APPENDIX D

Noise Assessment Report

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Environmental Noise Assessment Report
Waikapu Country Town
Waikapu, Island of Maui, Hawaii

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1.0 EXECUTIVE SUMMARY

1.1 The proposed Waikapu Country Town project is located in the Waikapu community on the Island of Maui. The project site, consisting of approximately 1576 acres, is intersected by Honoapiilani Highway and is bordered by mostly agricultural fields to the east, with and south, and the residential community of Waikapu to the north. A majority of the land is zoned for agricultural uses and a small portion is zoned as an urban district. Waikapu Country town is proposed to be a "complete community" development with various categories of residential units (i.e., single family, mufti family, etc.) along with commercial and civic uses. The purpose of this environmental noise assessment is to evaluate potential noise impacts to the proposed development as well as to the surrounding community.

1.2 The project area is currently exposed to varying daytime ambient noise levels, depending on the proximity to major roadways. The areas adjacent to Honoapiilani Highway experience the highest ambient noise levels during peak traffic hours where vehicular traffic noise is the dominant noise source. Ambient noise levels range from 53 to 64 dBA adjacent to Honoapiilani Highway. The ambient noise environment is relatively low in areas that are far from the major roadways. The noise sources that exist throughout the project site include traffic, wind, birds, occasional aircraft flyovers, and construction equipment.

1.3 Development of project areas will involve excavation, grading, and other typical construction activities. The Waikapu Country Town project may impact the adjacent residential homes in the Waikapu community due to their proximity to the construction site. In addition, residences from the initial phases may be impacted by construction noise from subsequent phases. Noise from construction activities should be short term and must comply with State of Hawaii Department of Health (HDOH) noise regulations.

1.4 The various phases in the long range development plan will incorporate stationary mechanical equipment that is typical for commercial and residential buildings. Expected mechanical equipment may include air handling equipment, condensing units, refrigeration units, etc. Noise from this mechanical equipment and other equipment must meet the State Department of Health *Community Noise Control* rules, which stipulate maximum permissible noise limits at the property line. The design of the proposed Waikapu Country Town community should give consideration to controlling the noise emanating from stationary mechanical equipment so as to comply with the HDOH noise rules and to prevent noise impacts to the residences.

1.5 Future traffic volume increases on Honoapiilani Highway, Waiko Road and the surrounding roadways due to the development of the Waikapu Country Town project are not significant, i.e., less than 1 dB which is insignificant and less than the threshold of human perception.

1.6 For homes within the Waikapu Country Town development located more than 60 feet from the edge-of-pavement of Honoapiilani Highway, the FHWA maximum noise limit of 67 dBA will be satisfied. The projected traffic volumes and speed limits on the future roadways that provide access to the proposed development are expected to be insignificant.

1.7 To satisfy HUD site acceptability standards and reduce the noise impact to the Waikapu Country Town homes adjacent to Honoapiilani Highway, a minimum setback distance of 60 feet from the edge-of-pavement must be provided. If the minimum setback distance cannot be provided, additional noise mitigation options (such as a noise barrier wall) should be considered.

2.0 PROJECT DESCRIPTION

The proposed Waikapu Country Town project is located in the Waikapu community on the Island of Maui. The project site, consisting of approximately 1576 acres, is intersected by Honoapiilani Highway and is bordered by mostly agricultural fields to the east, with and south, and the residential community of Waikapu to the north. A majority of the land is zoned for agricultural uses and a small portion is zoned as an urban district. Waikapu Country town is proposed to be a "complete community" development with various categories of residential units (i.e., single family, mufti family, etc.) along with commercial and civic uses. The purpose of this environmental noise assessment is to evaluate potential noise impacts to the proposed development as well as to the surrounding community.

3.0 NOISE STANDARDS

Various local and federal agencies have established guidelines and standards for assessing environmental noise impacts and set noise limits as a function of land use. A brief description of common acoustic terminology used in these guidelines and standards is presented in Appendix A.

3.1 State of Hawaii, Community Noise Control (HDOH)

The State of Hawaii Community Noise Control Rule [Reference 1] defines three classes of zoning districts and specifies corresponding maximum permissible sound levels due to *stationary* noise sources such as air-conditioning units, exhaust systems, generators, compressors, pumps, etc. The Community Noise Control Rule does not address most *moving* sources, such as vehicular traffic noise, aircraft noise, or rail transit noise. However, the Community Noise Control Rule does regulate noise related to agricultural, construction, and industrial activities, which may not be stationary.

The maximum permissible noise levels for stationary mechanical equipment are enforced by the State of Hawaii Department of Health (HDOH) for any location at or beyond the property line and shall not be exceeded for more than 10% of the time during any 20-minute period. The specified noise limits which apply are a function of the zoning and time of day as shown in Figure 1. With respect to mixed zoning districts, the rule specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level. In determining the maximum permissible sound level, the background noise level is taken into account by HDOH.

The criteria for *impulse* or impact noise is separate from stationary noise due to the nature of the sound. HDOH defines impulse noise as " any sound with a rapid rise and decay of sound pressure level, lasting less than one second, caused by sudden contact between two or more surfaces…". Noise from pile driving is considered impulse noise and the maximum permissible noise level is 10 dB above the specified noise limits for stationary sources, as shown in Figure 1.

3.2 U.S. Federal Highway Administration (FHWA)

The FHWA regulation 23 CFR 772 contains highway traffic noise abatement criteria (NAC) for seven land use activity categories and assigns corresponding maximum hourly equivalent sound levels ($L_{eq(h)}$) for traffic noise exposure [Reference 2, 3]. The Noise Abatement Criteria (NAC) for all seven categories are listed in Figure 2. Due to the mixed-use nature of the proposed project, Waikapu Country Town would fall under Categories B, C and E. The limits are viewed as design goals, and all projects meeting these limits are deemed in conformance with FHWA noise standards.

3.3 State of Hawaii Department of Transportation (HDOT)

The HDOT has implemented the requirements of the FHWA's design goals for traffic noise exposure in its noise analysis and abatement policy [Reference 4]. According to the policy, a traffic noise impact occurs when the predicted traffic noise levels "approach" or exceed FHWA's NAC or when the predicted traffic noise levels "substantially exceed the existing noise levels." The policy also states that "approach" is defined as 1 dB less than FHWA's NAC and "substantially exceed" is defined as an increase of at least 15 dB.

3.4 U.S. Environmental Protection Agency (EPA)

The U.S. EPA has identified a range of yearly day-night equivalent sound levels (L_{dn}) sufficient to protect public health and welfare from the effects of environmental noise [Reference 5]. The EPA has established a goal to reduce exterior environmental noise to an L_{dn} not exceeding 65 dBA and a future goal to further reduce exterior environmental noise to an L_{dn} not exceeding 55 dBA. Additionally, the EPA states that these goals are not intended as regulations as it has no authority to regulate noise levels, but rather they are intended to be viewed as levels below which the general population will not be at risk from any of the identified effects of noise.

3.5 U.S. Department of Housing and Urban Development (HUD)

HUD's environmental noise criteria and standards in 24 CFR 51 [Reference 6] were established for determining housing project site acceptability. These standards are based on day-night equivalent sound levels, L_{dn}, and are not limited to traffic noise exposure. However, for project sites in the vicinity of highways, the L_{dn} may be estimated to be equal to the design hour $L_{eq(h)}$, provided "heavy trucks (vehicles with three or more axles) do not exceed 10 percent of the total traffic flow in vehicles per 24 hours and the traffic flow between 10:00 p.m. and 7:00 a.m. does not exceed 15 percent of the average daily traffic flow in vehicles per 24 hours." For these same conditions, L_{dn}, may also be estimated as 3 dB less than the design hour L_{10}. The HUD Site Acceptability Standards for exterior sound levels are summarized in Table 1. However, HUD also recommends the EPA's L_{dn} 55 dBA goal for outdoors in residential areas.

Table 1. HUD Site Acceptability Standards

Category	Day-Night Sound Level	Comments
Acceptable	Less than or equal to 65 dBA	No special acoustical design consideration necessary
Normally Unacceptable	Greater than 65 dBA, but less than or equal to 70 dBA	5 dB additional attenuation required through use of barriers or in design to ensure interior noise levels are acceptable
	Greater than 70 dBA, but less than or equal to 75 dBA	10 dB addition attenuation required through the use of barriers or in design to ensure interior noise levels are acceptable
Unacceptable	Greater than 75 dBA	Attenuation measures must be submitted on a case-by-case basis

The intent of the L_{dn} 65 dBA outside criteria is to achieve 45 dBA indoors, however, the standard also applies to locations where quiet outdoor space is required. HUD will sometimes allow upgrades to the building shell to meet an interior L_{dn} of 45 in Normally Unacceptable or Unacceptable areas. This can be accomplished by specifying building facades, windows, and doors with a higher STC rating than normal construction.

3.6 Community Response to Change in Noise Level

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, the average ability of an individual to perceive changes in noise levels is well documented and has been summarized in Table 2 [Reference 7]. These guidelines permit direct estimation of an individual's probable perception of changes in noise levels.

Table 2. Average Ability to Perceive Changes in Noise Level

Sound Level Change (dB)	Human Perception of Sound
0	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	Two times (or 1/2) as loud
20	Four times (or 1/4) as loud

A commonly applied criterion for estimating a community's response to changes in noise level is the 'community response scale' proposed by the International Standards Organization (ISO) of the United Nations [Reference 8]. The scale shown in Table 3 relates changes in noise level to the degree of community response and allows for direct estimation of the probable response of a community to a predicted change in noise level.

