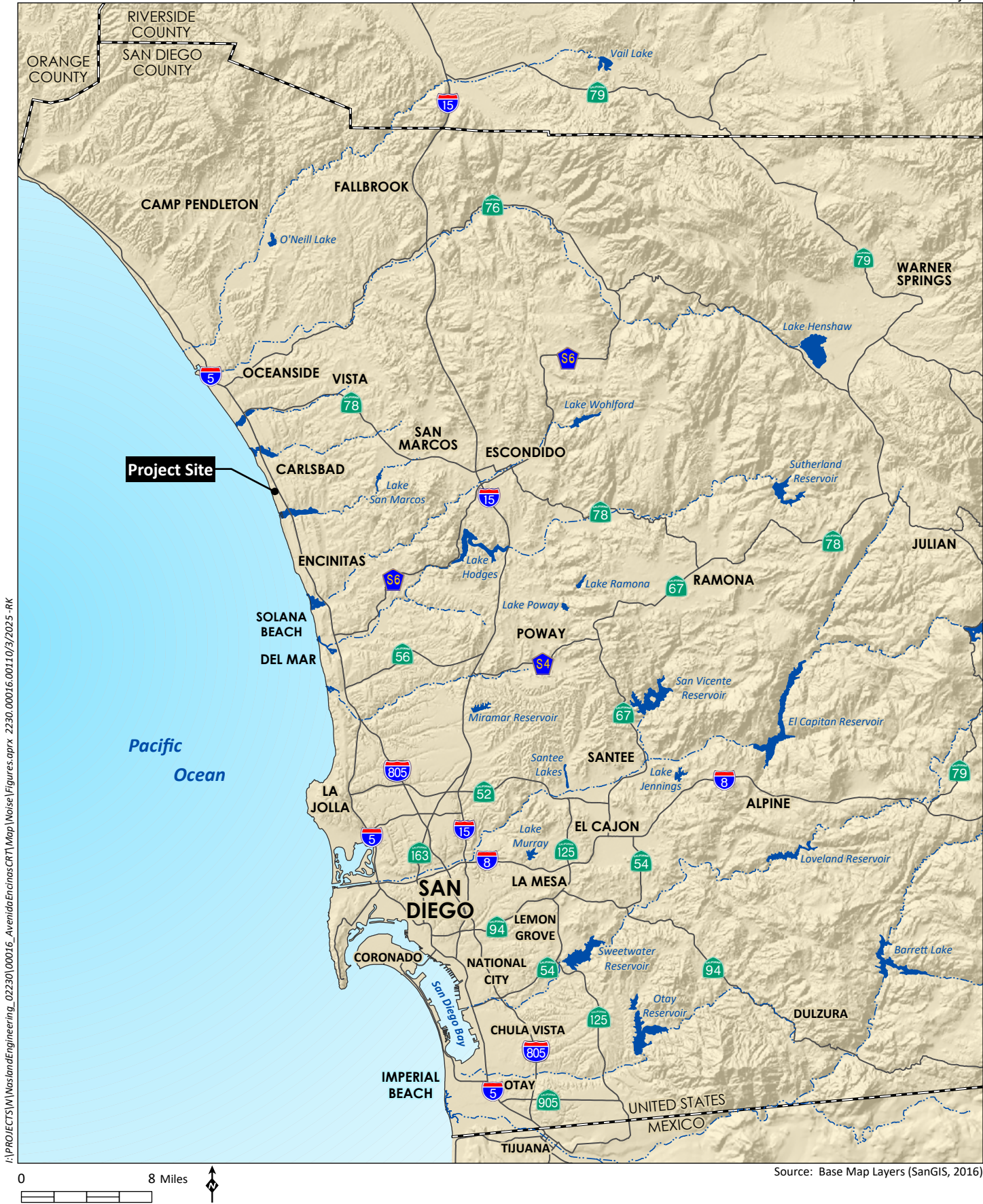
California Department of Transportation (Caltrans). 2020. Transportation and Construction Vibration Guidance Manual. April. Available at: <https://dot.ca.gov/programs/environmental-analysis/noise-vibration/guidance-manuals>.

