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Environmental Noise Assessment Report
University of Hawaii West Oahu Campus
Kapolei, Oahu, Hawaii

June 2006

DLAA Project No. 05-18

Prepared for:
University of Hawaii
Honolulu, Hawaii

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1.0 EXECUTIVE SUMMARY

1.1 The project area is currently exposed to daytime ambient noise levels of 42 to 57 dBA, with the dominant noise sources being traffic, wind, and occasional distant aircraft fly overs. Along the northern edge of the site, the ambient noise levels range from 48 to 63 dBA due to the proximity of Farrington Highway.

1.2 Development of project areas will involve excavation, grading, and other typical construction activities during construction. The UH West Oahu project is not expected to impact adjacent properties, however, residences from the initial phases may be impacted by construction noise from subsequent phases due to their proximity to the construction site. Noise from construction activities should be short term and must comply with State Department of Health noise regulations.

1.3 The proposed mixed use areas may include activities which could impact adjacent residences. Noise mitigation measures should be incorporated into the project design to prevent such impacts, such as creating a buffer zone, installing mufflers and/or erecting barriers around noisy equipment, locating traffic access points away from residences, or including restrictions on excessive noise producing activities in sale and lease documents.

1.4 Increases in peak hour traffic noise along Farrington Highway due to the project are estimated to be less than 2 dB. This does not represent a significant increase for homes currently located along Farrington Highway.

1.5 Vehicular traffic noise from Farrington Highway may significantly impact the proposed development. Any homes within 225 feet of Farrington Highway will require some type of noise mitigation to meet the FHWA maximum exterior L_{eq} noise limit of 67 dBA. No homes should be built within 75 feet of Farrington Highway, even if noise mitigation treatments are planned.

1.6 Vehicular traffic noise from the proposed North-South Road may significantly impact the proposed development. Any homes within 100 feet of North-South Road will require some type of noise mitigation to meet the FHWA maximum exterior L_{eq} noise limit of 67 dBA.

1.7 Aircraft noise due to operations at nearby Kalaeloa Airport and the Honolulu International Airport may be audible at the project site. However, flights directly above the site are infrequent and the project site is outside of the L_{dn} 55 noise contour for both airports.

1.8 One of the proposed alignments of the future Honolulu rail transit system runs along North-South Road and includes two transit stations. Design of the UH West Oahu campus should include a minimum setback distance between the nearest residences and the transit guideway and stations to minimize the impact due to the transit system noise.

1.9 The elementary school within the UH West Oahu Campus development will not be exposed to noise levels in excess of the Board of Education (BOE) Policy 6700 design exterior noise guideline of $L_{10} = 65$ dBA

2.0 PROJECT DESCRIPTION

The University of Hawaii West Oahu (UH West Oahu) property is a 500 acre site located in the 'Ewa Plain region of Oahu, adjacent to Kapolei and Makakilo (Figure 1). Farrington Highway borders the entire mauka portion of the property. A proposed North-South road would border the eastern side of the project site. Historically, the site was cultivated in sugarcane and is currently utilized for diversified agriculture.

The current master plan designates an area of approximately 103.5 acres for the development of the UH West Oahu campus which includes academic facilities, libraries, administration/student services buildings, campus center, parking areas and open spaces. The remaining land will be used for long-term campus expansion or non-campus development, including detention/basin, an elementary school, and other open spaces, as well as lands designated for a mixed-use village, commercial uses, and residential uses.

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 (DOH)

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, air traffic noise, or rail traffic 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 are enforced by the State Department of Health (DOH) 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 2. 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 the DOH.

3.2 U.S. Federal Highway Administration (FHWA)

The FHWA defines four land use categories and assigns corresponding maximum hourly equivalent sound levels, $L_{eq(h)}$, for traffic noise exposure [Reference 2], which are listed in Figure 3. For example, Category B, defined as picnic and recreation areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals, has a corresponding maximum exterior L_{eq} of 67dBA and a maximum

interior L_{eq} of 52 dBA. These limits are viewed as design goals, and all projects meeting these limits are deemed in conformance with FHWA noise standards. Calculation of traffic noise levels should be conducted using a Federal Highway Administration traffic noise model [Reference 3].

3.3 Hawaii Department of Transportation (HDOT)

The HDOT has adopted 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 design goals or when the predicted traffic noise levels "substantially exceed the existing noise levels." The policy also states that "approach" means at least 1 dB less than FHWA's design goals and "substantially exceed the existing noise levels" means 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}.

HUD site acceptability criteria rank sites as Acceptable, Normally Unacceptable, or Unacceptable. "Acceptable" sites are those where exterior noise levels do not exceed an L_{dn} of 65 dBA. Proposed housing projects on "Acceptable" sites do not require additional noise attenuation other than that provided by customary building techniques. "Normally Unacceptable" sites are those where the L_{dn} is above 65 dBA, but does not exceed 75 dBA. Housing on "Normally Unacceptable" sites requires some form of noise abatement, either at the property line or in the building construction, to ensure the interior noise levels are acceptable. "Unacceptable" sites are those where the L_{dn} is 75 dBA or higher.

The term "Unacceptable" does not necessarily mean that housing cannot be built on those sites; however, more elaborate sound attenuation will likely be needed.

3.6 Federal Aviation Administration (FAA)

The FAA addresses guidelines for compatible land use that surrounds airports [Reference 7]. Noise contour maps are expressed in terms of yearly day-night average sound levels, L_{dn}, due to aircraft operations. The FAA states that residences outside of the L_{dn} 65 noise contour are compatible without restrictions. Residences between the L_{dn} 65 and 75 contours are only compatible if noise mitigation measures are incorporated into the building structure. Residences inside of the L_{dn} 75 noise contour are generally not compatible. The compatibility of other land uses, such as commercial, manufacturing, public, and recreation, are shown in Table 1.

3.7 Hawaii Department of Transportation (HDOTA), Airports Division

The State of Hawaii, Department of Transportation, Airports Division has adopted noise restrictions that are similar to the FAA's, but more stringent [Reference 8]. Similar to the FAA, HDOTA expresses land use compatibility guidelines based on yearly day-night average sound levels, L_{dn}, due to aircraft operations. In most cases, the HDOTA states maximum noise limits that are 5 dB lower than the FAA. For example, the HDOTA states that residences outside of the 60 L_{dn} noise contour are compatible. Residences between 60 and 70 L_{dn} contours are only compatible if noise mitigation treatments are implemented. However, HDOTA states:

> "Where the community determines that these uses must be allowed, Noise Level Reduction (NLR) measures to achieve interior levels of 45 L_{dn}, or less should be incorporated into building codes and be considered in individual approvals. Normal local construction employing natural ventilation can be expected to provide an average NLR of approximately 9 dB. Total closure, plus air conditioning, may be required to provide additional outdoor to indoor NLR, and will not eliminate outdoor noise problems."

The HDOTA guidelines also specify 60 dBA as the maximum allowable L_{dn} level for school, day care center, and church uses without any mitigation measures. Commercial uses such as retail shops, restaurants, shopping centers, etc. are compatible with L_{dn} levels up to 65 dBA without any mitigation measures. With noise mitigation measures implemented, such commercial uses are allowed in areas exposed to an L_{dn} as high as 75 dBA. The compatibility of other land uses, such as manufacturing, public, and recreation, are shown in Table 2.

In addition to the HDOTA compatibility guidelines, The Hawaii Revised Statutes, Chapter 0508D, Section 15 states a notification is required to the buyer for real estate property that lies,

> "Within the boundaries of the noise exposure area shown on maps prepared by the department of transportation in accordance with Federal Aviation

Regulation Part 150-Airport Noise Compatibility Planning (14 Code of Federal Regulations Part 150) for any public airport;"

The FAR Part 150 noise exposure area boundary is defined as the 55 L_{dn} noise contour. Therefore, a notification to the buyer is required for all real estate transactions within the 55 L_{dn} noise contour.