Table 3. Community Response to Increases in Noise Levels

Sound Level Change (dB)	Category	Response Description
0	None	No observed reaction
5	Little	Sporadic Complaints
10	Medium	Widespread Complaints
15	Strong	Threats of Community Action
20	Very Strong	Vigorous Community Action

The values stated in Tables 2 and 3 should not be considered regulatory requirements because they are not associated with a specific governing document for this project. However, these tables are very useful in assessing the human perception to changes in sound levels and they are considered to be supplemental information to the governing State of Hawaii Community Noise Control Rule, which does not discuss community response to changes in noise levels.

4.0 EXISTING ACOUSTICAL ENVIRONMENT

Two types of noise measurements were conducted to assess the existing acoustical environment in the vicinity of the project location. The first noise measurement type consisted of continuous long-term ambient noise level measurements. The second type of noise measurement was short-term and included traffic counts. The purpose of the short-term noise measurements and corresponding traffic counts is to calibrate the traffic noise prediction model. The noise measurements were conducted between June 26, 2014 and June 29, 2014.

The methodology, location, and results for each of the measurements are described below and the measurement locations are illustrated in Figure 3. Photographs of the measurements locations are provided in Appendix B.

4.1 Long Term Noise Measurements

Continuous long-term ambient noise level measurements were conducted to assess the existing acoustical environment in the vicinity of the project site. Long-term measurements (taken continuously over the course of multiple days) offer a baseline for establishing

existing ambient noise levels in the area and are used for estimating future noise levels by adding the ambient levels to other noise levels generated from the proposed project.

4.1.1 Long-Term Noise Measurement Procedure

Hourly equivalent sound levels were recorded for approximately 3 days at one location. The measurements were taken using a Larson-Davis, Model 820, Type 1 Sound Level Meter together with a Gras, Model 40AQ Type 1 Microphone. Calibration was checked before and after the measurements with a Larson-Davis Model CAL200 calibrator. Both the sound level meter and the calibrator have been certified by the manufacturer within the recommended 2-year calibration period. The microphones were mounted on tripods at 8 feet above grade. A windscreen covered the microphone during the entire measurement period. The sound level meter was secured in weather-resistant cases.

4.1.2 Long-Term Noise Measurement Locations

Location L1: The sound level meter was located near the center of the project site, adjacent to the Maui Tropical Plantation events stage. This location is approximately 280 from the edge-of-pavement to Honoapiilani Highway. The dominant noise source was vehicular traffic from the highway. Secondary noise sources included birds, wind, occasional aircraft flyovers. There was also intermittent construction noise near the stage area during the measurement period.

4.1.3 Long-Term Noise Measurement Results

The measured $L_{eq(h)}$ and the 90 percent exceedance level (L_{90}) in dBA are graphically presented in Figure 4. The ambient sound levels at L1 were dynamic and depended significantly on the vehicular traffic patterns of the highway (where higher ambient noise levels occurred during peak traffic hours). The range of $L_{eq(h)}$ during the day (7:00 AM to 10:00 PM) and during the night (10:00 PM to 7:00 AM) and average calculated day-night level are summarized in Table 4 below.

Table 4. Summary of Noise Measurement Results (dBA)

Measurement Location	7 AM-10 PM $L_{eq(h)}$ Range	10 PM-7 AM $L_{eq(h)}$ Range	Average L_{dn}
L1 – Project Site Central	53-64	49-59	62

4.2 Short Term Noise Measurements

An approximate 30-minute L_{eq} was measured at two locations approximately 50 feet from the edge-of-pavement of Honoapiilani Highway and Waiko Road. Vehicular traffic counts and traffic mix were documented during the measurement period. The noise measurement was taken using a Larson-Davis Laboratories, Model 824, Type-1 Sound Level Meter together with a Larson-Davis, Model 2541 Type-1 Microphone. Calibration will was checked before and after the measurement with a Larson-Davis Model CAL200 calibrator. Both the sound level meter and the calibrator have been certified by the manufacturer within the recommended calibration period.

5.0 POTENTIAL NOISE IMPACTS

5.1 Project Construction Noise and Compliance with HDOH Community Noise Control Rule

The various construction phases of the project will generate significant amounts of noise. Depending on when construction occurs, the Waikapu Country Town development may impact existing adjacent properties, such as the homes and businesses adjacent to Honoapiilani Highway and Waiko Road. Similarly, residences from the initial phases may be impacted by construction noise from subsequent phases due to their proximity to the construction site.

Development of the project areas will involve excavation, grading, and other typical construction activities during construction. The use of impact equipment is not anticipated. The actual noise levels produced during construction will be a function of the methods employed during each stage of the construction process. Typical ranges of construction equipment noise are shown in Figure 5. Earthmoving equipment, e.g., bulldozers and diesel-powered trucks, will probably be the loudest equipment used during construction. In cases where construction noise is expected to exceed the HDOH "maximum permissible" property line noise levels, a permit must be obtained to allow the operation of construction equipment.

5.2 Project Generated Stationary Mechanical Noise and Compliance with HDOH Community Noise Control Rule

The Waikapu Country Town development is proposed to be a “complete community” which includes several categories of residential units (i.e., single family, mufti family, etc.) along with neighborhood retail and commercial uses, parks, open space, and a school. The town will be surrounded by agricultural land.

The various phases in the long range development plan will incorporate stationary mechanical equipment that is typical for commercial buildings. Expected mechanical equipment may include air handling equipment, condensing units, refrigeration units, etc. Noise from this mechanical equipment at the commercial, mixed-use, and school sites could significantly impact the proposed adjacent noise sensitive residential areas. The HDOH Community Noise Rule stipulates maximum permissible noise limits at the property line for mechanical equipment. The noise limits are 60 dBA during the day and 50 dBA during the night for business and commercial areas. Mitigation of mechanical noise to meet the HDOH noise rules should be incorporated into the project design. For mixed zoning districts, the primary land use designation is used to determine the maximum permissible noise limits. However, the HDOH takes into consideration background noise levels when assessing noise infractions.

The build out of residential units in the long range development plan may also incorporate stationary exterior mechanical equipment. For single family homes, noise limits are 55 dBA during the day and 45 dBA during the night. For multi-family homes, noise limits are 60 dBA during the day and 50 dBA during the night. As with the commercial build out, the design and selection of exterior mechanical equipment for the residential units must comply with the HDOH property line noise limits.

5.3 Vehicular Traffic Noise and Compliance with FHWA/HDOT Noise Limits

A vehicular traffic noise analysis was completed using the DataKustik CadnaA (version 4.4) software program [Reference 9] for the existing conditions (2013), and future year 2026 projections including the “with project” and “without project” conditions. The traffic noise analysis was based on the peak hour AM and PM traffic volumes provided by the Traffic Consultant [Reference 10]. Intersection geometric configurations and speed limits were also provided by the traffic consultant.

Vehicular traffic noise level contours were calculated throughout the project site and surrounding community. The noise measurement and corresponding traffic counts were used to validate the software at noise measurement locations L1, S1, and S2. The results of the traffic noise analysis for the existing and future year projections are shown graphically in Figures 6 to 8 for the peak AM traffic hour. The calculated hourly equivalent traffic noise levels are not significantly different for the peak AM and peak PM hour, i.e., less than 1 dB, so only the peak AM traffic contours have been presented.

5.3.1 Vehicular Traffic Noise Impacts on the Surrounding Community

Impacts on the surrounding community can be determined by comparing the estimated noise levels for the "future with the project" condition to the "future without the project" condition. Based on the Traffic Consultant's study, future traffic volume increases due to the development of the proposed project are not significant on Honoapiilani Highway, Kuihelani Highway, and Waiko Road. Therefore, existing residences located in the nearby Waikapu community will not experience a significant traffic noise increase due to the proposed Waikapu Country Town development. The change in daytime noise level (future with project vs. future without project) for the community is graphically represented in Figure 9. The yellow contours signify an increase of up to 3 dB which is less than the threshold of human perception. As shown in the figure, existing homes in the surrounding community are not expected to experience an increase in noise level of more than 1 dB and are unlikely to react to the insignificant increase in vehicular traffic noise.

5.3.2 Vehicular Traffic Noise Impacts on the Project

Future year traffic projections show that the FHWA maximum noise limit of 67 dBA will be satisfied for homes that are located more than 60 feet from the edge-of-pavement of Honoapiilani Highway. Although the FHWA criteria is not a regulatory requirement for this project, as it has no authority to enforce land use, its noise limit criteria is recommended by the FHWA to be used as a guideline for consideration of land use and the impact of traffic noise.

The projected traffic volumes and speed limits on the future roadways that provide access to the Waikapu Country Town development are not significant enough to generate noise levels greater than 60 dB at the adjacent residential property lines. This is true for the main access roads off of Honoapiilani Highway as well as the future Waiale Road extension.

5.4 Project Site Noise and Compliance with EPA and HUD Noise Guidelines

The results from the long-term noise measurements conducted at the Waikapu Country Town site indicate that the existing day-night level is less than 60 dBA for areas located beyond 65 feet from the edge-of-pavement of Honoapiilani Highway. Therefore, the noise levels for a majority of the project site are within the HUD site acceptability standards, which state a design goal of $L_{dn} \leq 65$ dBA for the exterior noise level.

The EPA has an existing design goal of $L_{dn} \leq 65$ dBA and a future design goal $L_{dn} \leq 55$ dBA for exterior noise levels. Noise levels at the project site are currently within both the EPA existing and future design goals at locations beyond 380 feet from the edge-of-pavement of Honoapiilani Highway.