¹ Equipment PPV = Reference PPV * (25/D)ⁿ (in/sec), where Reference PPV is PPV at 25 feet, D is distance from equipment to the receiver in feet, and n = 1.1 (the value related to the attenuation rate through the ground); formula from Caltrans 2020.

Carlsbad, City of (City). 2015. General Plan Noise Element. September 22.

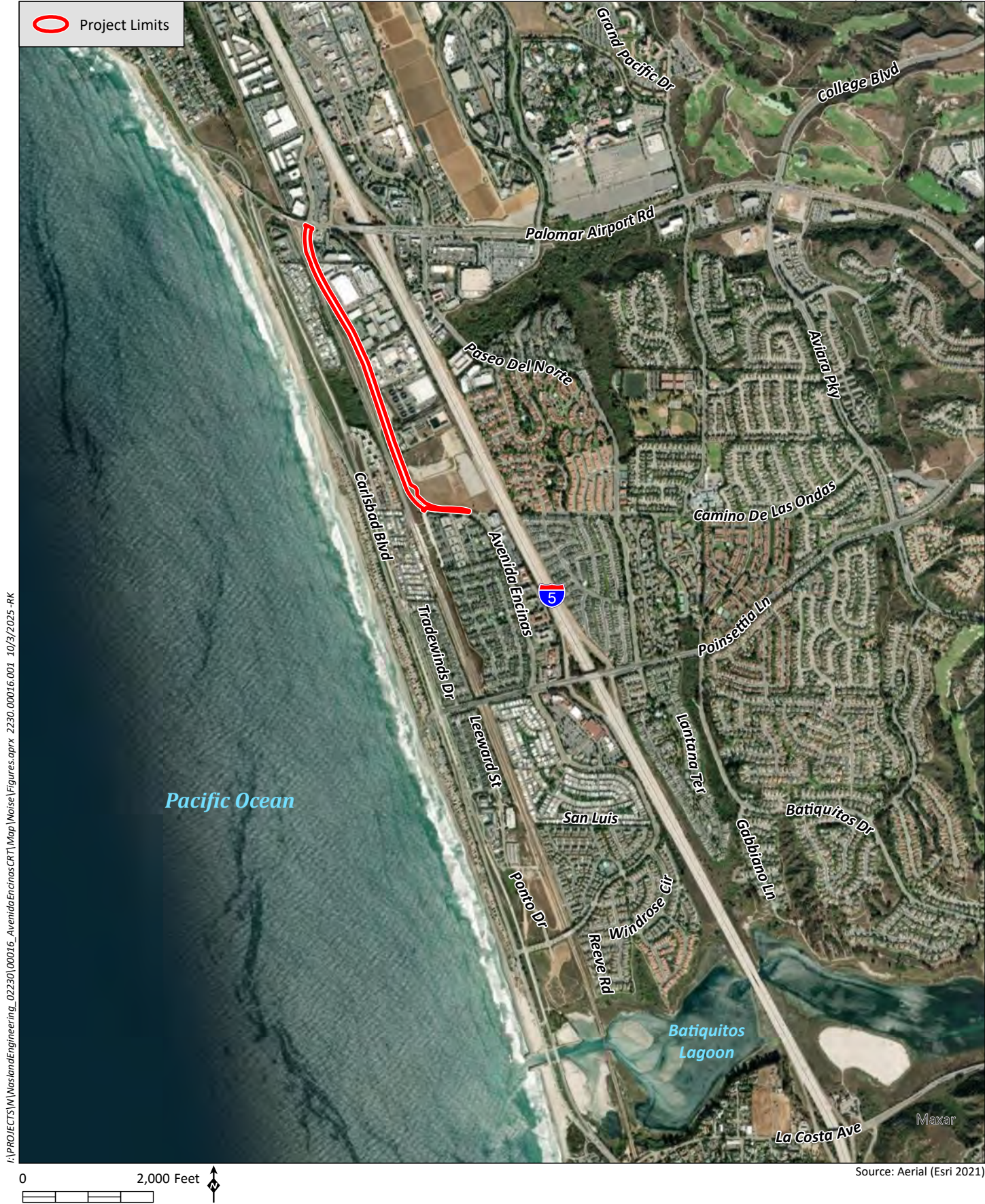
HELIX Environmental Planning, Inc. (HELIX). 2025. Air Quality and Greenhouse Gas Emissions Analysis for the Avenida Encinas Coastal Rail Trail and Pedestrian Improvements Project. September 16.