3.8 Federal Transit Administration (FTA)

The FTA defines three land use categories and provides guidance in the assessment of noise and vibration due to transit systems based on an increase in cumulative noise. Methods for determining noise and vibration impacts and possible mitigation measures for typical transit projects are provided in the Transit Noise and Vibration Impact Assessment report [Reference 9]. One set of criteria defined in the report applies to all rail projects (including light rail transit, rapid rail transit, etc.) and their fixed facilities. The criteria, specified in maximum hourly equivalent sound levels, $L_{eq(h)}$, and day-night equivalent sound levels, L_{dn}, varies according to the existing noise levels, the predicted transit system project noise levels, and the land use category, as shown in Figure 4. The area between the two curves labeled as "Impact" is a transitional area where the change in cumulative noise level will be noticeable to most individuals, but may not be sufficient to cause adverse reactions from the community.

The FTA criteria were developed to recognize the heightened community annoyance caused by late night and early morning transit service and the varying sensitivity of communities to transit systems under different background noise conditions and is concurrent with various noise standards defined by other Federal agencies. It is important to note that the criteria are not enforceable regulations, but design goals that are useful tools for assessing the noise environment.

3.9 Board of Education (BOE)

BOE policy 6700 [Reference 10] sets four classroom noise level requirements:

1. Soundproofing design shall be used to reduce the noise level whenever the internal noise level exceeds 50 dBA.

2. Noise control shall be provided for all school facilities which generate exterior noise levels at the property line exceeding DOH standards.

3. Noise control measures shall be installed in classrooms and administration/staff facilities (excluding shop classrooms) whenever 50 percent of the intruding noise level measurements exceed 55 dBA when inside the classroom with windows and doors open and the room empty.

4. Air conditioning shall be provided to facilities exposed to exterior noise levels greater than L_{10} =65dBA.

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 (Location L1 and L2), as shown in Figure 1. Long term measurements were conducted between March 7, 2005 and March 11, 2005. The second type of noise measurement was short-term and included traffic counts (Location S1). The purpose of the short-term noise measurements and corresponding traffic counts were to calibrate a traffic noise prediction model. Short term measurements were conducted between May 2, 2006 and May 3, 2006.

4.1 Noise Measurement Procedure

Long-Term Noise Measurement Procedure

Continuous, hourly, statistical sound levels were recorded for approximately 4 days at each location. The measurements were taken using a Larson-Davis Laboratories, Model 820, Type-1 Sound Level Meter together with a Larson-Davis, Model 2560 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 calibration period. The microphone was mounted on a tripod, approximately 6 feet above grade. A windscreen covered the microphone during the entire measurement period. The sound level meter was secured in a weather resistant case.

Short-Term Noise Measurement Procedure

An approximate 30-minute equivalent sound level, L_{eq}, was measured. 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 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 calibration period. The microphone and sound level meter were mounted on a tripod, approximately 6 feet above grade. A windscreen covered the microphone during the entire measurement period.

4.2 Noise Measurement Locations

Long-Term Noise Measurement Locations

Location L1: Southern end (makai) of the project area, in a field near the proposed North-South Road, as indicated in Figure 1. Vehicles or farm equipment may have been operated in the vicinity of the sound meter.

Location L2: Approximately 100 ft from the edge of Farrington Highway on the northern (mauka) end of the project site, as indicated in Figure 1.

Short-Term Noise Measurement Location

Location S1: Positioned adjacent to Farrington Highway, approximately 45 feet makai of the edge-of-pavement.

4.3 Long-Term Noise Measurement Results

The 500-acre site, which is currently utilized for diversified agriculture or is undeveloped, currently experiences relatively low ambient noise levels except for some portions adjacent to Farrington Highway. The measured equivalent sound levels, L_{eq}, in A-weighted decibels (dBA) are graphically presented in Figure 5 for both locations.

Location L1 Noise Measurement Results

The sound levels at Location L1 are typical of a "rural" ambient environment. The daytime (7:00 AM to 10:00 PM) L_{eq} ranges from 42 dBA to 57 dBA. The average nighttime (10:00 PM to 7:00 AM) L_{eq} ranges from 34 dBA to 55 dBA. A meter overload occurred between 3:00 and 5:00 AM on March 9, 2005, possibly due to rain or excessive winds, therefore the average day-night level, L_{dn}, was estimated to be 55 dBA. The dominant and secondary noise sources at Location L1 are described below:

Dominant:	Wind, birds, aircraft flyovers, possible operation of farming equipment and farm workers
Secondary:	Vehicular traffic from Farrington Highway and H-1 Freeway

Location L2 Noise Measurement Results

The hourly equivalent sound levels, L_{eq}, at Location L2 range from 48 dBA to 63 dBA during the daytime hours and 39 dBA to 59 dBA during the nighttime hours. The average day-night level, L_{dn}, was calculated to be 59 dBA.

The dominant and secondary noise sources at Location L2 are described below:

Dominant:	Vehicular traffic from Farrington Highway, wind.
Secondary:	Birds, farming equipment, electrical lines, vehicular traffic from H-1 Freeway

4.4 Project Vicinity

The undeveloped lands west of the project site experience an acoustical environment similar to the project site with wind and occasional aircraft flyovers being dominant noise sources. Presently, the nearest developed land includes Kapolei and Makakilo to the west, the Villages of Kapolei to the south, and Ewa Villages to the east. Vehicular noise from Farrington Highway and the H-1 Freeway located mauka of the project site dominate the ambient environment in the vicinity of these roadways. In addition, a quarry and a recycling plant located close to the project site may contribute to some of the ambient noise. Heavy

trucks, which generate more noise than automobiles, travel to and from the quarry and recycling plant and constitute 20% of the AM peak hour traffic total on Farrington Highway.

4.5 Kalaeloa Airport and Honolulu International Airport Noise Contours

The project is several miles northeast of the Kalaeloa Airport and west of Honolulu International Airport. Therefore, the project site was assessed for aircraft noise using airport noise contour maps. The Kalaeloa Master Plan [Reference 11] includes year 2020 projections of airport operations and noise contour maps for airport alternates. Also included in the airport noise contour maps is the affect of the Honolulu International Airport operations [Reference 8]. A complete description of the Kalaeloa Airport alternates can be found in the Kalaeloa Master Plan. The UH West Oahu project site is outside of the L_{dn} 55 noise contours for both airports.

5.0 POTENTIAL NOISE IMPACTS AND NOISE MITIGATION

5.1 Project Construction Noise

Development of project areas will involve excavation, grading, and other typical construction activities during construction. The various construction phases of the project may generate significant amounts of noise. The UH West Oahu project is not expected to impact adjacent properties, since much of the land surrounding the project site is agricultural. Future developments on adjacent properties that are completed before the UH West Oahu development may be impacted by construction noise. Similarly, residences from the initial phases may be impacted by construction noise from subsequent phases due to their proximity to the construction site. 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 6. Pile driving and earthmoving equipment, e.g., bulldozers and diesel-powered trucks, will probably be the loudest equipment used during construction.

5.2 Project Generated Stationary Mechanical Noise and Compliance with State of Hawaii Community Noise Control Rule

A large portion of the project site is proposed for non-campus development, including residential and commercial use. Noise emanating from these commercial uses could significantly impact the proposed adjacent noise sensitive residential areas. The various phases in the long range development plan will incorporate stationary mechanical equipment that is typical for residential and commercial 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 noise rules, which stipulate maximum permissible noise limits at the property line. For multi-family dwellings, business, and commercial areas, the noise limits are 60 dBA during the day and 50 dBA during the night, as shown in Figure 2. For residential areas (i.e., single-family homes), noise limits are 55 dBA during the day and 45 during the night. For mixed zoning districts, the primary land use designation is used to

determine the maximum permissible noise limits. Mitigation of mechanical noise to meet the State DOH noise rules should be incorporated into the project design.

