# Draft Environmental Impact Report (Draft EIR)

[State Clearinghouse No. 2012091037]

for

## Los Angeles International Airport (LAX) West Aircraft Maintenance Area Project

**Volume 4**

# Appendices C and D

City of Los Angeles
Los Angeles World Airports

**October 2013**

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Los Angeles World Airports

**October 2013**

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# Noise Analysis and Worksheets

# West Aircraft Maintenance Area Project
## Draft EIR
## Appendix C (Noise)

Noise Worksheets

Provided by PCR Services Corporation

September 2013

# Appendix C.1
## Construction Noise Calculations

**Project: West Aircraft Maintenance Area Project**

**Construction Phase:** **Phase**
***Demolition***

## Equipment

| Description | No. of Equip. | Reference Noise Level at 50ft, Lmax | Acoustical Usage Factor | Distance to Receptor, ft | Estimated Noise Shielding, dBA |
|---|---|---|---|---|---|
| Front End Loader | 2 | 79 | 40% | 1550 | 0 |
| Air Compressor | 1 | 78 | 50% | 1550 | 0 |
| Excavator | 2 | 81 | 40% | 1550 | 0 |
| Pickup Truck | 1 | 75 | 40% | 1550 | 0 |
| Dump/Haul Trucks | 8 | 76 | 20% | 1550 | 0 |

**Receptor:**

**Construction Hour:**

| | |
|---|---|
| 12 | Hours during daytime (7 am to 7 pm) |
| 0 | Hours during evening (7 pm to 10 pm) |
| 0 | Hours during nighttime (10 pm to 7 am) |

**Results:**

**Lmax:** **55**
**Leq:** **55**

Source for Ref. Noise Levels: LA CEQA Guides, 2006 & FHWA RCNM, 2005

**Project: West Aircraft Maintenance Area Project**

**Construction Phase:** **Phase**
***Excavation***

**Equipment**

| Description | No. of Equip. | Reference Noise Level at 50ft, Lmax | Acoustical Usage Factor | Distance to Receptor, ft | Estimated Noise Shielding, dBA |
|---|---|---|---|---|---|
| Front End Loader | 1 | 79 | 40% | 1550 | 0 |
| Excavator | 2 | 81 | 40% | 1550 | 0 |
| Water Trucks | 1 | 80 | 10% | 1550 | 0 |
| Pickup Truck | 1 | 75 | 40% | 1550 | 0 |
| Dump/Haul Trucks | 8 | 76 | 20% | 1550 | 0 |

**Receptor:**

**Construction Hour:**
12 Hours during daytime (7 am to 7 pm)
0 Hours during evening (7 pm to 10 pm)
0 Hours during nighttime (10 pm to 7 am)

**Results:**

**Lmax:** **55**
**Leq:** **54**

Source for Ref. Noise Levels: LA CEQA Guides, 2006 & FHWA RCNM, 2005

**Project: West Aircraft Maintenance Area Project**

**Construction Phase:** **Phase**
***Grading***

**Equipment**

| **Description** | **No. of Equip.** | **Reference Noise Level at 50ft, Lmax** | **Acoustical Usage Factor** | **Distance to Receptor, ft** | **Estimated Noise Shielding, dBA** |
|---|---|---|---|---|---|
| Dozer | 1 | 82 | 40% | 1550 | 0 |
| Front End Loader | 1 | 79 | 40% | 1550 | 0 |
| Other Equipment | 1 | 85 | 50% | 1550 | 0 |
| Compactor (Ground) | 2 | 83 | 20% | 1550 | 0 |
| Excavator | 1 | 81 | 40% | 1550 | 0 |
| Scrapers | 1 | 84 | 40% | 1550 | 0 |
| Water Trucks | 1 | 80 | 10% | 1550 | 0 |
| Pickup Truck | 1 | 75 | 40% | 1550 | 0 |
| Dump/Haul Trucks | 8 | 76 | 20% | 1550 | 0 |

**Receptor:**

**Construction Hour:**

| | |
|---|---|
| 12 | Hours during daytime (7 am to 7 pm) |
| 0 | Hours during evening (7 pm to 10 pm) |
| 0 | Hours during nighttime (10 pm to 7 am) |

**Results:**

**Lmax:** **56**
**Leq:** **58**

Source for Ref. Noise Levels: LA CEQA Guides, 2006 & FHWA RCNM, 2005

**Project: West Aircraft Maintenance Area Project**

**Construction Phase:** **Phase**
***UG Utilities Installation***

**Equipment**

| Description | No. of Equip. | Reference Noise Level at 50ft, Lmax | Acoustical Usage Factor | Distance to Receptor, ft | Estimated Noise Shielding, dBA |
|---|---|---|---|---|---|
| Pickup Truck | 1 | 75 | 40% | 2250 | 0 |
| Crew Vans | 2 | 75 | 40% | 2250 | 0 |
| Excavator | 1 | 81 | 40% | 2250 | 0 |
| Front End Loader | 2 | 79 | 40% | 2250 | 0 |
| Tractor/Loader/Backhoe | 2 | 80 | 25% | 2250 | 0 |
| Backhoe | 1 | 80 | 40% | 2250 | 0 |
| Dump/Haul Trucks | 3 | 76 | 20% | 2250 | 0 |
| Roller | 1 | 80 | 20% | 2250 | 0 |
| Air Compressor | 1 | 78 | 50% | 2250 | 0 |
| Welders | 2 | 74 | 40% | 2250 | 0 |

**Receptor:**

**Construction Hour:**

12 Hours during daytime (7 am to 7 pm)
0 Hours during evening (7 pm to 10 pm)
0 Hours during nighttime (10 pm to 7 am)

**Results:**

**Lmax: 50**
**Leq: 52**

Source for Ref. Noise Levels: LA CEQA Guides, 2006 & FHWA RCNM, 2005

**Project: West Aircraft Maintenance Area Project**

**Construction Phase:** **Phase**
***Foundation***

**Equipment**

| Description | No. of Equip. | Reference Noise Level at 50ft, Lmax | Acoustical Usage Factor | Distance to Receptor, ft | Estimated Noise Shielding, dBA |
|---|---|---|---|---|---|
| Pickup Truck | 1 | 75 | 40% | 2250 | 0 |
| Air Compressor | 1 | 78 | 50% | 2250 | 0 |
| Skid Steer Loaders | 1 | 80 | 40% | 2250 | 0 |
| Backhoe | 1 | 80 | 40% | 2250 | 0 |
| Dump/Haul Trucks | 3 | 76 | 20% | 2250 | 0 |
| Concrete Mixer Trucks | 1 | 79 | 40% | 2250 | 0 |
| Aerial Lift | 1 | 75 | 20% | 2250 | 0 |
| Other Equipment | 1 | 85 | 50% | 2250 | 0 |