Residences within the Waikapu Country Town development that are located along Honoapiilani Highway and the major perimeter roadways will be exposed to elevated traffic noise. HUD site acceptability standards must be satisfied by providing minimum setback distances or other traffic noise mitigation measures in order to reduce the noise impact to these homes.

It is important to note that the HUD and EPA noise guidelines are design goals and not enforceable regulations, although the HUD site acceptability standards must be satisfied for projects involving HUD or federal financing. However, these guidelines and design goals are useful tools for assessing the noise environment.

6.0 NOISE IMPACT MITIGATION

6.1 HDOH Noise Permit

In cases where construction noise exceeds, or is expected to exceed the State's "maximum permissible" property line noise levels [Reference 1], a permit must be obtained from HDOH to allow the operation of vehicles, cranes, construction equipment, power tools, etc., which emit noise levels in excess of the "maximum permissible" levels.

In order for HDOH to issue a construction noise permit, the contractor must submit a noise permit application to HDOH, which describes the construction activities for the project. Prior to issuing the noise permit, HDOH may require action by the contractor to incorporate noise mitigation into the construction plan. HDOH may also require the contractor to conduct noise monitoring or community meetings inviting the neighboring residents and business owners to discuss construction noise. The contractor should use reasonable and standard practices to mitigate noise, such as using mufflers on diesel and gasoline engines, using properly tuned and balanced machines, etc. However, HDOH may require additional noise mitigation, such as temporary noise barriers, or time of day usage limits for certain kinds of construction activities.

Specific permit restrictions for construction activities [Reference 1] are:

> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels ... before 7:00 AM and after 6:00 PM of the same day, Monday through Friday."
>
> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels... before 9:00 AM and after 6:00 PM on Saturday."
>
> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels on Sundays and on holidays."

Although not anticipated during construction of the housing development, the use of pile drivers, hoe rams and jack hammers 25 pounds (lbs.) or larger, high pressure sprayers, and chain saws are restricted to 9:00 AM to 5:30 PM, Monday through Friday. In addition, construction equipment and on-site vehicles or devices whose operations involve the exhausting of gas or air, excluding pile hammers and pneumatic hand tools weighing less than 15 pounds (lbs.), must be equipped with mufflers [Reference 1].

The HDOH noise permit does not limit the noise level generated at the construction site, but rather the times at which noisy construction can take place. However, when considering a noise permit application, consideration is also given to any proposed noise mitigation for the project. Therefore, noise mitigation for construction activities should be addressed using project management and the source and path noise control measures discussed in Section 6.3 below.

6.2 HDOH Noise Variance

In cases where nighttime construction is expected, a variance must be obtained from the HDOH to allow the operation of a noise source which emits noise levels in excess of the maximum permissible levels and which operation does not conform to the requirements of the noise permit (i.e., nighttime construction activities which occur between 6:00 p.m. and

7:00 a.m., Monday through Friday). However, nighttime construction is not anticipated for this project so a variance will not be required.

6.3 Mitigation of Construction Noise

6.3.1 Mitigation of Noise Source

Mitigating construction noise at the source is the most effective form of noise control. The source control methods listed in Table 5 below can be applied to most construction equipment.

Table 5. Construction Noise Source Control Methods

Scheduling	Limit activities that generate the most noise to less sensitive time periods (e.g. daytime hours).
Substitution	Use quieter methods/equipment when possible (e.g. low noise generators, smaller excavators, etc.).
Exhaust Mufflers	Install quality mufflers on equipment.
Reduced Power Options	Use smallest size and/or lowest power as required.
Quieter Backup Alarms	Install manual adjustable or ambient sensitive alarms. Do not use backup alarms during night work.
Motors	Insulate or enclose motors
Equipment Selection	Electric equipment is quieter than pneumatic equipment
Equipment Retrofit	Rubber chucks in jackhammers
Equipment Maintenance	Sharpen and balance tools, repair silencing equipment, replace worn parts and open airways
Staging Area	Maximize the distance between the construction staging areas and nearby receptors to the greatest extent possible

In general, a majority of the construction noise mitigation is in the form of scheduling, specifically, limiting the construction hours to the time frame specified by the HDOH. The jackhammer is expected to be the most disruptive piece of equipment used during the construction process so the allowable hours of operation are even more restrictive, as described in Section 6.1.

6.3.2 Mitigation of Noise Path

When source control measures are not sufficient to avoid a noise impact, path control measures must be considered. Non-permanent noise barriers or curtains and equipment enclosures could be installed at the construction site to reduce construction noise in noise sensitive locations. The general contractor could also conduct noise monitoring of construction during noisy or extensive activities at locations close to residential properties.

6.4 Mitigation of Development Noise

The site and building design of the new Waikapu Country Town development should give consideration to controlling the noise emanating from stationary mechanical equipment so as to comply with the HDOH Community Noise Rules [Reference 1]. The location of mechanical equipment on residential, commercial, mixed-use and school properties should take into account proximity to the nearest noise sensitive receiver to reduce noise impacts. For example, outside condensing units should be located far from the neighboring residence's windows or area of outside use (such as a lanai or yard). If sufficient space is not provided between the noise source and receiver, the equipment may require some form of mitigation. Typical noise mitigation for stationary equipment such as air-conditioning and ventilation equipment, refrigerators, compressors, etc, includes mufflers, silencers, acoustical enclosures, noise barrier walls, etc.

A noise map of Waikapu Country Town development, as shown in Figure 10, illustrates the expected noise levels due to AM traffic and stationary mechanical equipment at the commercial, mixed use, and school sites. The graphic assumes that mechanical equipment noise has been mitigated to comply with the daytime property line noise limit of 60 dBA. Refer to Section 5.3 for a description of the traffic noise projections.

6.5 Mitigation of Vehicular Traffic Noise

Vehicular traffic noise from Honoapiilani Highway may impact the proposed development unless noise mitigation is considered.

6.5.1 Mitigation Through Setbacks or Buffer Zones

According to the FHWA's Highway Traffic Noise Analysis and Abatement Guidance [Reference 3], "the FHWA encourages State and local governments to practice compatible land use planning and control near highways. Local governments may use their power to regulate land development to prohibit noise-sensitive land uses adjacent to a highway, or require developers to plan, design, and construct projects that minimize highway traffic noise impacts on adjacent developments." Although the FHWA criteria is not a regulatory requirement for this project, as it has no authority to enforce land use, its noise limit criteria is recommended by the FHWA to be used as a guideline for consideration of land use and the impact of traffic noise. Furthermore, HUD site acceptability standards must be satisfied for projects involving HUD or federal financing. The setback distances shown in Table 6 are recommended to minimize traffic noise impact and be in compliance with the FHWA's maximum exterior $L_{eq(h)}$ noise limit of 67 dBA and the HUD site acceptability standard of L_{dn} 65 dBA. The setback should be measured from the roadway edge-of-pavement.

Table 6. Minimum Setback Distances to Satisfy HUD Site Acceptability Standards

Roadway	Setback Distance
Honoapiilani Highway	60 feet
Future Waiale Road Extension	None required
Future Main Street	None required
Future Collector and Minor Streets	None Required

6.5.2 Additional Noise Mitigation Options

A comprehensive traffic noise and barrier analysis using roadway layout data and the FHWA Traffic Noise Model Software was not performed. The guidelines listed below are general in nature and should be applied where residential housing is constructed within the setback limits listed above and noise mitigation becomes necessary. The following are effective noise mitigation measures.

- Construct barrier walls and/or earth berms along roadways.
- Air-condition buildings instead of relying on natural ventilation.
- Acoustically soften interior spaces by the addition of thick carpeting with a padding underlayment, an acoustical tile ceiling, louvered closet doors, etc.
- Use exterior wall constructions which exhibit high noise reductions.

Typical exterior-to-interior noise reductions for naturally ventilated homes, i.e., with open windows, are approximately 9 dB. Adding absorption to interior spaces, (acoustically softening), can further reduce the noise levels 1 to 5 dB, depending upon the absorption initially present, and the amount of absorption added to the space. Air-conditioned or mechanically ventilated homes will also typically exhibit

higher exterior-to-interior noise reductions achieved by several types of building constructions.

Estimating the noise reduction provided by a barrier, however, is more difficult to generalize. Factors such as distances to roadways and setbacks, intervening ground conditions, barrier construction, barrier height, roadway elevations, etc., will determine the noise reduction afforded by a traffic noise barrier. In general, a 5 to 10 dB reduction can be expected.