5.3 Compliance with FHWA/HDOT Noise Limits

A vehicular traffic noise analysis was completed for the existing conditions, future year 2015 projections with the "No Build" condition, and future year 2015 projections with the "Build" condition using the FHWA Traffic Noise Model Look-up Tables Software Version 2.5 (2004) [Reference 12]. The traffic noise analysis is based on the traffic counts provided by the Traffic Consultant [Reference 13]. Vehicular traffic noise levels were calculated for 4 locations, Locations A, B, C, and D as shown in Figure 7. The short-term noise measurement and corresponding traffic counts were used to calibrate the software at the noise prediction location along Farrington Highway (Location A). Only future noise level predictions were made for Locations B, C, and D because the corresponding roadways do not yet exist. The results of the traffic noise analysis for the existing (Farrington Highway only) and future year projections are described below and summarized in Table 3.

5.3.1 Vehicular Traffic Noise Impacts on the Project

Noise Prediction Location A

For the parcels adjacent to Farrington Highway, vehicular traffic noise levels are expected to increase by approximately 2 to 4 dB in the future under the "No Build" condition. The increase in traffic noise due to the UH West Oahu project is less than 2 dB. A 3 dB change or less in noise level is not considered to be significant. At noise prediction location A, 225' makai of Farrington Highway, existing noise levels were calculated to be slightly below the FHWA/HDOT maximum noise limit of 67 dBA during peak traffic hours. In the future, however, noise levels are expected to be at the FHWA/DOT limit.

Noise Prediction Location B

Future year traffic projections show that traffic noise levels at locations at least 100 feet from North-South Road (Location B) are expected to be slightly below the FHWA/HDOT maximum noise limit of 67 dBA under both "No Build" and "Build" conditions. The increase in traffic noise due to the UH West Oahu project is expected to be less than 2 dB.

Noise Prediction Locations C and D

The UH West Oahu Campus development project will provide campus facilities, housing, and some commercial business, which will create vehicular traffic in the campus area. Noise levels due to vehicular traffic were predicted for locations 25 feet from Roads B and F, noise prediction location C and D, respectively, and are well below the FHWA/HDOT maximum noise limit of 67 dBA.

5.3.2 Vehicular Traffic Noise Impacts on the Surrounding Community

Residences located adjacent to Farrington Highway southwest of the project site are beyond the route of the heavy trucks that dominate the noise environment at the UH West Oahu project site. The existing noise levels are estimated to be less than the FHWA/HDOT maximum noise limit of 67 dBA during the peak traffic hours. Vehicular traffic noise levels are expected to increase by 2 to 4 dB in the future (2015) without the UH West Oahu project. The increase in traffic noise due to the project is less than 2 dB. A 3 dB change or less in noise level is not considered to be significant.

5.4 Compliance with EPA and HUD Noise Guidelines

The results from the long-term noise measurements conducted at the proposed UH West Oahu site show a calculated day-night level, L_{dn}, of 59 dBA near Farrington Highway. As described above, traffic noise levels at the proposed project site are predicted to increase by approximately 3 to 5 dB due to the projected increase in vehicular traffic on Farrington Highway. Day-night noise levels are expected to be within the HUD noise guidelines, which state an exterior design goal of $L_{dn} \leq 65$ dBA, for residential units located at least 225 feet from the roadway. Similarly, the HUD "acceptable" maximum noise limit will be satisfied for all homes 100 feet, or more, from North-South Road.

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 homes 225 feet from Farrington Highway and 100 feet from North-South Road are expected to be below the existing EPA design goal but exceed the future EPA design goal.

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

5.5 Compliance with FAA and HDOT Airports Division Guidelines

The UH West Oahu project site is outside of the 55 L_{dn} noise contour of both Honolulu International Airport and Kalaeloa Airport. Therefore, the project will not be impacted by aircraft noise. However, due to certain arrival and departure flight tracks associated with Kalaeloa Airport, aircraft flyovers may, at times, be audible at the project site. These flyovers should be infrequent, and therefore, should not significantly impact the proposed development.

5.6 Honolulu High Capacity Transit Project and Compliance with FTA Guidelines

The City and County of Honolulu Department of Transportation Services is currently evaluating alternatives for a high capacity transit service between Kapolei and Manoa. Two of the alignment alternatives run along the proposed North-South Road between Farrington Highway and Kapolei Parkway and will

include at least two stations in the vicinity of the UH West Oahu project site. A complete description of all alignment alternatives and current planning documents can be found on the Honolulu High Capacity Transit Project website [Reference 14]. Typical sound exposure levels of various transit systems are shown in Table 4.

The day-night level, L_{dn}, is estimated to be between 62-64 dBA at the project site due to increased traffic noise levels, not including rail transit noise. The FTA noise impact criteria shown in Figure 4 shows that an impact will occur if the rail transit project noise exceeds 58 dBA and a severe impact will occur if the transit project noise exceeds 64 dBA. This means the overall noise level increase of 2 to 4 dBA due to the transit line will become noticeable to residents closest to the transit line. Residents will likely complain if the overall noise levels increase by more than 4 dB.

5.7 Compliance with BOE Noise Guidelines

Board of Education (BOE) Policy 6700 [Reference 10] requires that air conditioning be installed for schools exposed to an exterior noise level of L_{10}=65dBA. An elementary school within the proposed UH West Oahu campus site is not likely to experience an L_{10} greater than 65dBA at its present proposed location at the intersection of Road "F" and Road "G".

6.0 POTENTIAL NOISE IMPACT ON THE PROJECT AND NOISE MITIGATION

6.1 Mitigation of Construction Noise

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 the State DOH 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 the State DOH to issue a construction noise permit, the Contractor must submit a noise permit application to the DOH, which describes the construction activities for the project. Prior to issuing the noise permit, the State DOH may require action by the Contractor to incorporate noise mitigation into the construction plan. The DOH 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, the State DOH 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 a.m. and after 6:00 p.m. 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 a.m. and after 6:00 p.m. 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."

The use of hoe rams and jack hammers 25 lbs. or larger, high pressure sprayers, chain saws, and pile drivers are restricted to 9:00 a.m. to 5:30 p.m., 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, must be equipped with mufflers [Reference 1].

The DOH noise permit does not limit the noise level generated at the construction site, but rather the times at which noisy construction can take place. Therefore, noise mitigation for construction activities should be addressed using project management, such that the time restrictions within the DOH permit are followed.

6.2 Mitigation of the UH West Oahu Development Noise

The design of the new development should give consideration to controlling the noise emanating from stationary mechanical equipment so as to comply with the State Department of Health *Community Noise Control* rules [Reference 1]. Noisy equipment should be located away from neighbors and the residential units, as much as is practical. Enclosed mechanical rooms may be required for some equipment.

In order for the commercial areas to be compatible with the adjacent residential areas, noise mitigation measures should be implemented. 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. However, other noise sources may include non-stationary equipment such as trucks loading and unloading supplies. Additional industrial and commercial noise source may include ambulance sirens, backup alarms on trucks and forklifts, which are exempt from DOH noise regulations. Consideration could also be given to the layout of the commercial areas to meet DOH noise regulations and reduce the noise impact. For example, noisier activities, such as traffic access and loading areas, should be located away from nearby residential areas.

Restrictions may need to be placed on all commercial uses allowed in the commercial areas in order to strictly control development of potential noise

producing industries within the commercial areas. For example, sale and lease documents for the commercial property should disclose and emphasize the significance of the DOH noise regulations with respect to the abutting residential areas. With respect to mixed zoning districts, the DOH regulations specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level. However, zoning district class B includes commercial, business, multi-family dwellings, and apartments with the corresponding maximum permissible sound level listed in Figure 2.

6.3 Mitigation of Traffic Noise

Vehicular traffic noise from Farrington Highway may significantly impact the proposed development. The calculated traffic noise levels show that the residences constructed on parcels that border Farrington Highway should be at least 225 feet from the edge of pavement so as not to exceed the FHWA's maximum exterior L_{eq} noise limit of 67 dBA. Any homes within 225 feet of Farrington Highway will require some type of noise mitigation to meet the criteria. No homes should be built within 75 feet of Farrington Highway, even if noise mitigation treatments are planned.

Similarly, vehicular traffic noise from the proposed North-South Road may significantly impact the proposed development. The calculated traffic noise levels show that the residences constructed on parcels that border North-South Road should be at least 100 feet from the edge of pavement so as not to exceed the FHWA's maximum exterior L_{eq} noise limit of 67 dBA. Any homes within 100 feet of North-South Road will require some type of noise mitigation to meet the criteria.