**Receptor:**

**Construction Hour:**

| | |
|---|---|
| 12 | Hours during daytime (7 am to 7 pm) |
| 0 | Hours during evening (7 pm to 10 pm) |
| 0 | Hours during nighttime (10 pm to 7 am) |

**Results:**

**Lmax:** **52**
**Leq:** **52**

Source for Ref. Noise Levels: LA CEQA Guides, 2006 & FHWA RCNM, 2005

**Project: West Aircraft Maintenance Area Project**

**Construction Phase:** **Phase**
***Paving***

**Equipment**

| Description | No. of Equip. | Reference Noise Level at 50ft, Lmax | Acoustical Usage Factor | Distance to Receptor, ft | Estimated Noise Shielding, dBA |
|---|---|---|---|---|---|
| Pavers | 1 | 77 | 50% | 1550 | 0 |
| Roller | 1 | 80 | 20% | 1550 | 0 |
| Other Construction Equipmen | 1 | 85 | 50% | 1550 | 0 |
| Front End Loader | 1 | 79 | 40% | 1550 | 0 |
| Pickup Truck | 1 | 75 | 40% | 1550 | 0 |
| Flat Bed Truck | 1 | 76 | 20% | 1550 | 0 |
| Dump/Haul Trucks | 13 | 76 | 20% | 1550 | 0 |

**Receptor:**

**Construction Hour:**

12 Hours during daytime (7 am to 7 pm)
0 Hours during evening (7 pm to 10 pm)
0 Hours during nighttime (10 pm to 7 am)

**Results:**

**Lmax:** **57**
**Leq:** **56**

Source for Ref. Noise Levels: LA CEQA Guides, 2006 & FHWA RCNM, 2005

# Appendix C.2

**Noise Analysis Results for the Proposed WAMA at LAX**
**HMMH, June 26, 2013.**

## Memorandum

*To:* *Lisa Trifiletti, LAWA*

*From:* *Dorothy Meyer and Tony Skidmore, CDM Smith*

*Date:* *July 1, 2013*

*Subject:* *Submittal of Draft Technical Memorandum from HMMH Regarding Noise Analysis for the Proposed LAX West Aircraft Maintenance Area (WAMA), Specifically as Related to Aircraft Engine Run-up Activity*

In conjunction with submittal to LAWA the technical report referenced above, CDM Smith would like to note the additional information related to completion of the analysis for the technical report.

1. Rationale Behind Three Analysis Scenarios – As described on page 2 of the HMMH Memorandum, the noise analysis addressed the following three scenarios:
    a. Existing aircraft engine run-up conditions
    b. Future aircraft engine run-up conditions with WAMA and no GRE
    c. Future aircraft engine run-up conditions with WAMA and GRE

    This range of analysis scenarios is considered reasonable and appropriate for purpose of the WAMA Draft Environmental Impact Report (EIR) in that it: (1) establishes baseline run-up noise levels associated with existing conditions; (2) addresses potential changes in run-up noise levels resulting from implementation of the WAMA project (hereafter referred to as the proposed project) including relocation of existing aircraft maintenance operations, and associated engine run-up activities, for Qantas Airlines and US Airways from their current location to the proposed project site; and (3) provides a quantitative indication of the amount of noise reduction associated with the inclusion of a ground run-up enclosure (GRE), particularly as related to potential increases in noise levels at sensitive noise receptors nearby for project-related aircraft engine run-up activities with and without a GRE. Based on the analysis results for these three scenarios, there is no need for the identification and quantitative analysis of additional scenarios. While the WAMA Draft EIR identifies and evaluates alternatives for the proposed project, such as the No Project Alternative, the Reduced Project Alternative, and the Alternative Location, the proposed project site would relocate aircraft engine run-up activity to an area closer to sensitive noise receptors than are the other two alternative locations, and the noise analysis concludes that no noise significant noise impacts would occur from run-up activity at the proposed project site with or without the GRE. In the absence of any significant noise impacts from the proposed project, it is not necessary to model the run-up noise levels for the other alternative sites, which are located farther away from noise-sensitive receptors.

2. GRE Location within the Proposed Project Site – The noise impact analysis completed by HMMH took into account the site plan refinement that occurred subsequent to publication of the EIR Notice of Preparation, whereby the location of GRE was moved north from the originally proposed location in order to move run-up activities farther away from the nearest noise sensitive receptors, which are located in El Segundo south of the project site.

3. Distances to Noise-Sensitive Receptors – Table 4 in the HMMH Memorandum identifies the locations of the 31 representative noise sensitive receptors considered in the noise analysis, and Figure 3 in the Memorandum shows the geographic relationships between the receptor locations and each of the six sites within LAX where aircraft engine run-ups would occur following implementation of the proposed project. The table below indicates the approximate distance to each noise-sensitive location as measured from the proposed run-up location within the proposed project site.

| Approximate Distance Between Representative Noise-Sensitive Locations and Proposed WAMA Site | | |
|---|---|---|
| **ID #** | **Address/Location** | **Approximate Distance in Miles** |
| **School** | | |
| 1 | El Segundo High School 640 Main St. | 1.20 |
| 2 | Center St. Elementary School 700 Center St. | 1.65 |
| 3 | Richmond Street Elementary 615 Richmond St. | 1.15 |
| 4 | Imperial School 540 E. Imperial Ave. | 1.25 |
| 5 | St. Anthony's Catholic School 233 Lomita St. | 1.80 |
| 6 | El Segundo Middle School 332 Center St. | 1.90 |
| 7 | El Segundo Pre-School 301 West Grand Ave. | 1.50 |
| 8 | Hilltop Christian School 777 E. Grand Ave. | 1.80 |
| 9 | Loyola Village Elementary School Villanova St. and Rayford Dr. | 1.45 |
| 10 | Paseo Del Rey Natural Science Magnet 7751 Paseo Del Rey St. | 1.30 |
| 11 | Westchester High School 7400 W. Manchester Ave. | 1.45 |
| 12 | St. Bernard High School 9100 Falmouth Ave. | 1.10 |
| 13 | St. Anastasia School 8631 S. Stanmoor Dr. | 1.45 |
| **Health Care Facility** | | |
| 14 | Playa Del Rey Care and Rehabilitation Center 7716 W. Manchester Ave. | 1.45 |
| **Library** | | |
| 15 | El Segundo Public Library 111 W. Mariposa Ave. | 1.20 |
| **Place of Worship** | | |
| 16 | Pacific Baptist Church 859 Main St. | 0.95 |