REFERENCES

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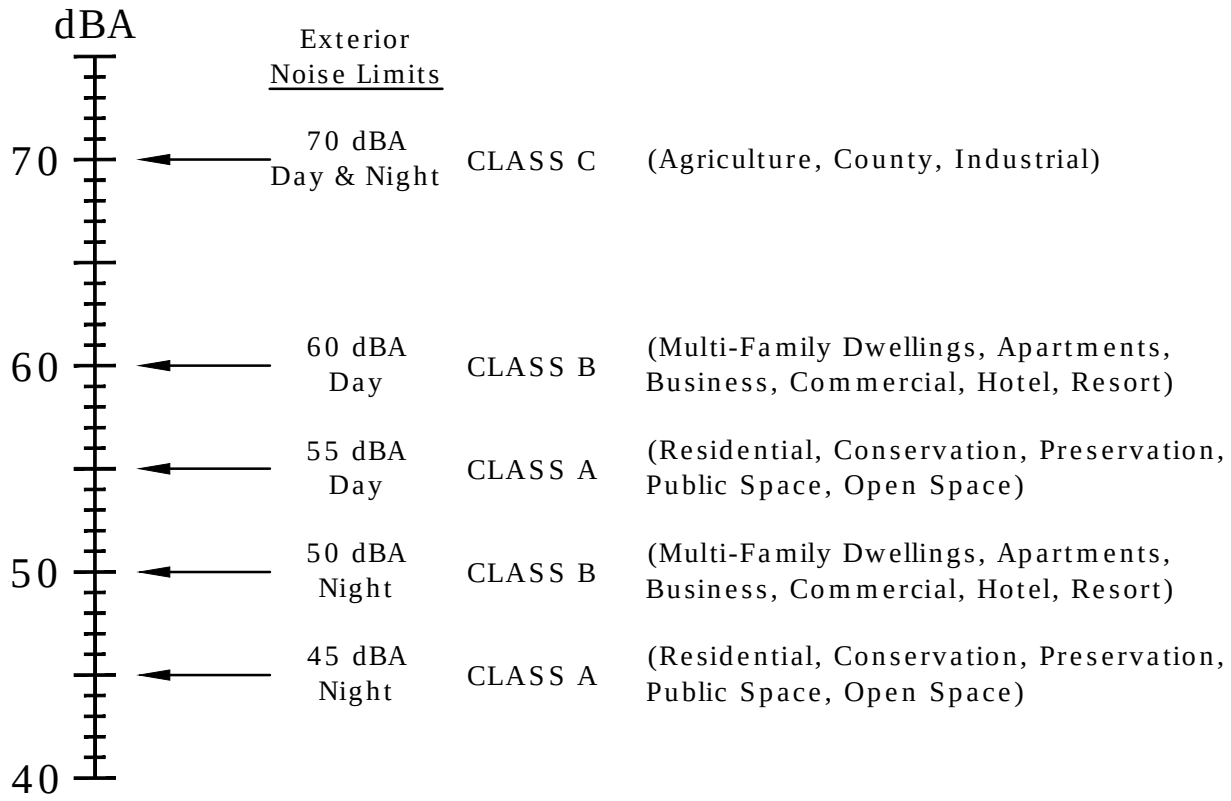
HAWAII DEPARTMENT OF HEALTH MAXIMUM PERMISSIBLE SOUND LEVELS FOR VARIOUS ZONING DISTRICTS

Zoning District	Day Hours (7 AM to 10 PM)	Night Hours (10 PM to 7 AM)
CLASS A Residential, Conservation, Preservation, Public Space, Open Space	55 dBA (Exterior)	45 dBA (Exterior)
CLASS B Multi-Family Dwellings, Apartments, Business, Commercial, Hotel, Resort	60 dBA (Exterior)	50 dBA (Exterior)
CLASS C Agriculture, Country, Industrial	70 dBA (Exterior)	70 dBA (Exterior)



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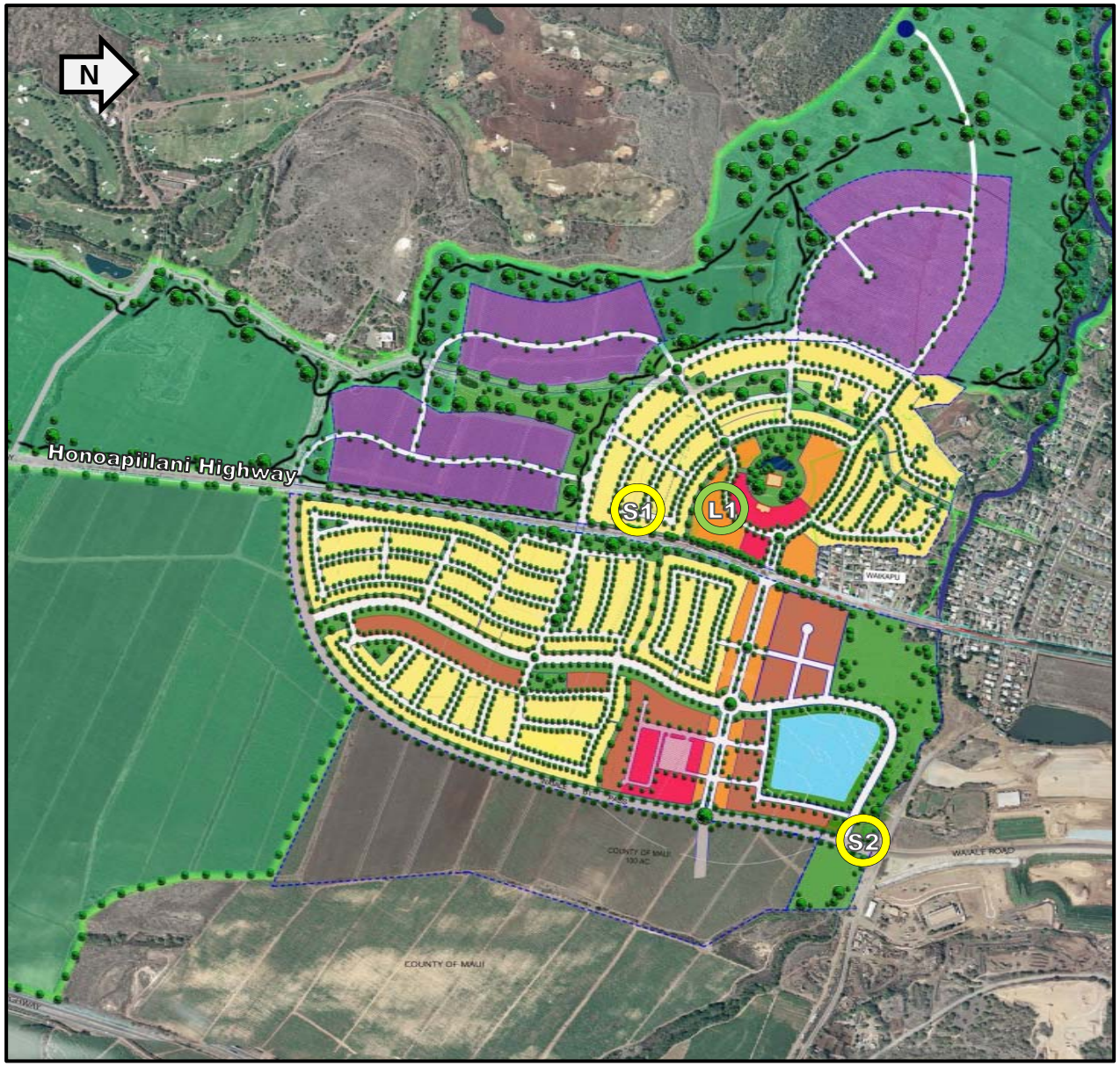
PROJECT: Waikapu Country Town		
PROJECT NO: 13-06	DATE: January 2015	FIGURE: 1

FEDERAL HIGHWAY ADMINISTRATION NOISE ABATEMENT CRITERIA FOR HIGHWAY NOISE

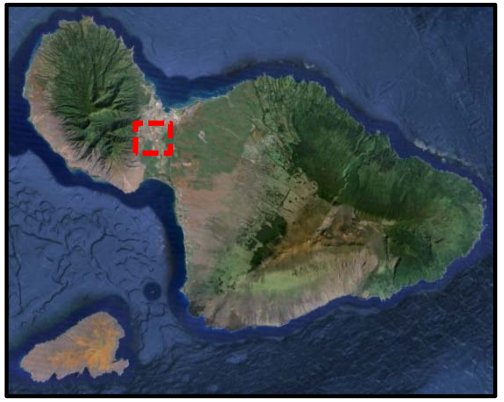
ACTIVITY CATEGORY	ACTIVITY CATEGORY DESCRIPTION	HOURLY EQUIVALENT SOUND LEVEL L_{eq}
A	LANDS ON WHICH SERENITY AND QUIET ARE OF EXTRAORDINARY SIGNIFICANCE AND SERVE AN IMPORTANT PUBLIC NEED AND WHERE THE PRESERVATION OF THOSE QUALITIES IS ESSENTIAL IF THE AREA IS TO CONTINUE TO SERVE ITS INTENDED PURPOSE.	57 dBA (EXTERIOR)
B	RESIDENTIAL	67 dBA (EXTERIOR)
C	ACTIVE SPORT AREAS, AMPHITHEATERS, AUDITORIUMS, CAMPGROUNDS, CEMETERIES, DAY CARE CENTERS, HOSPITALS, LIBRARIES, MEDICAL FACILITIES, PARKS, PICNIC AREAS, PLACES OF WORSHIP, PLAYGROUNDS, PUBLIC MEETING ROOMS, PUBLIC OR NONPROFIT INSTITUTIONAL STRUCTURES, RADIO STUDIOS, RECORDING STUDIOS, RECREATION AREAS, SECTION 4(F) SITES, SCHOOLS, TELEVISION STUDIOS, TRAILS, AND TRAIL CROSSINGS	67 dBA (EXTERIOR)
D	AUDITORIUMS, DAY CARE CENTERS, HOSPITALS, LIBRARIES, MEDICAL FACILITIES, PLACES OF WORSHIP, PUBLIC MEETING ROOMS, PUBLIC OR NONPROFIT INSTITUTIONAL STRUCTURES, RADIO STUDIOS, RECORDING STUDIOS, SCHOOLS, AND TELEVISION STUDIOS .	52 dBA (INTERIOR)
E	HOTELS, MOTELS, OFFICES, RESTAURANTS/BARS, AND OTHER DEVELOPED LANDS, PROPERTIES OR ACTIVITIES NOT INCLUDED IN A-D OR F.	72 dBA (EXTERIOR)
F	AGRICULTURE, AIRPORTS, BUS YARDS, EMERGENCY SERVICES, INDUSTRIAL, LOGGING, MAINTENANCE FACILITIES, MANUFACTURING, MINING, RAIL YARDS, RETAIL FACILITIES, SHIPYARDS, UTILITIES (WATER RESOURCES, WATER TREATMENT, ELECTRICAL), AND WAREHOUSING	N/A
G	UNDEVELOPED LANDS THAT ARE NOT PREMITTED	N/A