A comprehensive traffic noise and barrier analysis using roadway coordinates 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 abatement becomes necessary. Effective noise mitigation measures might include:

- constructing barrier walls and/or earth berms along roadways;
- air-conditioning 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.;
- using exterior wall constructions which exhibit high noise reductions; or
- reducing the elevation of the roadways relative to adjacent lands.

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.

6.4 Mitigation of Aircraft Noise

The UH West Oahu project site is well outside the L_{dn} 55 dBA noise contour. Therefore, noise mitigation to attenuate aircraft noise is not necessary.

6.5 Mitigation of Rail Transit Noise

The FTAs impact assessment report has identified appropriate "screening" distances, i.e. minimum setback distances, within which a transit project has little possibility of creating a noise impact. The screening distances for various fixed guideway systems and facilities are listed in Table 5.

If a transit system noise impact has been determined, noise mitigation may be required. Noise can be effectively mitigated at the noise source (rail car) and along the noise path (tracks). Reducing rail noise may include the installation of:

- resilient rubber wheels,
- vehicle skirts,
- wheel truing,
- rail grinding, or
- undercar absorption.

Along the path of noise, sound barrier walls close to the guideway are very effective, often reducing noise 6 to 10 dB, and at the right-of-way line, less effective with typical reductions of 3 to 5 dB. Ballast laid to reduce noise can be expected to produce a 3-dB reduction at grade and a 5-dB reduction on aerial guideways.

6.6 Mitigation of Noise at the Proposed Elementary School

The elementary school within the proposed UH West Oahu campus site is not likely to experience an L_{10} greater than 65dBA at the intersection of Road "F" and Road "G", therefore noise mitigation is not required.

Temporary noise mitigation measures will be required if construction activities occur in the vicinity of the elementary school. Construction and/or occupancy of the schools should occur after other construction activities near the school site are completed.

REFERENCES

1. Chapter 46, *Community Noise Control*, Department of Health, State of Hawaii, Administrative Rules, Title 11, September 23, 1996.

2. *Department of Transportation, Federal Highway Administration Procedures for Abatement of Highway Traffic Noise,* Title 23, CFR, Chapter 1, Subchapter J, Part 772, 38 FR 15953, June 19, 1973; Revised at 47 FR 29654, July 8, 1982.

3. *Federal Highway Administration's Traffic Noise Model,* FHWA-RD-77-108; U.S. Department of Transportation, December 1978.

4. *Noise Analysis and Abatement Policy,* Department of Transportation, Highways Division, State of Hawaii, June 1977.

5. *Toward a National Strategy for Noise Control*, U.S. Environmental Protection Agency, April 1977.

6. *Department of Housing and Urban Development Environmental Criteria and Standards*, Title 24, CFR, Part 51, 44 FR 40860, July 12, 1979; Amended by 49 FR 880, January 6, 1984.

7. *FAA Regulations on Airport Noise Compatibility Planning Programs,* Code of Federal Regulations, Title 14, Chapter 1, Subchapter 1, Part 150; Issued by 49 FR 49269, December 18, 1984; corrected by 50 FR 5063, February 6, 1985; amended by 53 FR 8723, March 16, 1988; corrected by 53 FR 9726, March 24, 1988.

8. *Honolulu International Airport Master Plan Update and Noise Compatibility Program*, State of Hawaii Department of Transportation, Airports Division, Vol. 2, December 1989.

9. *Transit Noise and Vibration Impact Assessment*, Office of Planning, Federal Transit Administration, April 1995.

10. *Policies and Standards for School Facilities Design*, Board of Education, Policy 6700, Appendix A, Acoustical and Environmental Control, March 1995.

11. *Kalaeloa Airport Master Plan,* State of Hawaii Department of Transportation, Airports Division, November 1998.

12. *Federal Highway Administration's Traffic Noise Model Look-up Tables Software*, Ver. 2.5; U.S. Department of Transportation, December 17, 2004.

13. *Traffic Impact Analysis Report for the UH West Oahu Campus,* Parsons Brinckerhoff Quade & Douglas, Inc., May, 2006.

14. *Honolulu High Capacity Transit Corridor Project,* www.honolulutransit.org.

TABLE 1:
FAR Part 150 Recommendations for Land Use Compatibility in Yearly Day-Night Average Sound Levels

TYPE OF LAND USE	Yearly Day-Night Average Sound Level (L_{dn})					
	< 65	65-70	70-75	75-80	80-85	> 85
RESIDENTIAL:						
Residential (except mobile homes & transient lodgings)	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
PUBLIC USE:						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Government services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
COMMERCIAL USE:						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale/Retail:(bldg. Mater., hardware, & farm equip.)	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade -- general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
MANUFACTURING AND PRODUCTION:						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL USE:						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

Note: Numbers in parentheses refer to the following notes.

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor-to-indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(3) Measures to achieve NLR 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(4) Measures to achieve NLR 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(5) Land use compatible provided special sound reinforcement systems are installed.

(6) Residential buildings require a NLR of 25.

(7) Residential buildings require a NLR of 30.

(8) Residential buildings are not permitted.

Abbreviations:

Y(Yes) = Land Use and related structures compatible w/o restrictions.

N(No) = Land Use and related structures are not compatible and should be prohibited.

NLR = Noise Level Reduction (outdoor-to-indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.

25, 30, or 35 = Land use and related structures general compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structures.

Regulatory Note.
The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

Source: FAR Part 150, Appedix A, Table 1. "Land Use Compatibility with Yearly Day-Night Average Sound Levels."

TABLE 2:
State Department of Transportation Airports Division Recommendations for Local Land Use Compatibility in Yearly Day-Night Average Sound Levels (Ldn)

TYPE OF LAND USE	Yearly Day-Night Average Sound Level (L_{dn})					
	< 60	60-65	65-70	70-75	75-80	80-85
RESIDENTIAL:						
Low density residential, resorts, & hotels (w/ outdoor fac)	Y(a)	N(b)	N	N	N	N
Low density apartment w/ moderate outdoor use	Y	N(b)	N	N	N	N
High density apartment with limited outdoor use	Y	N(b)	N(b)	N	N	N
Transient lodgings (w/limited outdoor use)	Y	N(b)	N(b)	N	N	N
PUBLIC USE:						
Schools, day care centers, libraries, and churches	Y	N(c)	N(c)	N(c)	N	N
Hospitals, nursing homes, clinics, and health facilities	Y	Y(d)	Y(d)	Y(d)	N	N
Indoor auditoriums, and concert halls	Y(c)	Y(c)	N	N	N	N
Government services and offices serving the public	Y	Y	Y(d)	Y(d)	N	N
Transportation and parking	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
COMMERCIAL USE:						
Offices - government, business and professional	Y	Y	Y(d)	Y(d)	N	N
Wholesale/Retail: bldg. Mater., hardware, & heavy equip	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
Airport businesses - car rental, ticketing, lei stands, etc	Y	Y	Y(d)	Y(d)	N	N
Retail trade, restaurants, shp. Centers, financial inst., etc	Y	Y	Y(d)	Y(d)	N	N
Power plants, sweage treatment plants, & base yards	Y	Y	Y(d)	Y(d)	Y(d)	N
Studios w/o outdoor sets, broadcasting & Production fac	Y(c)	Y(c)	N	N	N	N
MANUFACTURING AND PRODUCTION:						
Manufacturing, general	Y	Y	Y(d)	Y(d)	Y(d)	N
Photographic and optical	Y	Y	Y(d)	Y(d)	N	N
Agriculture (except livestock) and forestry	Y	Y(e)	Y(e)	Y(e)	Y(e)	Y(e)
Livestock farming and breeding	Y	Y(e)	Y(e)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL USE:						
Outdoor sports arenas and spectator sports	Y	Y(f)	Y(f)	N	N	N
Outdoor music shells, amphitheaters	Y(f)	N	N	N	N	N
Nature exhibits and zoos, neighborhood parks	Y	Y	Y	N	N	N
Amusements, beach parks, active playgrounds, etc	Y	Y	Y	Y	N	N
Public golf courses, riding stables, cemeteries, gardens, etc	Y	Y	N	N	N	N
Professional/resort sports facil., media event facil., etc	Y(f)	N	N	N	N	N
Extensive natural wildlife and recreation areas	Y(f)	N	N	N	N	N

Note: Letters in parentheses refer to the following notes.