| Approximate Distance Between Representative Noise-Sensitive Locations and Proposed WAMA Site | | |
|---|---|---|
| ID # | Address/Location | Approximate Distance in Miles |
| 17 | United Methodist Church 54 Main St. | 1.30 |
| 18 | First Baptist Church 591 E. Palm Ave. | 1.40 |
| 19 | St. John's Lutheran Church 1611 E. Sycamore Ave. | 1.90 |
| 20 | Church of Christ of Latter Day Saints 1215 E. Mariposa Ave. | 1.80 |
| 21 | St. Anthony's Catholic Church 720 E. Grand Ave. | 1.70 |
| 22 | St. Andrew Catholic Church 538 Concord St. | 1.15 |
| 23 | St. Michaels Episcopal Church 361 Richmond St. | 1.40 |
| 24 | El Segundo Christian Church Franklin Ave. and Concord St. | 1.50 |
| 25 | Kingdom Hall of Jehovah's Witnesses 608 E. Grand Ave. | 1.65 |
| 26 | St. Anastasia Catholic Church 7390 W. Manchester Ave. | 1.50 |
| 27 | Messiah Congregational Church W. Manchester Ave. and Rayford Dr. | 1.50 |
| 28 | Hope Chapel Del Rey Foursquare 7299 W. Manchester Ave. | 1.55 |
| 29 | Del Rey Hills Evangelical Free Church 8505 Saran Dr. | 1.50 |
| **El Segundo Residential Area near LAX Boundary** | | |
| P-ESG1 | Roof of building at 770 West Imperial Ave. | 0.55 |
| P-ESG2 | Greenbelt across from 216 East Imperial Ave. | 1.00 |
| Source: LAWA, Google Earth | | |

4. Run-Up Activity Assumptions for Proposed Project Site – The underlying assumption regarding aircraft engine run-up activity for the proposed project site is that the existing run-up operations, specifically those currently associated with Qantas airlines and with US Airways, which would be displaced by imminent Master Plan improvements would relocate to the proposed project. The noise analysis focuses on the relocation of the existing run-up activities as being the activity level that is currently known to occur. No assumptions are made as to potential increases in run-up activities by Qantas and US Airways, as projecting such increases in activity would be speculative in nature, and potential increases in run-up activity are ostensibly just as likely to occur at the existing locations as they are to occur at the proposed project site (i.e., potential increases in activity are not exclusive to, or attributable to, the proposed project).

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## TECHNICAL MEMORANDUM

| | |
|---|---|
| **To:** | Suzanne Tracy |
| **CC:** | Lisa Trifiletti, Scott Tatro, Kathryn Pantoja |
| **From:** | Bob Behr and Gene Reindel |
| **Date:** | June 26, 2013 |
| **Subject:** | Noise Analysis Results for the Proposed WAMA at LAX |
| **Reference:** | HMMH Project #305210.003 |

## 1. INTRODUCTION

Through the Environmental On-Call contract withCH2M Hill, Los Angeles World Airports (LAWA) engaged the services of Harris Miller Miller & Hanson Inc. (HMMH) to conduct a noise analysis of proposed aircraft high-power engine run-up activity associated with the West Aircraft Maintenance Area (WAMA) (Project) at Los Angeles International Airport (LAX).

This memorandum describes the methodology and results of an environmental noise assessment of aircraft engine run-up activity at the WAMA as compared to existing conditions. The assessment included: obtaining aircraft maintenance operations from LAX leaseholders (i.e., airlines), conducting source noise level measurements of aircraft engine run-ups at LAX, conducting and analyzing noise measurements at two locations in the adjacent City of El Segundo community during the source noise level measurements, and modeling aircraft maintenance run-up noise levels for the existing and future proposed conditions at the WAMA Project site.

To assist LAWA with evaluating the significance of noise impacts associated with the proposed Project as required under the California Environmental Quality Act (CEQA), the noise assessment used the criteria defined in the Federal Aviation Administration (FAA) Order 1050.1E, "Environmental Impacts: Policies and Procedures"[1], and reiterated in the L.A.CEQA Thresholds Guide[2] to establish an appropriate threshold of significance for the CEQA analysis. Appendices A and B are provided as background on noise terminology and land use compatibility with regard to aircraft noise exposure.

To characterize the noise effects of existing and future aircraft run-up operations to communities near LAX, HMMH modeled single-event noise levels (using the maximum sound level) to allow a comparison of the results of the proposed Project to existing conditions.

This Technical Memorandum is organized as follows;

- Summary of the results (Section 2)
- Brief description of the proposed Project (Section 3)
- Descriptions of the data collection process and noise model inputs (Section 4)
- Applicable criteria, methodology and results of the noise assessment process (Section 5)
- Study conclusions (Section 6)

[1] FAA Order 1050.1E, "Environmental Impacts: Policies and Procedures", March 20, 2006.
[2] L.A. CEQA Thresholds Guide, Section I.4 "Airport Noise", 2006.

## 2. SUMMARY

The proposed Project provides little to no change in aircraft run-up noise to the nearby communities as evaluated against the significant impact criteria in terms of the Community Noise Equivalent Level (CNEL). On a CNEL basis, the noise reduction, as determined through assessment at the noise sensitive receivers (e.g., residences, schools and places of worship) in the nearby communities, range from -0.1 to 0.2 dB CNEL.