Site Plan and Noise Measurement Locations



Legend

- **Long Term Noise Measurement Location**
- **Short Term Noise Measurement Location**



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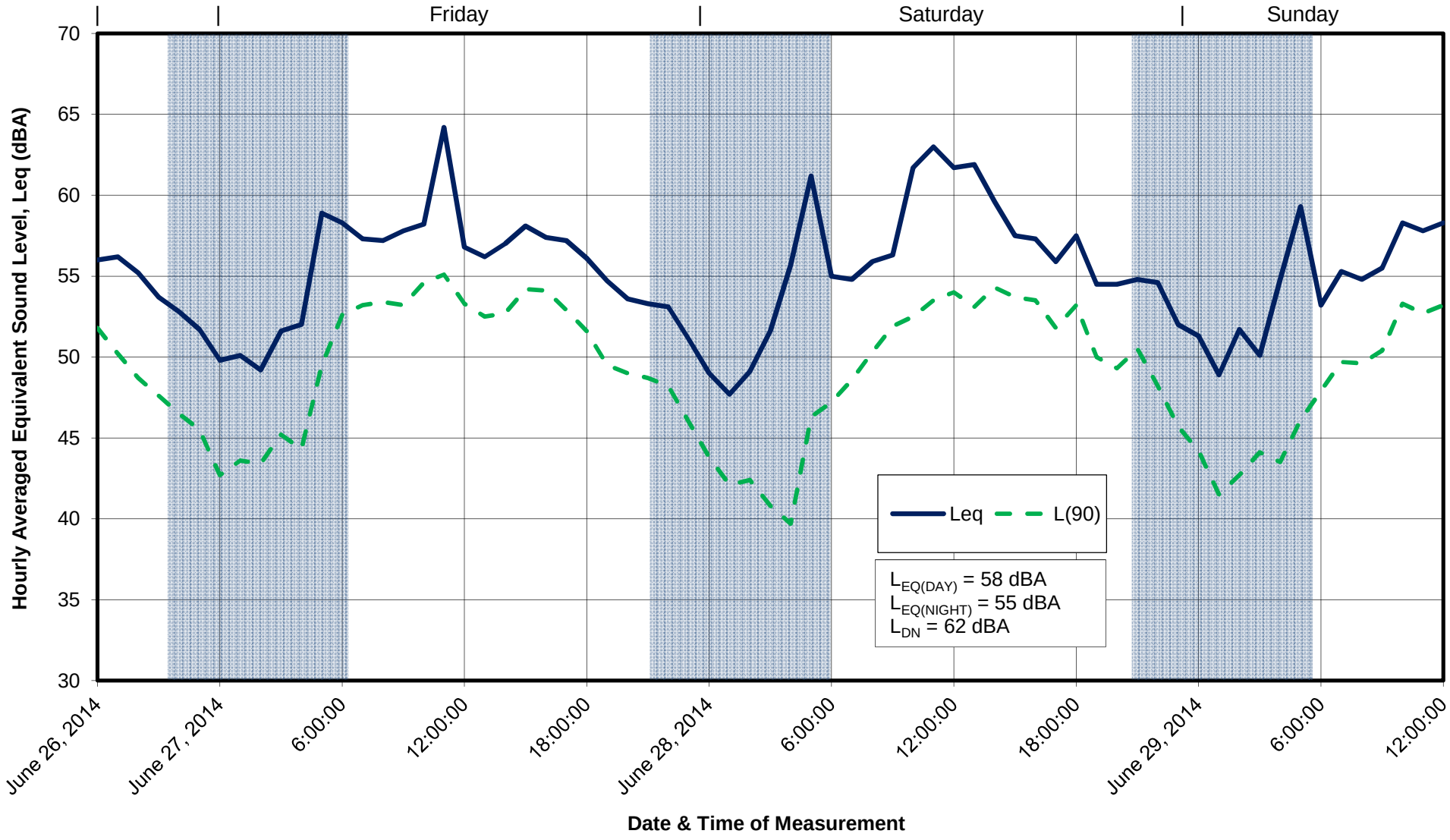
PROJECT NO:	DATE:	FIGURE:
13-06	January 2015	3

Long Term Noise Measurements - Location L1



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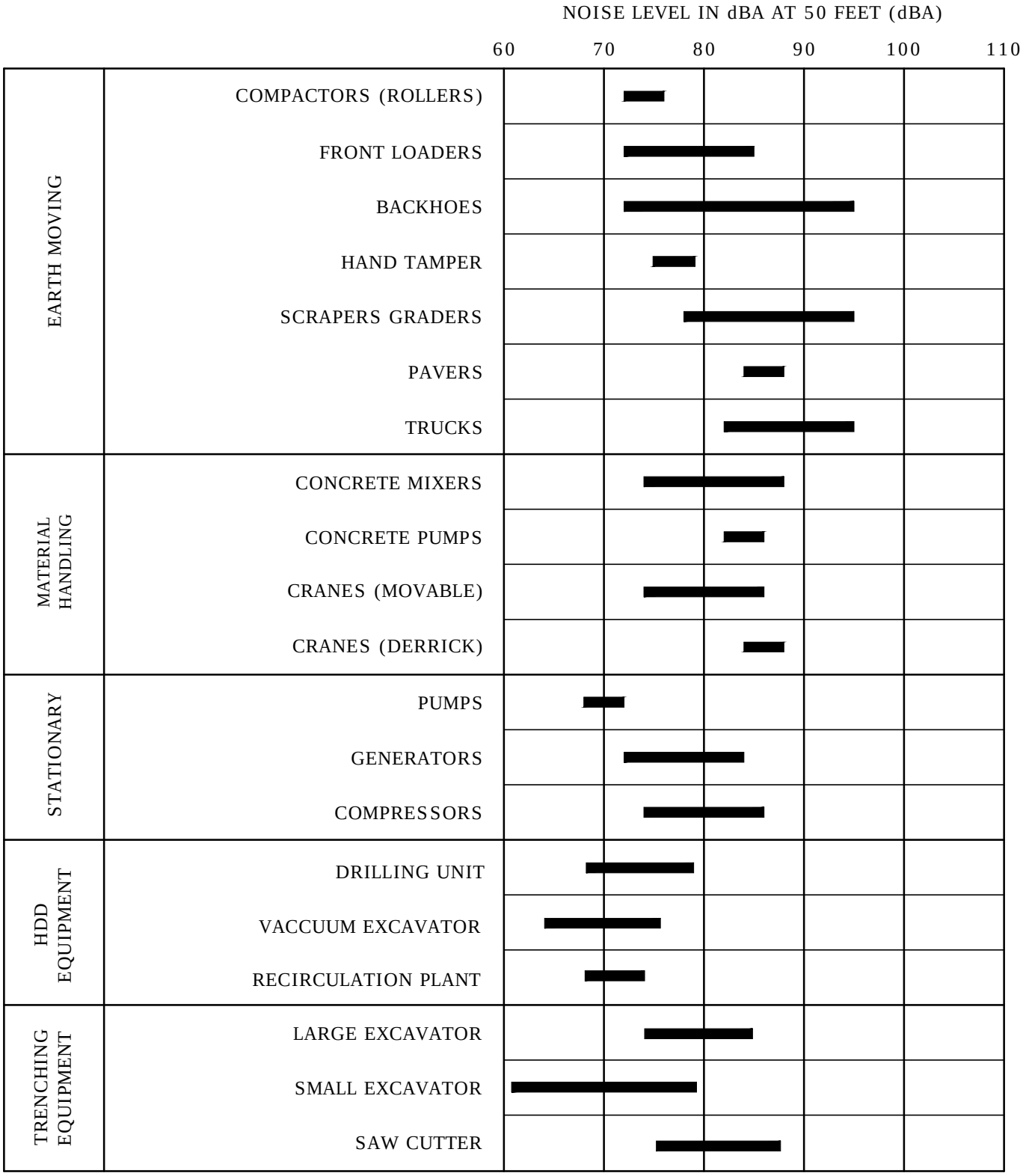
	PROJECT NO: 13-06	DATE: January 2015	FIGURE: 4

TYPICAL NOISE LEVELS FROM CONSTRUCTION EQUIPMENT



NOTE: BASED ON LIMITED AVAILABLE DATA SAMPLES

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PROJECT NO: 13-06	DATE: January 2015	FIGURE: 5

Vehicular Traffic Noise Contours – Existing Project Condition

Noise Level Contours

- = 40-45 dBA
- = 45-50 dBA
- = 50-55 dBA
- = 55-60 dBA
- = 60-65 dBA
- = 65-70 dBA
- = 70-75 dBA