(a) A noise level of 60 L_{dn} does not eliminate all risks of adverse noise impacts from aircraft noise. However, the 60 L_{dn} planning level has been selected by the State Airports Division as an appropriate compromise between the minimal risk of level of 55 L_{dn} and the significant risk level of 65 L_{dn}.

(b) Where the community determines that these uses should be allowed, Noise Level Reduction (NLR) measures to achieve interior levels of 45 L_{dn} or less should be incorporated into building codes and be considered in individual approvals. Normal local construction employing natural ventilation can be expected to provide an average NLR of approximately 9 dB. Total closure plus air conditioning may be required to provide additional outdoor-to-indoor NLR, but will not eliminate outdoor noise problems.

(c) Because the L_{dn} noise descriptor system represents a 24-hour average of individual aircraft noise events, each of which can be unique in respect to amplitude, duration, and tonal content, the NLR requirements should be evaluated for the specific land use, interior acoustical requirements, and properties of the aircraft noise events. NLR requirements should not be based solely upon the exterior L_{dn} exposure level.

(d) Measures to achieve required NLR must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(e) Residential buildings require NLR. Residential buildings should not be located where exterior noise is greater than 65 L_{dn}.

(f) Impact of amplitude, duration, frequency, and tonal content of aircraft noise events should be evaluated.

Abbreviations:

Y(Yes) = Land Use and related structures compatible without restrictions.

N(No) = Land Use and related structures are not compatible and should be prohibited.

Source: Airports Division, Department of Transportation, State of Hawaii

TABLE 3:
Predicted Traffic Noise Levels With and Without the Project and Resulting Increases Due to the Project[+]

Noise levels shown in the table are based on peak-hour traffic volumes, and are expressed in A-weighted decibels (dBA).

	Location A[*]		Location B[*]		Location C[*]		Location D[*]	
	AM	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Existing (Calculated)	64.7	57.6	N/A	N/A	N/A	N/A	N/A	N/A
Future Without Project (2015)	66.6	61.8	63.5	64.7	N/A	N/A	N/A	N/A
Future With Project (2015)	67.5	63.1	65.3	66.5	60.2	62.1	62.6	63.9
Future Increase Without Project (2015)	1.9	4.2	N/A	N/A	N/A	N/A	N/A	N/A
Future Increase With Project (2015)	2.8	5.5	N/A	N/A	N/A	N/A	N/A	N/A
Future Increase Due to Project (2015)	**0.9**	**1.3**	**1.8**	**1.8**	N/A	N/A	N/A	N/A

[+] The noise level calculations were based on the traffic study provided by the Traffic Consultant [Reference 12].
[*] Location A - 225 feet south of Farrington Highway edge of pavement
Location B - 100 feet west of the proposed North-South Road edge of pavement
Location C - 25 feet north of the proposed "Road B" edge of pavement
Location D - 25 feet south of the proposed "Road F" edge of pavement

TABLE 4:
Federal Transit Administration Transit System Source Reference Sound Exposure Level (SEL)

Source/Type		Reference Conditions	Reference SEL* (dBA)
Commuter Rail, At-Grade	Locomotives	Diesel-electric, 3000 hp, throttle 5	92
		Electric	90
	Cars	Ballast, welded rail	82
Rail Transit		At-grade, ballast, welded rail	82
AGT	Steel Wheel	Aerial, concrete, welded rail	80
	Rubber Tire	Aerial, concrete guideway	78
Monorail		Aerial, straddle beam	82
Maglev		Aerial, open guideway	72
Automobiles and Vans		Normal roadway surface conditions	73
City Buses		Normal roadway surface conditions	84
Commuter Buses		Normal roadway surface conditions	88
Rail System	Yards and Shops	20 train movements in peak activity hour	118
	Layover Tracks (commuter rail)	One train with diesel locomotive idling for one hour	116
Bus System	Storage Yard	100 buses accessing facility in peak activity hour	111
	Operating Facility	100 buses accessing facility, 30buses serviced and cleaned in peak activity hour	114
	Transit Center	20 buses in peak activity hour	101
Parking Garage		1000 cars in peak activity hour	92
Park and Ride Lot		12 buses, 1000 cars in peak activity hour	101

Note: Measured 50 feet from centerline of guideway/roadway for mobile sources at 50 mph; 50 feet from center of noise-generating activity for stationary sources..

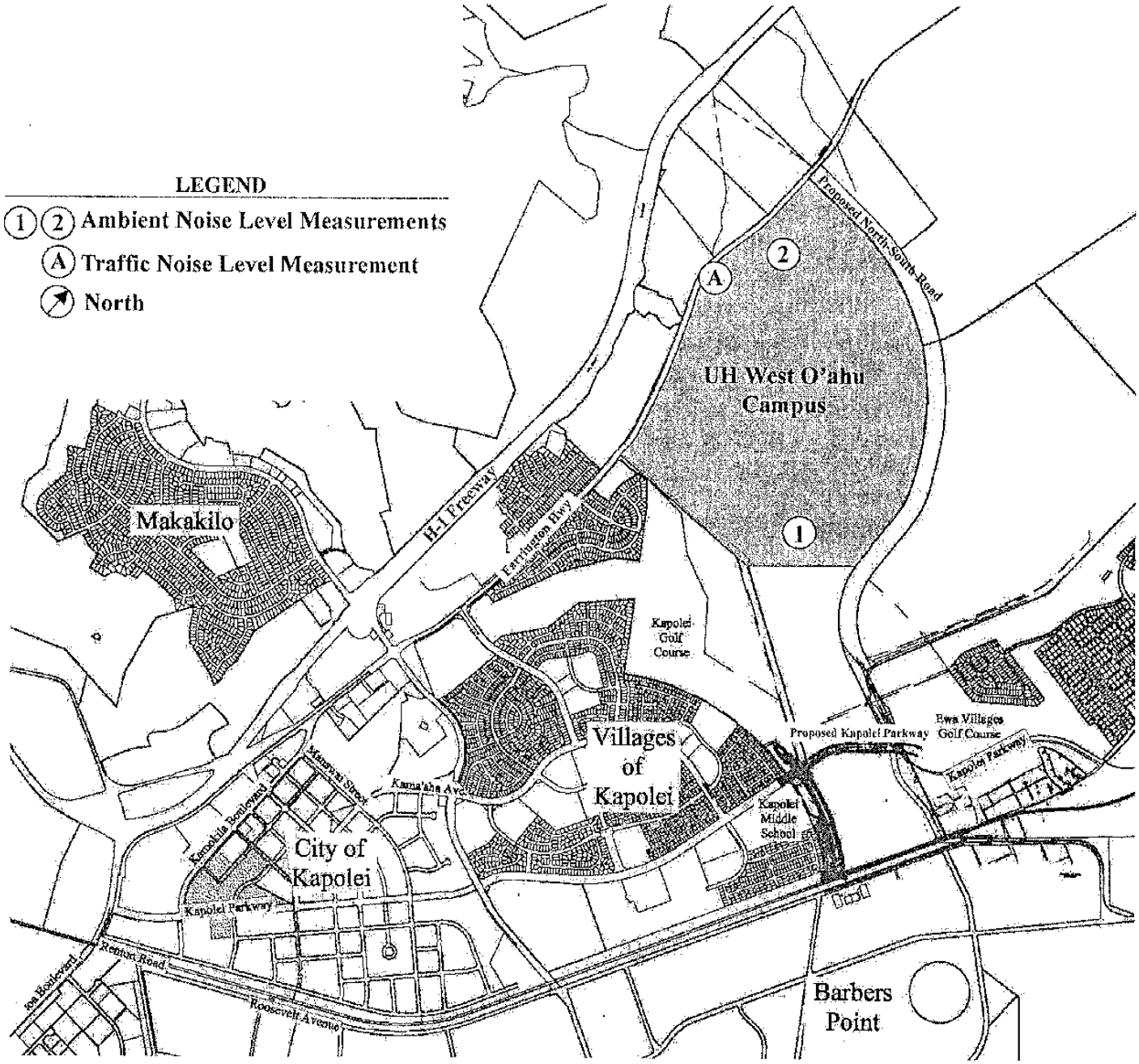
Source: Chapter 5: General Noise Assessment, Table 5-1, 5-3, 5-5. *Transit Noise and Vibration Impact Assessment*, Office of Planning, Federal Transit Administration, April 1995.