## 3. PROJECT DESCRIPTION

The existing configuration at LAX has several airline tenants conducting maintenance engine run-ups within their respective leaseholds. These tenants include American Airlines, Delta Airlines, Federal Express (FedEx) Airlines, Qantas Airlines, US Airways, and United Airlines. The engine run-ups at the various leaseholds include engine idle run-up checks to high-power engine run-ups (Qantas and US Airways only conduct idle run-ups on their leaseholds). Per the LAX Master Plan, several maintenance facilities located in the midfield area need to be demolished and removed in order to accommodate future improvements at LAX. Specifically, development of the Bradley West improvements and its associated construction of Taxilane T, the future Midfield Satellite Concourse, and an additional cross-field taxiway (Taxiway C14) delineated in the LAX Master Plan ultimately require the removal of the former TWA Hangar, the American Airlines High Bay Hangar, and the US Airways Hangar. These LAX Master Plan improvements also require the removal of the American Airlines Low Bay Hangar, which occurred in late-2012 through early-2013. Removal of these existing facilities would be offset in part by the new apron and maintenance facilities developed under the Project. For the purposes of this analysis, it was assumed that, based on current leases, Qantas Airlines and US Airways would be the tenants requiring relocation to the proposed WAMA site, which is located in the area south of World Way West and east of Pershing Drive near the western boundary of LAX.

To determine whether the proposed change in ground engine run-up operations due to the construction of the WAMA at LAX would significantly impact the surrounding local communities, HMMH modeled and analyzed the following two aircraft engine run-up scenarios:

1. Existing aircraft engine run-up conditions
2. Future aircraft engine run-up conditions with WAMA

The existing conditions scenario (scenario 1 above) considers the high-power run-ups occurring today at the American, Delta, FedEx, and United/Continental run-up locations. The future scenario (scenario 2 above) assumes no change in the number of total aircraft engine run-up operations, but relocates the Qantas and US Airways run-up operations to the WAMA. Scenario 2 includes a blast fence that all aircraft will use for run-ups in the WAMA.

## 4. DATA COLLECTION

HMMH requested and collected pertinent data to support the noise modeling process to assist in the characterization of the noise environment with respect to aircraft engine run-ups at LAX. The data collected included the following:

- Location of engine run-ups at the proposed WAMA
- Annual number of high-power engine run-ups by aircraft type, power setting, duration, and time of day by leasehold operator and location
- Local topography and ground cover
- Local building footprints and heights
- Local average meteorological conditions
- Noise sensitive locations in neighboring communities
- Noise criteria for evaluating significant impact

## 4.1 Location of WAMA Engine Run-ups

As provided by LAWA in March 2013, HMMH used the information presented in the AutoCAD files to locate the proposed run-up location in the WAMA at approximately N33° 56' 16.67", W118° 25' 44.97". The run-ups in the WAMA would be positioned facing into the prevailing westerly winds and parallel to the runway orientation (263° true or 250.2° magnetic) with a blast fence to the rear of the aircraft.

## 4.2 Run-up Activity

For the existing conditions, HMMH received information from LAWA and the airlines on the high-power run-up activity at the various leaseholds. For the future conditions at the WAMA HMMH received the high-power run-up activity that was to remain at the leaseholds as well as the activity that would be moved to the WAMA. Figure 1 and Figure 2 show the high-power run-up locations for the existing and proposed future conditions, and also delineate by number and symbol the location and nature of sensitive noise receptors, discussed in Section 4.6, considered for modeling community noise levels from high-power engine run-up activity.

While most of the high-power run-ups are single engine, the other engine or, in the case of four engine aircraft, an engine on the other side of the aircraft centerline, is run above idle setting to balance out the aircraft during engine run-ups. Discussions with United Airlines indicated they have three engine run-up locations on their ramp, two facing east (083 degrees true) and one facing west (263 degrees true). United Airlines indicated that the high-power run-up operations are evenly split between the east (50%) and west (50%) heading run-up locations.

For each scenario modeled, details of the run-up operations are listed in the tables below. These include:

- airline and specific aircraft type
- run-up location in latitude and longitude
- aircraft heading in relation to true north (083 or 263 degrees)
- number of run-up engines
- power setting of the run-up engine and that of an engine on the other side of the aircraft centerline (to provide aircraft stability)
- length of time in seconds that the engine is at the high-power run-up setting
- annual number of run-ups by time of day for all high-power aircraft run-ups

The estimated total high-power run-ups for each of the three scenarios are approximately 2,496 annually or 208 monthly.

Table 1 shows the data assumptions of run-up activity for the existing case at the five existing locations (Qantas Airlines currently conducts high power run-ups at the United/Continental Airlines ramp[3] and US Airways conducts high-power run-ups at the American Airlines ramp). Table 2 shows the data assumptions for the future run-up activity with the aircraft of the displaced airlines using the WAMA site with approximately 60 run-ups annually (5 monthly) occurring in the WAMA. The majority of the high-power run-ups remain at the current leaseholds (approximately 2,436 annually or 203 monthly).

[3] The United/Continental Airlines ramp refers to the aircraft maintenance area located in the western portion of the airport. The subject area was operated by Continental Airlines which has merged with United Airlines. For brevity, the subject area is identified in the figures presented herein as the "United" area.


LAX Los Angeles World Airports

Figure 1

**Existing Run-up Locations**

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LAX Los Angeles World Airports

Figure 2

**Proposed Future Run-up Locations**

HARRIS MILLER MILLER & HANSON INC.