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PROJECT NO:	DATE:	FIGURE:
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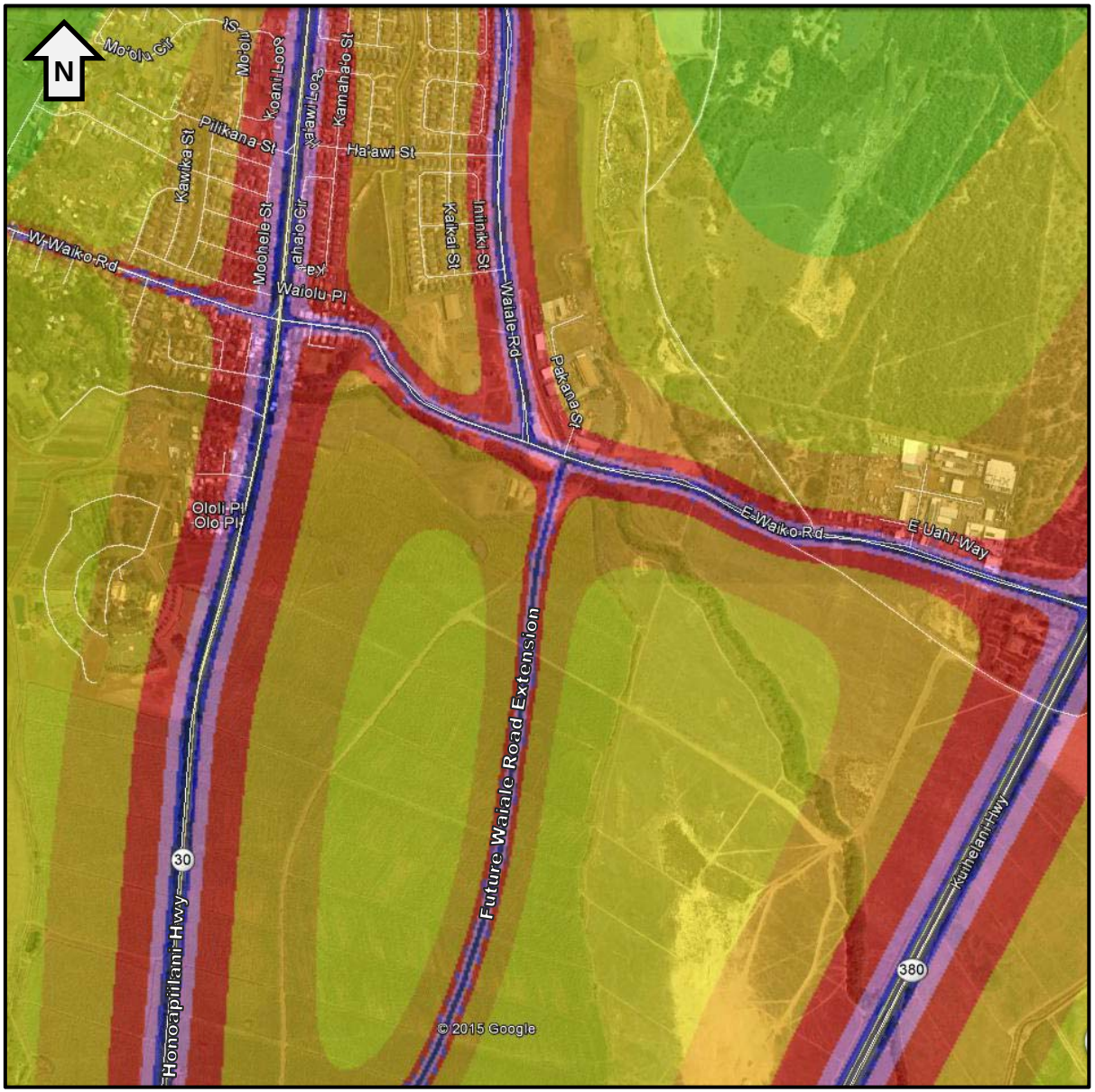
Vehicular Traffic Noise Contours – Future without Project Condition



Noise Level Contours

- = 40-45 dBA
- = 45-50 dBA
- = 50-55 dBA
- = 55-60 dBA
- = 60-65 dBA
- = 65-70 dBA
- = 70-75 dBA

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PROJECT NO:	DATE:	FIGURE:
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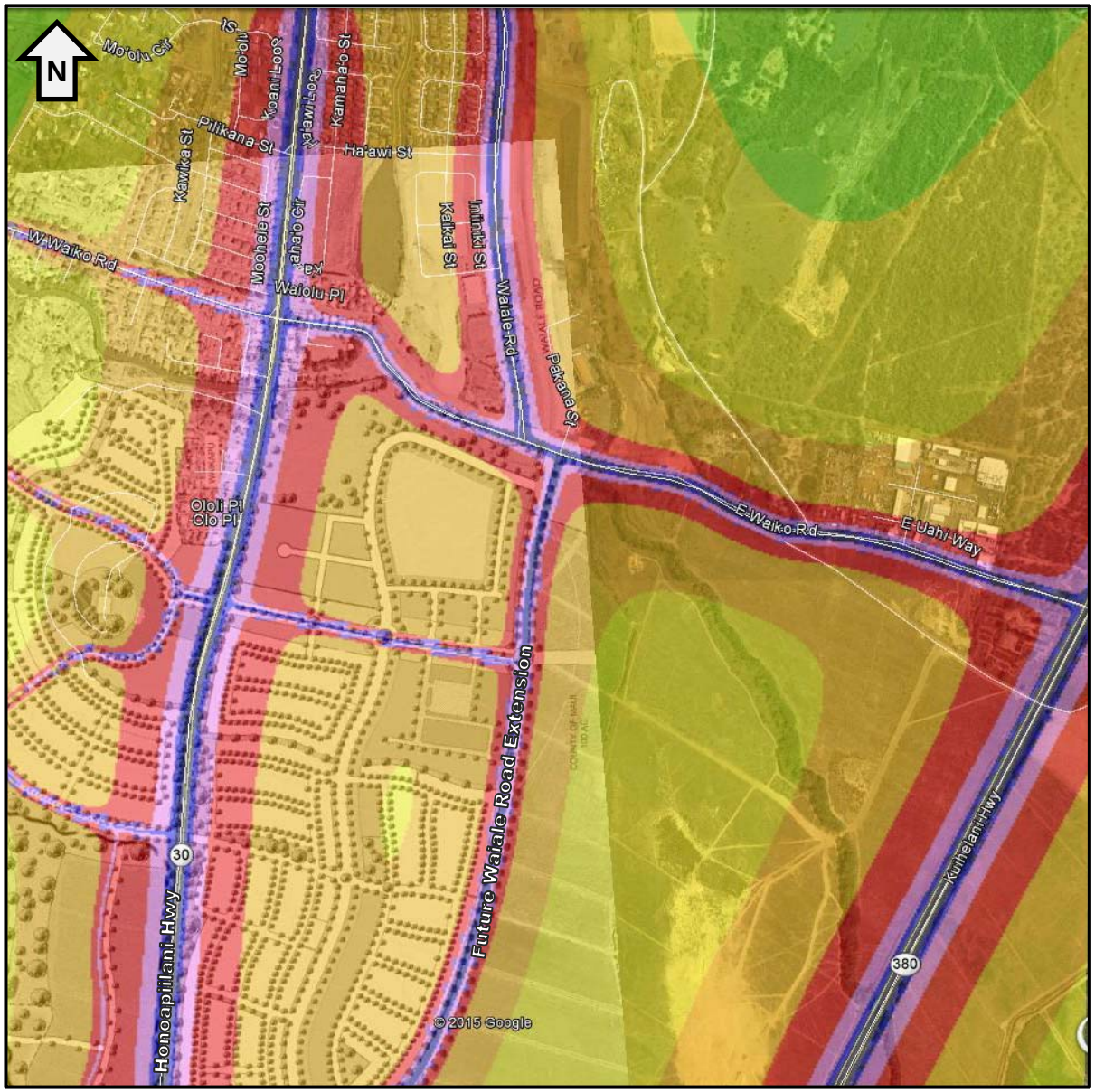
Vehicular Traffic Noise Contours – Future with Project Condition



Noise Level Contours

- = 40-45 dBA
- = 45-50 dBA
- = 50-55 dBA
- = 55-60 dBA
- = 60-65 dBA
- = 65-70 dBA
- = 70-75 dBA