TABLE 5:
Federal Transit Administration Screening Distances for Noise Assessments

Type of Project		Screening Distance* (ft)	
		Unobstructed	**Intervening Buildings**
Fixed Guideway Systems:			
Commuter Rail Mainline		750	375
Commuter Rail Station		450	225
Rail Transit Guideway		700	350
Rail Transit Station		200	100
Access Roads		100	50
Low-and Intermediate-Capacity Transit	Steel Wheel	200	100
	Rubber Tire	125	75
	Monorail	300	150
Yards and Shops		2000	1000
Parking Facilities		150	75
Access Roads		100	50
Ancillary Facilities			
Ventilation Shafts		200	100
Power Substations		250	125

Note: Measured from centerline of guideway/roadway for mobile sources; from center of noise-generating activity for stationary sources.

Source: Chapter 4: Noise Screening Procedure, Table 4-1. *Transit Noise and Vibration Impact Assessment*, Office of Planning, Federal Transit Administration, April 1995.



Noise Measurement Locations and Project Vicinity

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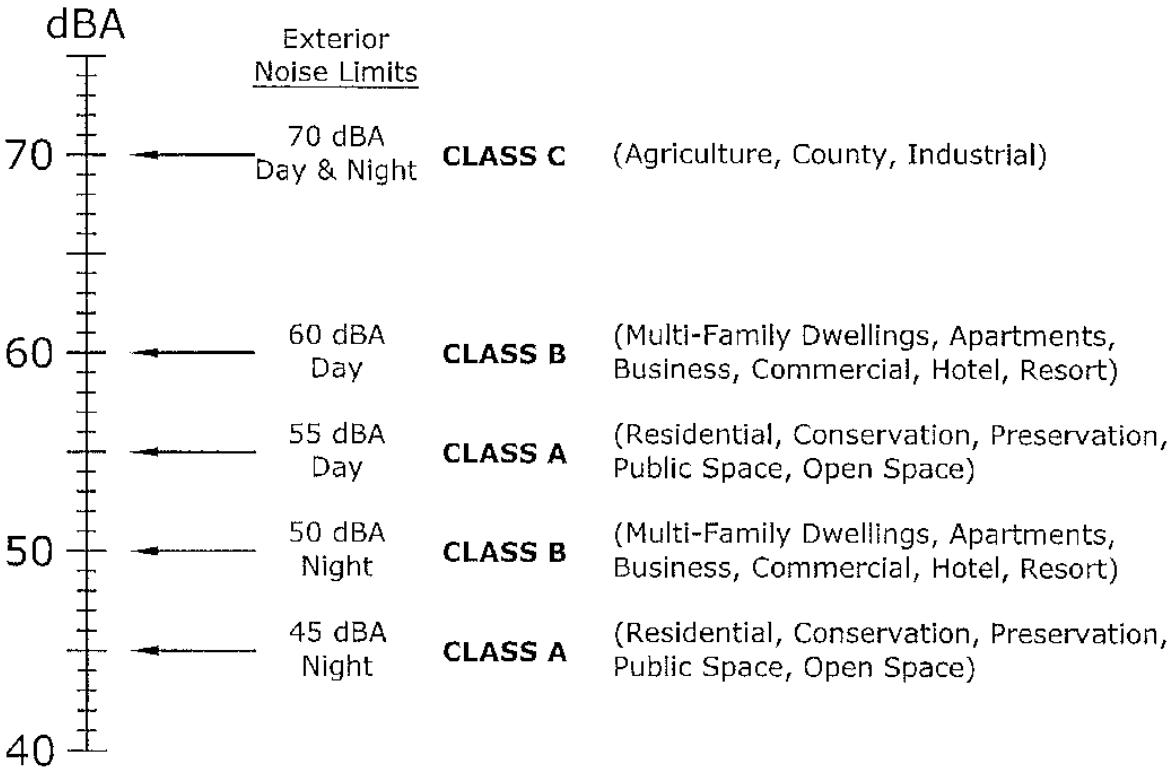
UH West Oahu

Not to Scale

Date	Project No.	Drawn By
June 2006	05-18	DFD

Figure No 1

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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Hawaii Maximum Permissible Sound Levels for Various Zoning Districts

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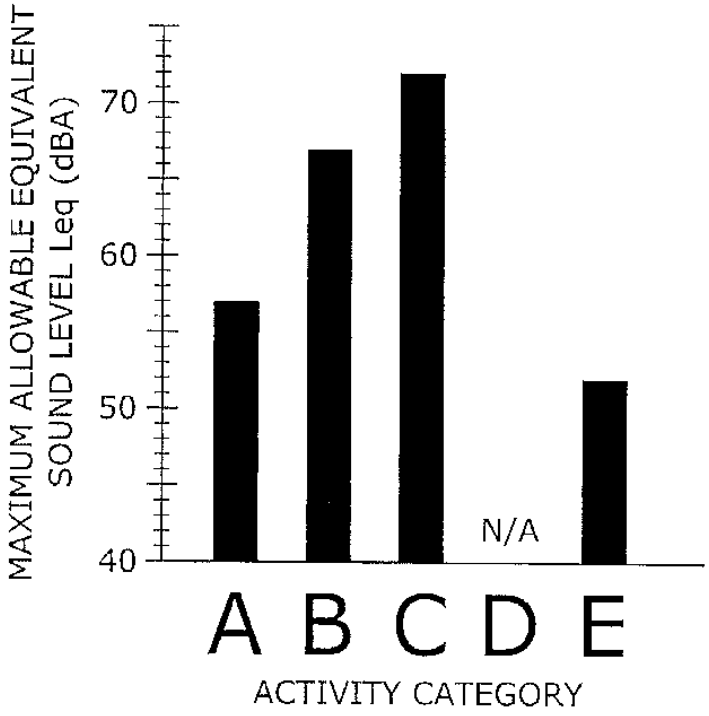
Figure No 2

Date	Project No.	Drawn By
June 2006	05-18	TRB

ACTIVITY CATEGORY	ACTIVITY CATEGORY DESCRIPTION	MAXIMUM EQUIVALENT SOUND LEVEL $L_{eq(h)}$
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	PICNIC AREAS, RECREATION AREAS, PLAYGROUNDS, ACTIVE SPORT AREAS, PARKS, RESIDENCES, MOTELS, HOTELS, SCHOOLS, CHURCHES, LIBRARIES, AND HOSPITALS.	67 dBA (EXTERIOR)
C	DEVELOPED LANDS, PROPERTIES, OR ACTIVITIES NOT INCLUDED IN ACTIVITY CATEGORIES A OR B ABOVE.	72 dBA (EXTERIOR)
D	UNDEVELOPED LAND	N/A
E	RESIDENCES, MOTELS, HOTELS, PUBLIC MEETING ROOMS, SCHOOLS, CHURCHES, LIBRARIES, HOSPITALS, AND AUDITORIUMS.	52 dBA (INTERIOR)



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Federal Highways Administration Recommended Equivalent Hourly Sound Levels Based on Land Use