**Table 1 Existing Conditions High-Power Run-up Activity**

| Airline Aircraft | Location | | | Parameters | | | Annual Number | | |
|---|---|---|---|---|---|---|---|---|---|
| | Latitude (deg) | Longitude (deg) | True Heading (deg) | Number of Engines | Power Setting (lbs per engine or %) (other engine) | Duration for a single run-up (sec) | Day 7am to 7 pm | Evening 7 pm to 10 pm | Night 10 pm to 7 am |
| Qantas A380 | 33° 56'16.88"N | 118° 25'16.42"W | 263 | 1 | 80% (50%) | 600 | 24 | | |
| Qantas B747-400 | 33° 56'16.88"N | 118° 25'16.42"W | 263 | 1 | 80% (50%) | 600 | 12 | | |
| American B767-300ER | 33° 56'20.03"N | 118° 24'48.96W | 263 | 1 | 100% (80%) | 300 | 72 | 28.8 | 187.2 |
| American B757-200 | 33° 56'20.03"N | 118° 24'48.96W | 263 | 1 | 100% (80%) | 300 | 54 | 21.6 | 140.4 |
| American B737-800 | 33° 56'20.03"N | 118° 24'48.96W | 263 | 1 | 100% (80%) | 300 | 36 | 14.4 | 93.6 |
| American B777-200ER | 33° 56'20.03"N | 118° 24'48.96W | 263 | 1 | 100% (80%) | 300 | 9 | 3.6 | 23.4 |
| American MD-80 | 33° 56'20.03"N | 118° 24'48.96W | 263 | 1 | 100% (80%) | 300 | 9 | 3.6 | 23.4 |
| FedEx MD-11 | 33° 56'44.16"N | 118° 25'22.89"W | 263 | 3 | 100% | 300 | | 48 | |
| US Airways A321/320/319 | 33° 56'20.03"N | 118° 24'48.96"W | 263 | 1 | 100% (idle) | 300 | 6 | 2.4 | 15.6 |
| United B737-900ER | 33° 56'16.88"N | 118° 25'16.42"W | 263 | 1 | 100% (idle) | 300 | 129.6 | 32.4 | 162 |
| United B737-900ER | 33° 56'16.55"N | 118° 25'23.35"W | 083 | 1 | 100% (idle) | 300 | 129.6 | 32.4 | 162 |
| United B757-200/300 | 33° 56'16.88"N | 118° 25'16.42"W | 263 | 1 | 100% (idle) | 300 | 129.6 | 32.4 | 162 |
| United B757-200/300 | 33° 56'16.55"N | 118° 25'23.35"W | 083 | 1 | 100% (idle) | 300 | 129.6 | 32.4 | 162 |
| United B777-200ER | 33° 56'16.88"N | 118° 25'16.42"W | 263 | 1 | 100% (idle) | 300 | 26.4 | 6.6 | 33 |
| United B777-200ER | 33° 56'16.55"N | 118° 25'23.35"W | 083 | 1 | 100% (idle) | 300 | 26.4 | 6.6 | 33 |
| United B787 | 33° 56'16.88"N | 118° 25'16.42"W | 263 | 1 | 100% (idle) | 300 | 2.4 | 0.6 | 3 |
| United B787 | 33° 56'16.55"N | 118° 25'23.35"W | 083 | 1 | 100% (idle) | 300 | 2.4 | 0.6 | 3 |
| Delta B757-200/300 | 33° 56'36.31"N | 118° 23'39.87"W | 263 | 1 | 80% (50%) | 600 | 30 | 12 | 78 |
| Delta B767-300 | 33° 56'36.31"N | 118° 23'39.87"W | 263 | 1 | 80% (50%) | 600 | 27 | 10.8 | 70.2 |

Source: LAWA and Airlines

**Table 2 Proposed Future Conditions High-Power Run-up Activity at the WAMA**
(Changes from Existing Conditions Highlighted in Yellow)

| Airline Aircraft | Location | | | Parameters | | | Annual Number | | |
|---|---|---|---|---|---|---|---|---|---|
| | Latitude (deg) | Longitude (deg) | True Heading (deg) | Number of Engines | Power Setting (lbs per engine or %) | Duration for a single run-up (sec) | Day 7am to 7 pm | Evening 7 pm to 10 pm | Night 10 pm to 7 am |
| Qantas A380 | 33° 56'16.67"N | 118° 25'44.97"W | 263 WAMA | 1 | 80% (50%) | 600 | 24 | | |
| Qantas B747-400 | 33° 56'16.67"N | 118° 25'44.97"W | 263 WAMA | 1 | 80% (50%) | 600 | 12 | | |
| American B767-300ER | 33° 56'20.03"N | 118° 24'48.96W | 263 | 1 | 100% (80%) | 300 | 72 | 28.8 | 187.2 |
| American B757-200 | 33° 56'20.03"N | 118° 24'48.96W | 263 | 1 | 100% (80%) | 300 | 54 | 21.6 | 140.4 |
| American B737-800 | 33° 56'20.03"N | 118° 24'48.96W | 263 | 1 | 100% (80%) | 300 | 36 | 14.4 | 93.6 |
| American B777-200ER | 33° 56'20.03"N | 118° 24'48.96W | 263 | 1 | 100% (80%) | 300 | 9 | 3.6 | 23.4 |
| American MD-80 | 33° 56'20.03"N | 118° 24'48.96W | 263 | 1 | 100% (80%) | 300 | 9 | 3.6 | 23.4 |
| FedEx MD-11 | 33° 56'44.16"N | 118° 25'22.89"W | 263 | 3 | 100% | 300 | | 48 | |
| US Airways A321/320/319 | 33° 56'16.67"N | 118° 25'44.97"W | 263 WAMA | 1 | 100% (idle) | 300 | 6 | 2.4 | 15.6 |
| United B737-900ER | 33° 56'16.88"N | 118° 25'16.42"W | 263 | 1 | 100% (idle) | 300 | 129.6 | 32.4 | 162 |
| United B737-900ER | 33° 56'16.55"N | 118° 25'23.35"W | 083 | 1 | 100% (idle) | 300 | 129.6 | 32.4 | 162 |
| United B757-200/300 | 33° 56'16.88"N | 118° 25'16.42"W | 263 | 1 | 100% (idle) | 300 | 129.6 | 32.4 | 162 |
| United B757-200/300 | 33° 56'16.55"N | 118° 25'23.35"W | 083 | 1 | 100% (idle) | 300 | 129.6 | 32.4 | 162 |
| United B777-200ER | 33° 56'16.88"N | 118° 25'16.42"W | 263 | 1 | 100% (idle) | 300 | 26.4 | 6.6 | 33 |
| United B777-200ER | 33° 56'16.55"N | 118° 25'23.35"W | 083 | 1 | 100% (idle) | 300 | 26.4 | 6.6 | 33 |
| United B787 | 33° 56'16.88"N | 118° 25'16.42"W | 263 | 1 | 100% (idle) | 300 | 2.4 | 0.6 | 3 |
| United B787 | 33° 56'16.55"N | 118° 25'23.35"W | 083 | 1 | 100% (idle) | 300 | 2.4 | 0.6 | 3 |
| Delta B757-200/300 | 33° 56'36.31"N | 118° 23'39.87"W | 263 | 1 | 80% (50%) | 600 | 30 | 12 | 78 |
| Delta B767-300 | 33° 56'36.31"N | 118° 23'39.87"W | 263 | 1 | 80% (50%) | 600 | 27 | 10.8 | 70.2 |

Note: Qantas and US Air run-ups at WAMA
Source: LAWA and Airlines

### 4.3 Local Topography and Ground Cover

HMMH extracted topographical data from digital CAD drawing files provided by LAWA to develop the base map data used in the run-up analysis. These data were projected to the California state plane coordinate system using meters as the unit of measure and saved as an ESRI (Environmental Systems Research Institute, Inc.) shapefile for import into SoundPLAN for the noise analysis[4]. Mapping of these data elements was completed in ESRI's ArcGIS Desktop 10.0 service pack 5.