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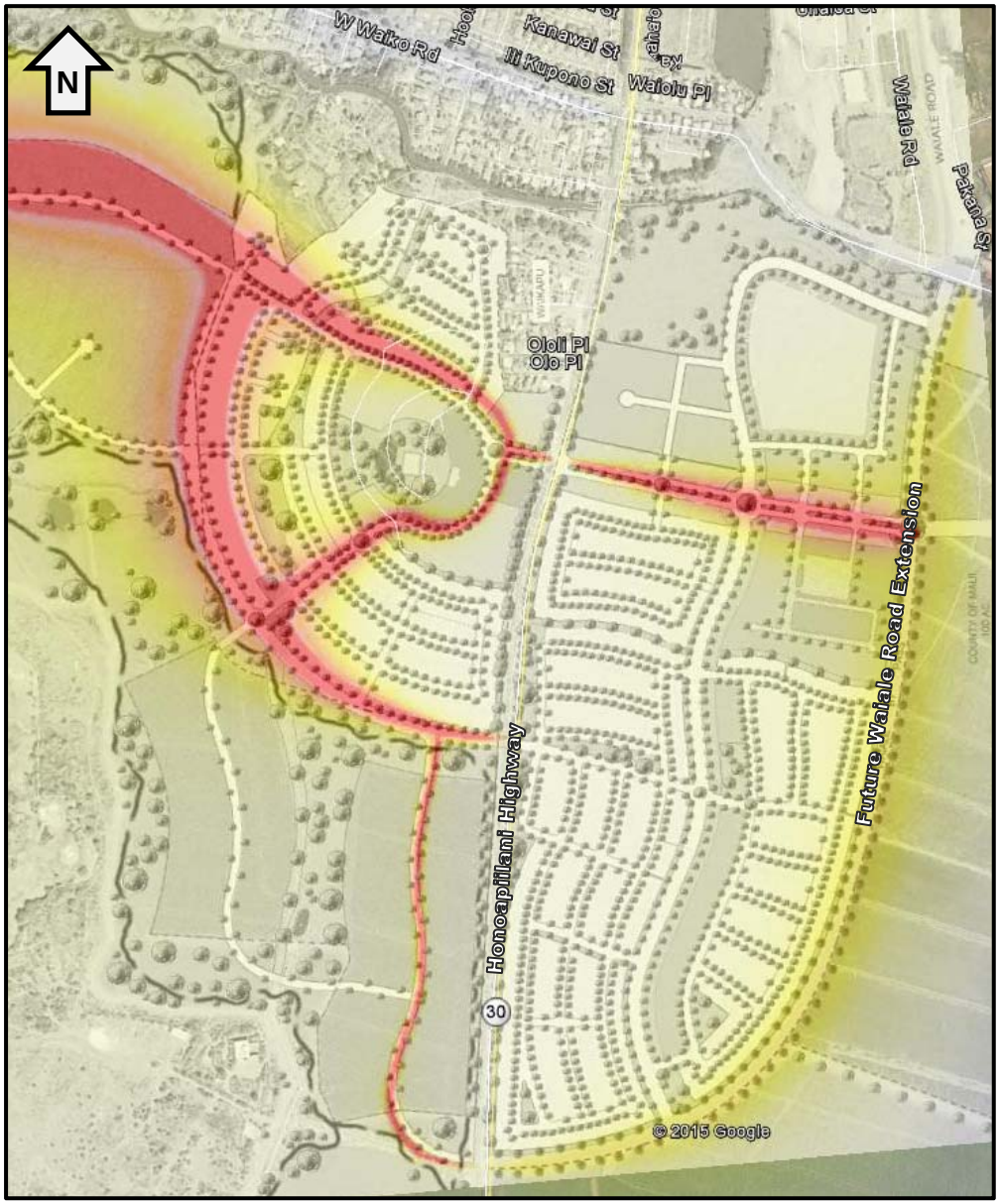
Projected Change in Traffic Noise Levels Due to Project



Daytime Traffic Noise Delta Contours

= Δ 1-3 dB
= Δ 3-5 dB
= Δ >5 dB

Δ = "Future with Project" - "Future without Project"

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PROJECT NO:	DATE:	FIGURE:
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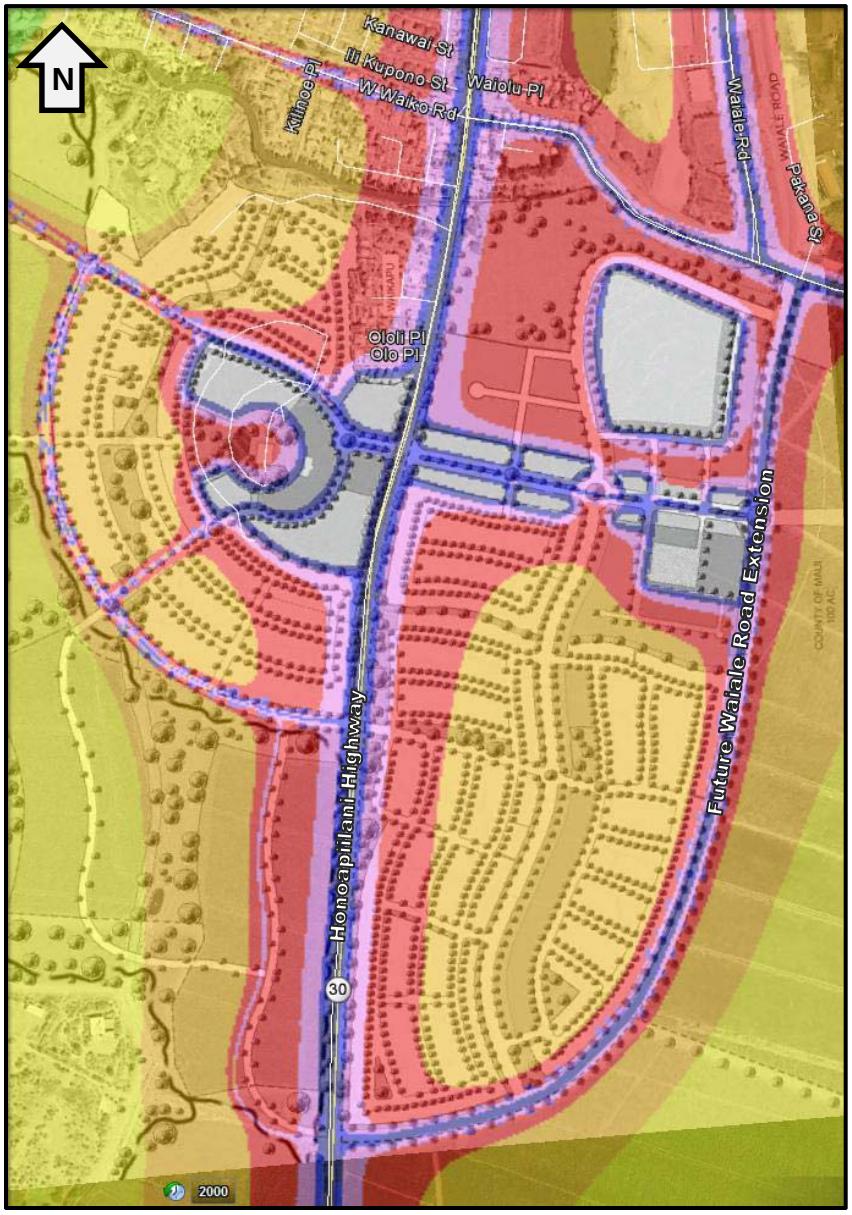
Waikapu Country Town Noise Map



Noise Level Contours

- = 40-45 dBA
- = 45-50 dBA
- = 50-55 dBA
- = 55-60 dBA
- = 60-65 dBA
- = 65-70 dBA
- = 70-75 dBA

Noise map includes daytime vehicular traffic and stationary mechanical equipment at the commercial, mixed use, and school sites.

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PROJECT NO:	DATE:	FIGURE:
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APPENDIX A

Acoustic Terminology

Acoustic Terminology

Sound Pressure Level

Sound, or noise, is the term given to variations in air pressure that are capable of being detected by the human ear. Small fluctuations in atmospheric pressure (sound pressure) constitute the physical property measured with a sound pressure level meter. Because the human ear can detect variations in atmospheric pressure over such a large range of magnitudes, sound pressure is expressed on a logarithmic scale in units called decibels (dB). Noise is defined as Aunwanted@ sound.

Technically, sound pressure level (SPL) is defined as:

$$SPL = 20 \log (P/P_{ref}) \text{ dB}$$

where P is the sound pressure fluctuation (above or below atmospheric pressure) and P_{ref} is the reference pressure, 20 µPa, which is approximately the lowest sound pressure that can be detected by the human ear. For example:

If P = 20 µPa, then SPL = 0 dB
If P = 200 µPa, then SPL = 20 dB
If P = 2000 µPa, then SPL = 40 dB

The sound pressure level that results from a combination of noise sources is not the arithmetic sum of the individual sound sources, but rather the logarithmic sum. For example, two sound levels of 50 dB produce a combined sound level of 53 dB, not 100 dB. Two sound levels of 40 and 50 dB produce a combined level of 50.4 dB.

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, in general, a change of 1 or 2 dB in the level of sound is difficult for most people to detect. A 3 dB change is commonly taken as the smallest perceptible change and a 6 dB change corresponds to a noticeable change in loudness. A 10 dB increase or decrease in sound level corresponds to an approximate doubling or halving of loudness, respectively.

A-Weighted Sound Level

Studies have shown conclusively that at equal sound pressure levels, people are generally more sensitive to certain higher frequency sounds (such as made by speech, horns, and whistles) than most lower frequency sounds (such as made by motors and engines)[1] at the same level. To address this preferential response to frequency, the A-weighted scale was developed. The A-weighted scale adjusts the sound level in each frequency band in much the same manner that the human auditory system does. Thus the A-weighted sound level (read as "dBA") becomes a single number that defines the level of a sound and has some correlation with the sensitivity of the human ear to that sound. Different sounds with the same A-weighted sound level are perceived as being equally loud. The A-weighted noise level is commonly used today in environmental noise analysis and in noise regulations. Typical values of the A-weighted sound level of various noise sources are shown in Figure A-1.

[1] D.W. Robinson and R.S. Dadson, AA Re-Determination of the Equal-Loudness Relations for Pure Tones,@ *British Journal of Applied Physics*, vol. 7, pp. 166 - 181, 1956. (Adopted by the International Standards Organization as Recommendation R-226.