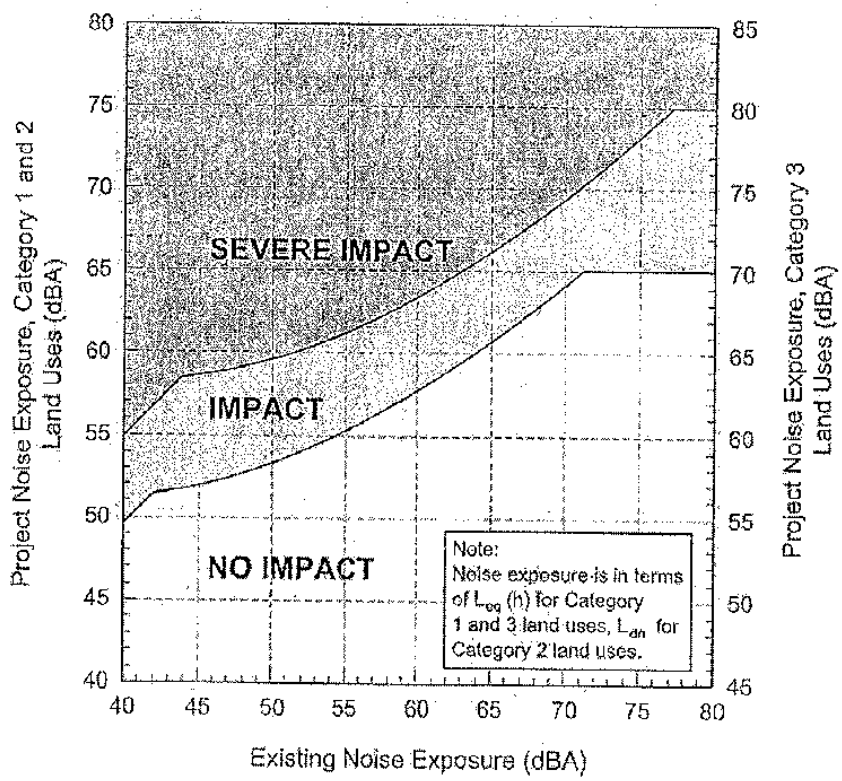
UH West Oahu

Not to Scale

Date	Project No.	Drawn By
June 2006	05-18	TRB

Figure No 3

LAND USE CATEGORY	LAND USE CATEGORY DESCRIPTION	NOISE METRIC (dBA)
1	TRACTS OF LAND WHERE QUIET IS AN ESSENTIAL ELEMENT IN THEIR INTENDED PURPOSE. THIS CATEGORY INCLUDES LANDS SET ASIDE FOR SERENITY AND QUIET, AND SUCH LAND USES AS OUTDOOR AMPHITHEATERS AND CONCERT PAVILIONS, AS WELL AS NATIONAL HISTORIC LANDMARKS WITH SIGNIFICANT OUTDOOR USE.	OUTDOOR Leq(h)
2	RESIDENCES AND BUILDINGS WHERE PEOPLE NORMALLY SLEEP. THIS CATEGORY INCLUDES HOMES, HOSPITALS AND HOTELS WHERE A NIGHTTIME SENSITIVITY TO NOISE IS ASSUMED TO BE OF UTMOST IMPORTANCE.	OUTDOOR Ldn
3	INSTITUTIONAL LAND USES WITH PRIMARILY DAYTIME AND EVENING USE. THIS CATEGORY INCLUDES SCHOOLS, LIBRARIES, AND CHURCHES WHERE IT IS IMPORTANT TO AVOID INTERFERENCE WITH SUCH ACTIVITIES AS SPEECH, MEDITATION, AND CONCENTRATION ON READING MATERIAL. BUILDINGS WITH INTERIOR SPACES WHERE QUIET IS IMPORTANT, SUCH AS MEDICAL OFFICES, CONFERENCE ROOMS, RECORDING STUDIOS AND CONCERT HALLS FALL INTO THIS CATEGORY. PLACES FOR MEDITATION OR STUDY ASSOCIATED WITH CEMETERIES, MONUMENTS, MUSEUMS. CERTAIN HISTORICAL SITES, PARKS, AND RECREATIONAL FACILITIES ARE ALSO INCLUDED.	OUTDOOR Leq(h)



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Federal Transit Administration Noise Impact Criteria for Transit Projects

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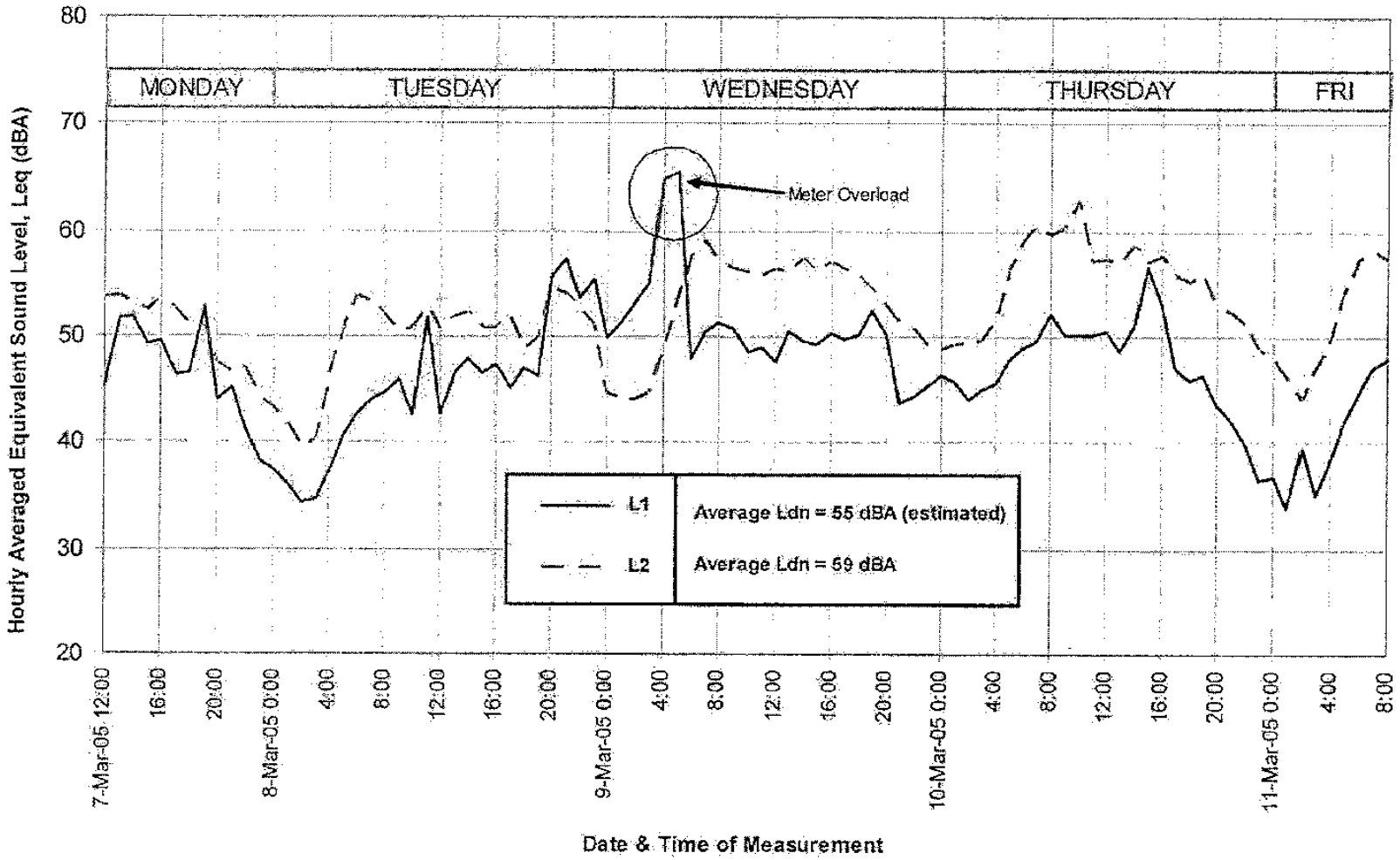
Date	Project No.	Drawn By
June 2006	05-18	DFD

Figure No 4



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Graph of Long Term Noise Measurements