For ground cover it is important to identify acoustically "hard" (water, concrete, etc.) and "soft" (soil, vegetation, etc.) ground to better estimate the correct sound attenuation over the ground from the noise source to the respective receiver. HMMH used aerial views of the LAX property to define and designate specific geographic sections as either acoustically hard or soft.

### 4.4 Building Footprints

Footprints of buildings on the airport that may reflect or shield noise energy from the various run-up locations were included in the data base. Additionally for the future scenario, electronic data files were used to remove those buildings identified for demolition (the former TWA Hangar, the American Airlines Low Bay Hangar, and the US Airways Hangar) and adding new buildings in the WAMA (two aircraft hangars). Where building heights were not available, HMMH assumed building heights based on similar buildings through visual estimations.

### 4.5 Local Average Meteorological Conditions

The noise model accounts for atmospheric effects on sound propagation and thus requires certain meteorological or weather data as inputs. These phenomena are discussed in more detail in Section 5.4 and Appendix A.

The following meteorological conditions were used for this study:

- Average Temperature: 63.0° F
- Average Sea-Level Pressure: 29.98 inches of mercury
- Average Relative Humidity: 70.3%

These are the same conditions used for the recent LAX 14 CFR Part 161 Application.

### 4.6 Noise Sensitive Locations in Neighboring Communities

HMMH used LAWA's inventory of non-residential noise sensitive receptors and a review of Google Earth to determine potential noise sensitive locations that may be affected by this proposed action. Since the proposed WAMA run-up location would be situated to the west of the runway complex, the grid points for the receptors were limited to those in El Segundo west of Sepulveda Blvd/Pacific Coast Highway and to those in Playa del Rey and Westchester west of Lincoln Blvd. As shown in Table 3, there were 29 identified locations comprised of 13 schools, 1 health care facility, 1 library, and 14 places of worship.

In addition to these sites, HMMH set up two noise monitors on the boundary between LAX and the adjacent residential area of the City of El Segundo. These positions were selected at the closest residential areas to the proposed WAMA: P-ESG1 is on the roof of a condominium complex located nearest the proposed WAMA run-up location and at a higher elevation than the proposed WAMA site (i.e., more direct unobstructed noise path between noise source and noise receptor than might occur at-grade with intervening topography or structures along the noise path); and P-ESG2 is in the greenbelt area north of Imperial Way located at a position along the maximum directivity of the noise emanating from an aircraft high-power run-up within the WAMA.

[4] Projected Coordinate System: NAD_1983_StatePlane_California_V_FIPS_0405, Geographic Coordinate System: GCS_North_American_1983.

Table 3 identifies the 31 noise sensitive locations by address and ID number and Figure 1 and Figure 2 (earlier in the memorandum) show the sites in reference to LAX.

**Table 3 Representative Noise Sensitive Locations**

| ID # | Address/Location |
|---|---|
| **School** | |
| 1 | El Segundo High School 640 Main St. |
| 2 | Center St. Elementary School 700 Center St. |
| 3 | Richmond Street Elementary 615 Richmond St. |
| 4 | Imperial School 540 E. Imperial Ave. |
| 5 | St. Anthony’s Catholic School 233 Lomita St. |
| 6 | El Segundo Middle School 332 Center St. |
| 7 | El Segundo Pre-School 301 West Grand Ave. |
| 8 | Hilltop Christian School 777 E. Grand Ave. |
| 9 | Loyola Village Elementary School Villanova St. and Rayford Dr. |
| 10 | Paseo Del Rey Natural Science Magnet 7751 Paseo Del Rey St. |
| 11 | Westchester High School 7400 W. Manchester Ave. |
| 12 | St. Bernard High School 9100 Falmouth Ave. |
| 13 | St. Anastasia School 8631 S. Stanmoor Dr. |
| **Health Care Facility** | |
| 14 | Playa Del Rey Care and Rehabilitation Center 7716 W. Manchester Ave. |
| **Library** | |
| 15 | El Segundo Public Library 111 W. Mariposa Ave. |
| **Place of Worship** | |
| 16 | Pacific Baptist Church 859 Main St. |
| 17 | United Methodist Church 54 Main St. |
| 18 | First Baptist Church 591 E. Palm Ave. |
| 19 | St. John's Lutheran Church 1611 E. Sycamore Ave. |
| 20 | Church of Christ of Latter Day Saints 1215 E. Mariposa Ave. |
| 21 | St. Anthony’s Catholic Church 720 E. Grand Ave. |
| 22 | St. Andrew Catholic Church 538 Concord St. |
| 23 | St. Michaels Episcopal Church 361 Richmond St. |
| 24 | El Segundo Christian Church Franklin Ave. and Concord St. |
| 25 | Kingdom Hall of Jehovah's Witnesses 608 E. Grand Ave. |
| 26 | St. Anastasia Catholic Church 7390 W. Manchester Ave. |
| 27 | Messiah Congregational Church W. Manchester Ave. and Rayford Dr. |
| 28 | Hope Chapel Del Rey Foursquare 7299 W. Manchester Ave. |
| 29 | Del Rey Hills Evangelical Free Church 8505 Saran Dr. |
| **El Segundo Residential Area near LAX Boundary** | |
| P-ESG1 | Roof of building at 770 West Imperial Ave. |
| P-ESG2 | Greenbelt across from 216 East Imperial Ave. |
| Source: LAWA, Google Earth | |

## 5. APPLICABLE CRITERIA, NOISE ASSESSMENT METHODOLOGY AND RESULTS

This section provides and discusses the criteria used to determine significant impact, the methodology used to assess potential change in noise exposure from the Project, and the results of the analysis. Two specific scenarios were modeled: existing conditions and proposed future conditions with the WAMA. In addition, the maximum sound levels, Lmax, by aircraft type and location, were modeled for the respective receiver locations.