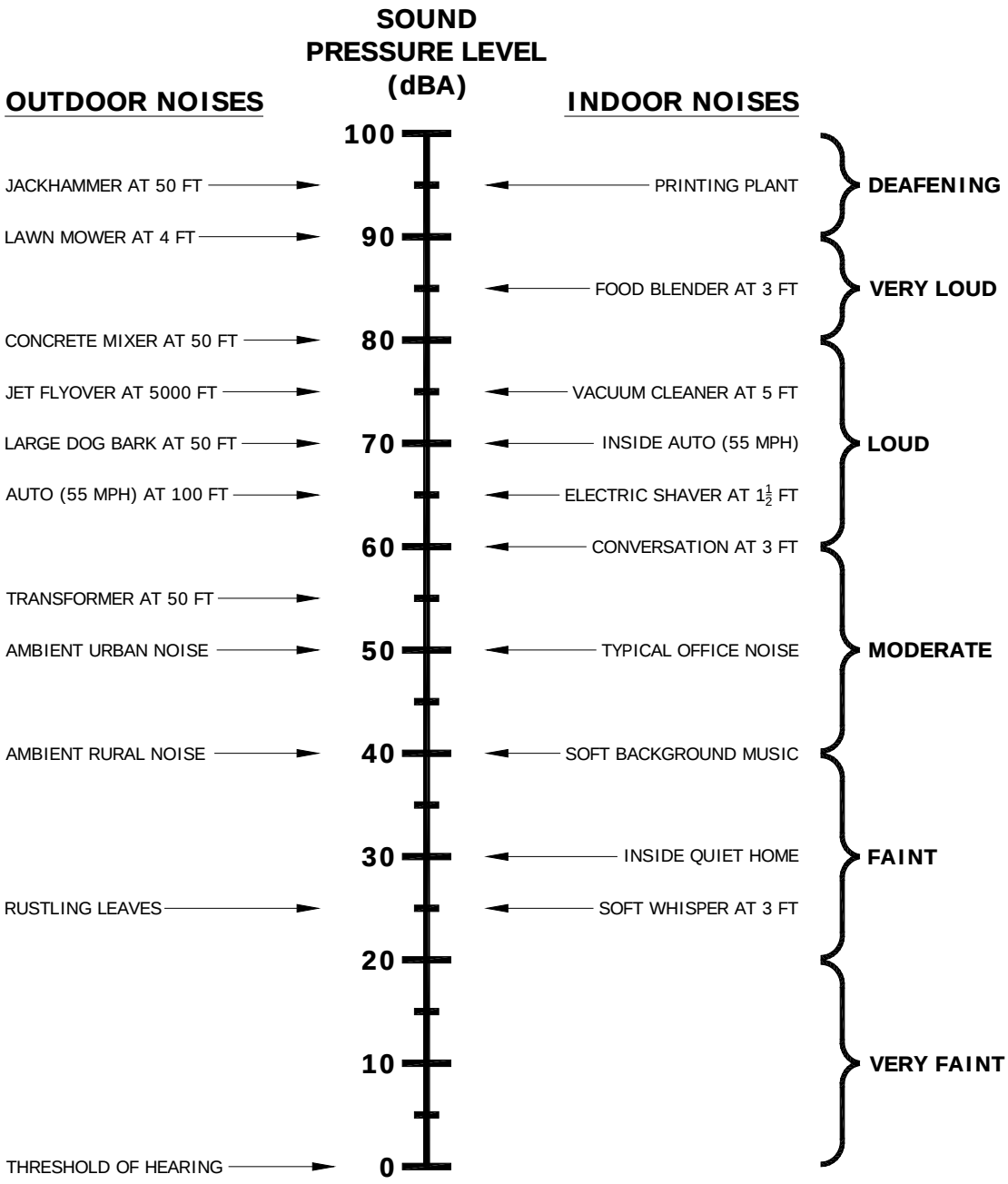


Figure A-1. Common Outdoor/Indoor Sound Levels

Equivalent Sound Level

The Equivalent Sound Level (L_{eq}) is a type of average which represents the steady level that, integrated over a time period, would produce the same energy as the actual signal. The actual *instantaneous* noise levels typically fluctuate above and below the measured L_{eq} during the measurement period. The A-weighted L_{eq} is a common index for measuring environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

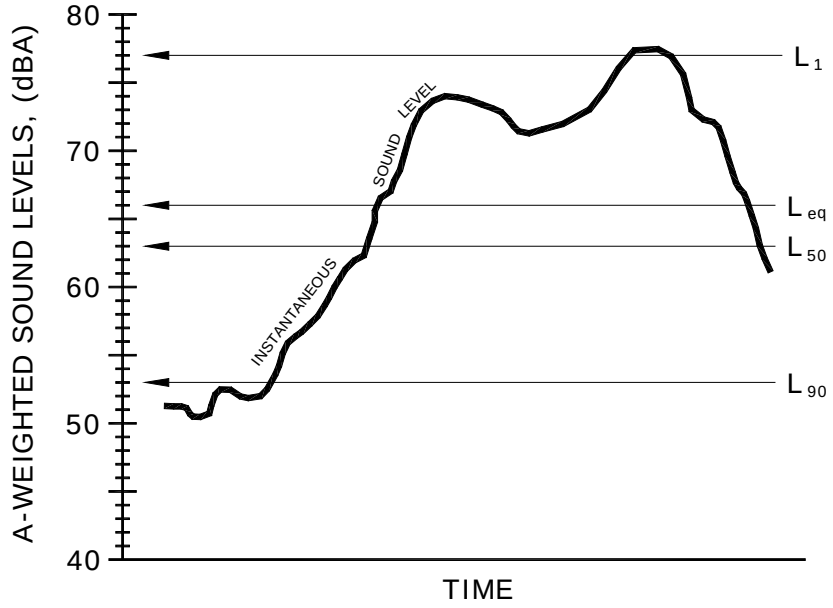


Figure A-2. Example Graph of Equivalent and Statistical Sound Levels

Statistical Sound Level

The sound levels of long-term noise producing activities such as traffic movement, aircraft operations, etc., can vary considerably with time. In order to obtain a single number rating of such a noise source, a statistically-based method of expressing sound or noise levels has been developed. It is known as the Exceedence Level, L_n. The L_n represents the sound level that is exceeded for n% of the measurement time period. For example, L_{10} = 60 dBA indicates that for the duration of the measurement period, the sound level exceeded 60 dBA 10% of the time. Typically, in noise regulations and standards, the specified time period is one hour. Commonly used Exceedence Levels include L_{01}, L_{10}, L_{50}, and L_{90}, which are widely used to assess community and environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

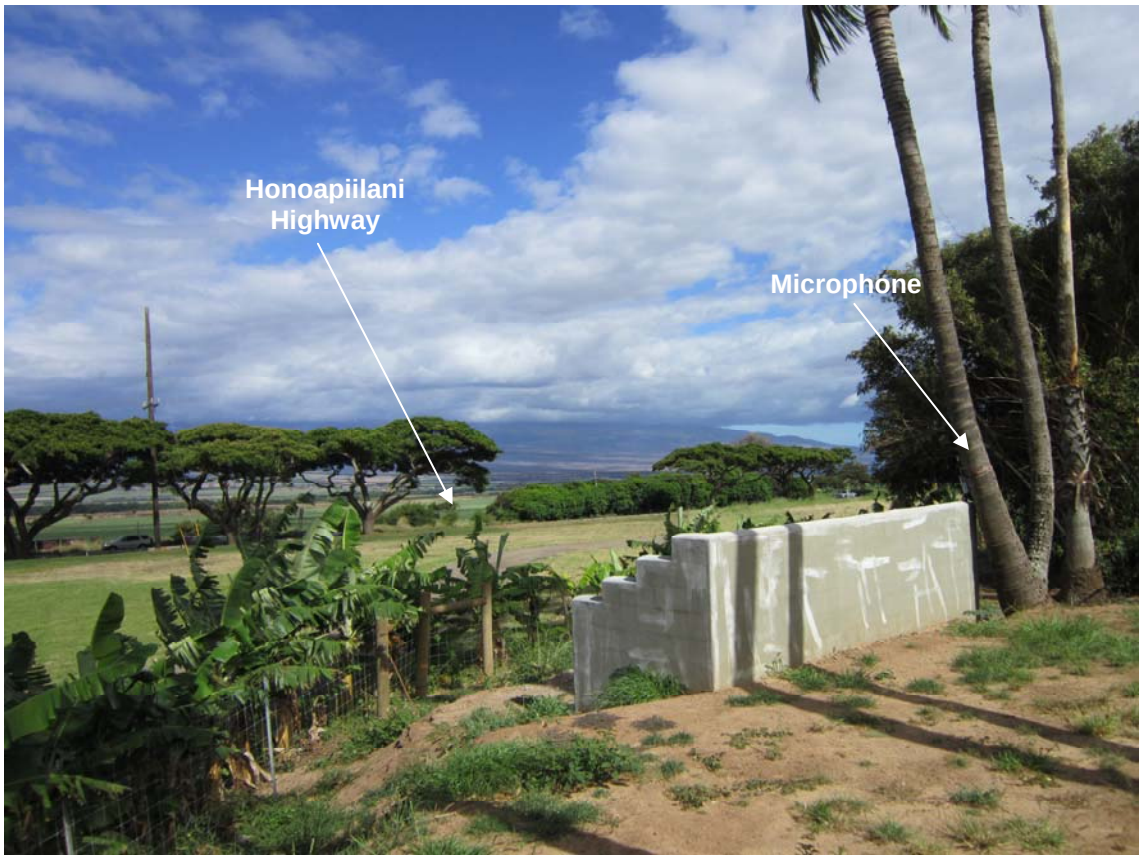
Day-Night Equivalent Sound Level

The Day-Night Equivalent Sound Level, L_{dn}, is the Equivalent Sound Level, L_{eq}, measured over a 24-hour period. However, a 10 dB penalty is added to the noise levels recorded between 10 p.m. and 7 a.m. to account for people's higher sensitivity to noise at night when the background noise level is typically lower. The L_{dn} is a commonly used noise descriptor in assessing land use compatibility, and is widely used by federal and local agencies and standards organizations.

APPENDIX B

Photographs at Project Site

.



Location L1

Located at the center of the project site near the events stage, approximately 280 feet from Honoapiilani Highway.

Microphone mounted on a tripod in palm tree approximately 8' above grade.