UH West Oahu

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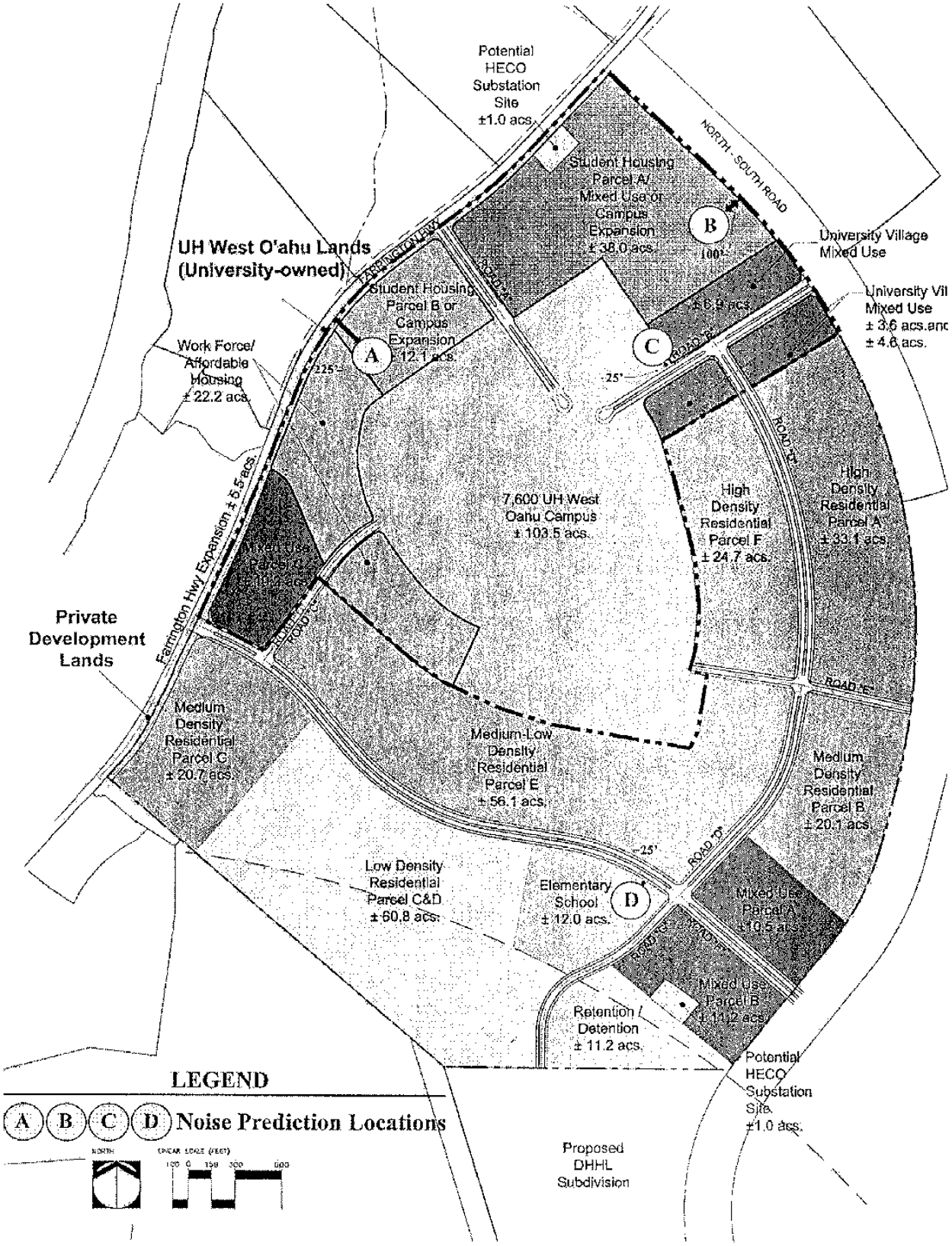
Date	Project No.	Drawn By
June 2006	05-18	DFD

Figure No
5



Noise Prediction Locations

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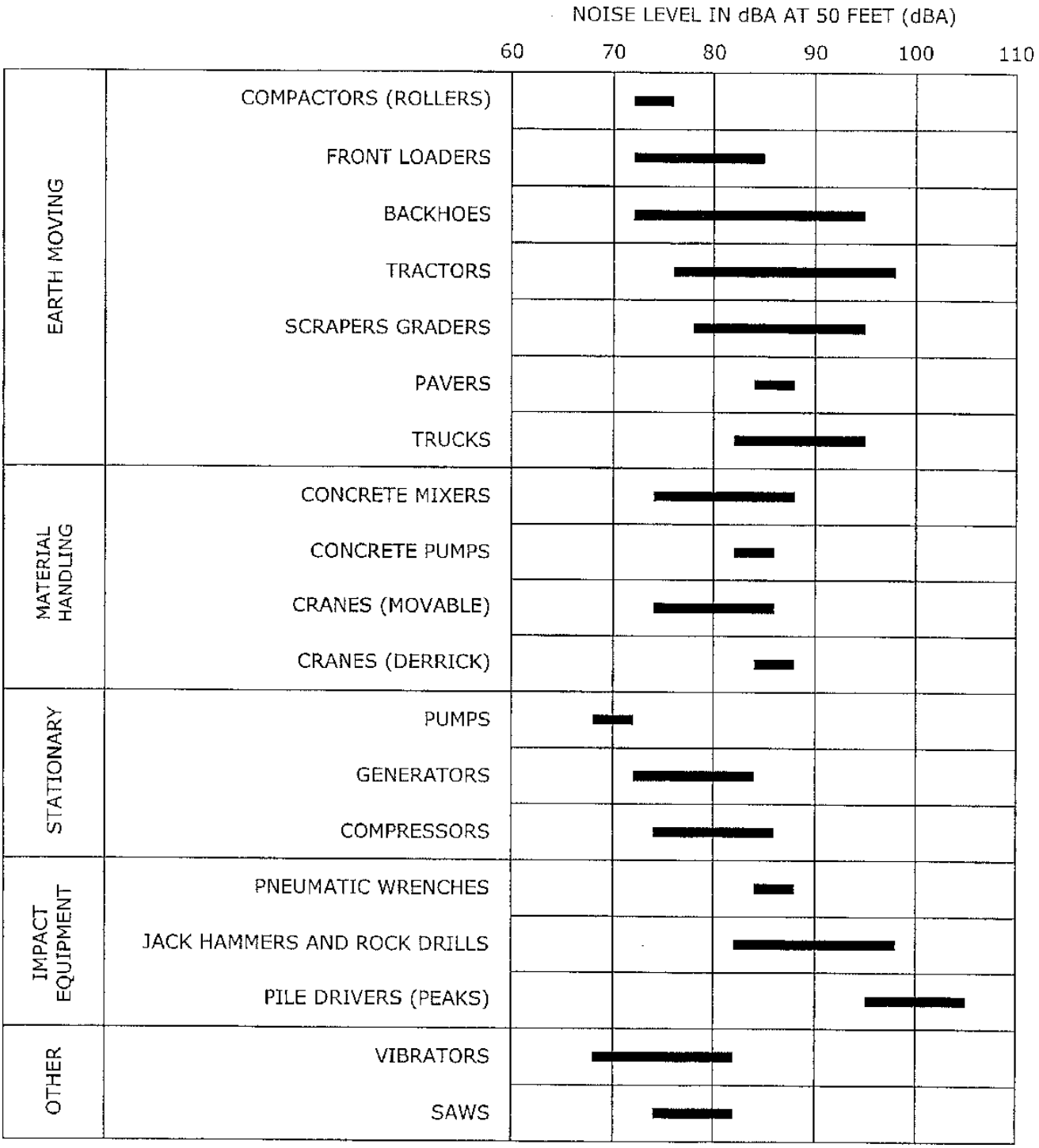
Date	Project No.	Drawn By
June 2006	05-18	DFD

Figure No 6



NOTE: BASED ON LIMITED AVAILABLE DATA SAMPLES

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Typical Sound Levels from Construction Equipment

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Date	Project No.	Drawn By
June 2006	05-18	TRB

Figure No 7