### 5.1 Noise Criteria for Evaluating Impact

As stated previously, HMMH assessed significant impact based on the criteria defined in the FAA Order 1050.1E, "Environmental Impacts: Policies and Procedures" and in the L.A. CEQA Thresholds Guide to determine the potential for significant impact.

The FAA Order uses the cumulative noise energy exposure metric defined as the annual Day-Night Average Sound Level (DNL) and recognizes, as an alternative for California, CNEL[5]. The noise criteria are defined in Appendix A, Section 14 of this Order where a significant impact is defined as follows (Note; CNEL can be inserted in place of DNL):

"A significant noise impact would occur if analysis shows that the proposed action will cause noise sensitive areas to experience an increase in noise of DNL 1.5 dB or more at or above DNL 65 dB noise exposure when compared to the no action alternative for the same timeframe."[6]

Similarly, the L.A. CEQA Thresholds Guide defines the significance threshold as follows:

"A significant impact on ambient noise levels would normally occur if noise levels at a noise sensitive use attributable to airport operations exceed 65 dB CNEL and the project increases ambient noise levels by 1.5 dB CNEL or greater."[7]

HMMH used the CNEL (DNL) threshold along with the land use compatibility guidelines in Appendix B to determine whether there was a significant impact due to the relocation of some aircraft high-power engine run-ups to the proposed WAMA.[8]

### 5.2 Noise Modeling and Analysis

HMMH used the FAA's Integrated Noise Model (INM) and actual aircraft source level measurements to develop the aircraft data inputs to the SoundPLAN® (Version 7.2) computer model[9]. The INM provides data on aircraft organized into noise spectral classes for arrival and departure profiles. Aircraft within a specific spectral class have the same shape to their spectrum. HMMH used the INM to develop test run-up scenarios for the specific aircraft conducting high-power run-ups at LAX and then generalized the noise spectrum and directivity for each aircraft based on data validation through aircraft source level measurements and the resulting A-weighted sound pressure levels (Section 5.3). Based on the types of aircraft conducting run-up activities at LAX, as delineated in Table 1 and Table 2, a total of 11 aircraft run-up source type inputs were developed for use in SoundPLAN® to compute sound levels in community locations attributed to the various aircraft run-ups.

Noise modeling, particularly with SoundPLAN® rather than only conducting a noise measurement program, provides the following benefits:

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[5] See Appendix A for more information on noise metrics.
[6] FAA Order 1050.1E, "Environmental Impacts: Policies and Procedures", Appendix A: "Analysis of Environmental Impact Categories," Section 14: Noise, Paragraph 14.3, March 20, 2006.
[7] L.A. CEQA Thresholds Guide, Section I.4-2 "Determination of Significance", 2006.
[8] The analysis focuses on potential noise impacts associated with high-power aircraft engine run-ups. Although aircraft engine maintenance activities can involve low-power engine checks, the associated noise levels are relatively low.
[9] Documentation provided in SoundPLAN® 7.0 User's Manual, Braunstein + Berndt GmbH, March 2010 (including update information for version 7.1 – June 2011 and version 7.2 – November 2012).

- Because it is not feasible to perform measurements in every location, the model provides estimates of sound levels in locations where measurements were not conducted.
- In cases where the presence of other masking noise sources (such as street traffic) prevents direct measurement of sound levels due to certain sources, the model provides estimates of sound levels in the absence of the masking source.
- The model allows evaluation of various scenarios, including past and future conditions, which cannot be measured.
- The model produces sound contour maps, which graphically depict estimated noise levels over broad areas.
- If desired, the model can be used to account for differences in sound propagation caused by various atmospheric conditions.

## 5.3 Aircraft Noise Measurements – Source Level and Community

Source-level data typically are obtained during controlled measurements made within several hundred feet of an aircraft to characterize that particular aircraft. These measurements are intended to represent the sound levels produced by aircraft performing a particular type of operation, including its directional and spectral (frequency) characteristics. Source-level measurements often are conducted at a relatively short reference distance so that the measurements will not be affected significantly by propagation effects (such as wind conditions, shielding provided by buildings, or effects of intervening terrain) or contaminated by other noise sources. The measured sound levels can then be used as input to a noise prediction model to determine the contribution of a particular noise source at a given prediction point or to assess the consistency of the noise prediction model to provide accurate results.

HMMH gathered noise measurements of aircraft high-power run-ups at LAX. The noise measurements were coordinated and planned with two of the major airline users at LAX. The airlines perform high-power engine run-ups as part of their normal maintenance check and the objective was for HMMH to gather noise data during these normal, but periodic operations.

A controlled high-power engine run-up on a Boeing 757-223 was conducted at the existing American Airlines run-up pad facing westerly on February 28, 2013 at approximately 6:50 am. Because the overall sound levels and spectral content (i.e., the frequency characteristics, ranging from the "whine" emitted from the front of a jet engine to the "rumble" towards the rear) of aircraft engines vary depending upon the orientation of the aircraft relative to the observer, the source-level measurements were conducted in a radial pattern around each aircraft in ten-degree increments at a uniform distance of 83 ft. Source level measurements were made on this aircraft for the left and right engines (RB-211), one set at 96% thrust level and one at approximately 80% thrust level. Once the engine run-up was stabilized at the above thrust level, ten-second average measurements were made at the ten-degree increments from in front of the engine (0 degrees) to approximately 180 degrees (120 ft.) from the front of the engine. An additional high-power run-up of the same aircraft was conducted in like fashion at the United Airlines run-up pad 12 facing easterly on February 28, 2013 beginning at approximately 8:10 am. Source level measurements at the ten-degree increments from in front of the engine (0 degrees) to approximately 150 degrees from the front of the engine were made on this aircraft for both the left and right engines set at full thrust level. Appendix C provides the data from the four separate engine run-up measurements of the Boeing 757-223 aircraft.

Prior to commencing the source level measurements, HMMH set up two short-term measurements sites in the adjacent City of El Segundo residential areas near the southern boundary of LAX on February 27, 2013. The objective was to collect noise data during the aforementioned aircraft high-power engine run-ups and provide additional data points for evaluating potential noise impacts. The sites included the roof of a condominium (designated as P-ESG1), which is elevated above the LAX elevation and nearest the proposed WAMA location, and a greenbelt area between Imperial Way and Imperial Highway (designated as P-ESG2), which is along the approximate maximum noise directivity path from aircraft run-ups in the proposed WAMA location. Appendix D provides photographs of the sites and the measurement equipment along with graphic presentations of the sound levels logged during the periods that included the source level engine run-ups on February 28, 2013 (during hours of 0600-0700 and 0800-0900). The higher sound level "spikes" shown on these graphics represent short term events associated with aircraft departures, arrivals with thrust reversers, or community specific sources (e.g., street traffic, people, or other unknown sources).