U.S. Department of Transportation. 2008. Roadway Construction Noise Model Version 1.1. Available at: https://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/.



Regional Location

Figure 1



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Appendix A

Construction Noise Modeling Outputs

Roadway Construction Noise Model (RCNM),Version 1.1

Report date 11/25/2024

Case Description:

		---- Receptor #1 ----					
		Baselines (dBA)					
Description	Land Use	Daytime	Evening	Night			
	1 Residential	40	40	40			
		Equipment					
		Spec	Actual	Receptor	Estimated		
		Lmax	Lmax	Distance	Shielding		
Description	Impact Device	Usage(%)	(dBA)	(dBA)	(feet)	(dBA)	
Backhoe	No	40		77.6	60	0	
Compactor (ground)	No	20		83.2	60	0	
Compressor (air)	No	40		77.7	60	0	
Concrete Mixer Truck	No	40		78.8	60	0	
Concrete Pump Truck	No	20		81.4	60	0	
Dozer	No	40		81.7	60	0	
Dump Truck	No	40		76.5	60	0	
Drum Mixer	No	50		80	60	0	
Excavator	No	40		80.7	60	0	
Front End Loader	No	40		79.1	60	0	
Mounted Impact Hammer	Yes	20		90.3	60	0	
Paver	No	50		77.2	60	0	
Roller	No	20		80	60	0	
Scraper	No	40		83.6	60	0	
Generator	No	50		80.6	60	0	
Grader	No	40	85		60	0	

Results

Equipment	Calculated (dBA)			Noise Limits (dBA)		
	*Lmax	Leq	Day	Leq	Evening	
			Lmax		Lmax	Leq
Backhoe	76	72	N/A	N/A	N/A	N/A
Compactor (ground)	81.6	74.7	N/A	N/A	N/A	N/A
Compressor (air)	76.1	72.1	N/A	N/A	N/A	N/A
Concrete Mixer Truck	77.2	73.2	N/A	N/A	N/A	N/A
Concrete Pump Truck	79.8	72.8	N/A	N/A	N/A	N/A
Dozer	80.1	76.1	N/A	N/A	N/A	N/A
Dump Truck	74.9	70.9	N/A	N/A	N/A	N/A
Drum Mixer	78.4	75.4	N/A	N/A	N/A	N/A
Excavator	79.1	75.1	N/A	N/A	N/A	N/A
Front End Loader	77.5	73.5	N/A	N/A	N/A	N/A
Mounted Impact Hammer	88.7	81.7	N/A	N/A	N/A	N/A
Paver	75.6	72.6	N/A	N/A	N/A	N/A
Roller	78.4	71.4	N/A	N/A	N/A	N/A
Scraper	82	78	N/A	N/A	N/A	N/A
Generator	79	76	N/A	N/A	N/A	N/A
Grader	83.4	79.4	N/A	N/A	N/A	N/A
Total	88.7	87.9	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 11/25/2024
Case Description:

---- Receptor #1 ----						
Baselines (dBA)						
Description	Land Use	Daytime	Evening	Night		
	1 Residential	40	40	40		
Equipment						
	Impact	Spec	Actual	Receptor	Estimated	
	Device	Usage(%)	Lmax	Lmax	Distance	Shielding
Description			(dBA)	(dBA)	(feet)	(dBA)
Excavator	No	40		80.7	60	0
Front End Loader	No	40		79.1	60	0

Results						
Calculated (dBA)			Noise Limits (dBA)			
			Day		Evening	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq
Excavator	79.1	75.1	N/A	N/A	N/A	N/A
Front End Loader	77.5	73.5	N/A	N/A	N/A	N/A
Total	79.1	77.4	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.