Although the SoundPLAN® model has been validated many times and uses sound propagation parameters consistent with international standards, comparison of the computed results to measured values provides additional confidence in the model's results for this evaluation. SoundPLAN® was used to compute sound levels at each of the measurement locations used during the close-in source-level measurements described above. On average, the computed A-weighted sound levels for the Boeing 757-223 aircraft run-ups agreed to within less than one-half decibel (0.5 dB) of the measured levels. This comparison validated the modeled source-level data in the model.

In addition the measured Lmax noise levels obtained at P-ESG1 for the respective run-up periods were compared to those computed by SoundPLAN at P-ESG1 and the levels from SoundPLAN were on the order of about 2-3 dB higher than measured. Therefore, we concluded that the SoundPLAN model results were conservatively high, but on the order of expected sound levels in the community under weather conditions conducive to high sound propagation into the community.

## 5.4 Noise Modeling Methodology

HMMH used SoundPLAN® to develop and provide an estimate of sound levels at a distance from a specific noise source, or sources, taking into account:

- *Specific characteristics of each noise source including its frequency spectrum and directivity characteristics.* For this evaluation, noise data for each of the various noise sources included in the study were obtained through analysis of the source-level measurements described in Section 5.3.
- *Terrain features including relative elevations of noise sources, receivers, and intervening objects.* The digital terrain model was based upon topographical data provided by LAWA staff for all locations on the airfield. US Geological Survey topographical data were used for the remainder of the study area.
- *Ground effects due to areas of pavement and unpaved ground.* Large paved areas including airport ramp areas were coded into the model. Composite characteristics were used for other areas including the airfield and residential areas.
- *Shielding and reflections due to intervening buildings or other structures and diffracted paths around and over structures.* On-airport buildings were coded into the model using "footprints" based on data provided by LAWA. Locations and "footprints" of some off-airport buildings were also available from LAWA. No additional buildings were added to the noise model, which results in a conservatively high estimate of noise levels in the community.
- *Atmospheric effects on sound propagation.* Because long-distance ground-to-ground sound propagation is dependent upon local weather conditions, a particular set of measurements is indicative only of expected sound levels under the weather conditions that were present during the measurements. Temperature gradients, including either lapse or inversion conditions, and characteristics of wind, including direction, speed, and gradient can cause sound levels at remote locations to vary by as much as 15 to 20 decibels from day to day, or even hour to hour. Appendix A describes the effects of weather on outdoor sound propagation in greater detail.

The SoundPLAN® model includes several methods of accounting for atmospheric effects on sound propagation. For this evaluation, the model's implementation of the General Prediction Method[10] was used. The equations in this standard assume propagation under conditions of a "moderate downwind

[10] "Environmental Noise from Industrial Plants General Prediction Method," Danish Acoustical Laboratory, The Danish Academy of Technical Science, Lyngby, Denmark, 1982.

or slight temperature inversion." This standard provides a conservatively-high estimate of community sound levels caused by ground-based airport sources.

SoundPLAN® uses the annual number of run-ups and run-up durations listed in Table 1 or Table 2 to derive annual average daily run-up durations for day, evening, and night periods for all aircraft high-power run-ups at the locations identified. The model then uses all of these annual average daily run-up durations for day, evening, and night periods for all sites and all aircraft to derive the CNEL values at specific locations.

## 5.5 Existing Conditions

Based on the stated run-up parameters for the existing conditions scenario and the existing high-power engine run-up sites listed in Table 1, HMMH modeled the existing aircraft run-up activity to determine CNEL values for the high-power run-up operations at the noise sensitive locations identified in Table 3. The resulting modeled CNEL values for the aircraft high-power run-ups are shown in Table 4. The CNEL at the cited locations varies based on exposure (shielded or not shielded) and distance, elevation, and orientation with respect to the high-power run-up locations. The values in Table 4 established the baseline upon which comparisons were made with regard to significant impacts of the future condition scenario.

## 5.6 Proposed Future Conditions with the WAMA

For the proposed future scenario at the WAMA, the changes to the existing conditions comprise the moving of aircraft high-power engine run-up activity to the WAMA for those airlines displaced by the project. Note: for the purposes of these analyses, HMMH assumed Qantas and US Airways were displaced. In addition, the assumption was made that the high-power engine run-ups would use a blast fence (an open one-sided structures that redirects high energy exhaust from a jet engine to prevent damage and injury in the downstream area) that would require the aircraft face the prevailing wind direction (west). As shown in Table 2 the aircraft moved to the WAMA include the Qantas A380 and B747 (from the United/Continental run-up location facing west) and the US Airways A320 series (from the American run-up location). HMMH modeled the CNEL values for this new aircraft distribution at the same locations as for the previous existing conditions plus the WAMA project. The footprints and heights of the proposed buildings on the north side of the WAMA were included in the modeling. Table 5 shows the CNEL results and the differences or change in CNEL from the existing conditions scenario. As shown, all the CNEL changes are between -0.1 and 0.2 dB or essentially little to no change in cumulative sound level (CNEL) for all locations.

**Table 4 Existing Conditions Aircraft High-Power Engine Run-up CNEL by Location**

| ID # | Address/Location | Existing Conditions CNEL (dB) |
|---|---|---|
| 1 | El Segundo High School 640 Main St. | 61.7 |
| 2 | Center St. Elementary School 700 Center St. | 62.8 |
| 3 | Richmond Street Elementary 615 Richmond St. | 60.5 |
| 4 | Imperial School 540 E. Imperial Ave. | 69.1 |
| 5 | St. Anthony’s Catholic School 233 Lomita St. | 51.3 |
| 6 | El Segundo Middle School 332 Center St. | 58.6 |
| 7 | El Segundo Pre-School 301 West Grand Ave. | 56.0 |
| 8 | Hilltop Christian School 777 E. Grand Ave. | 57.0 |
| 9 | Loyola Village Elementary School Villanova St. and Rayford Dr. | 58.0 |
| 10 | Paseo Del Rey Natural Science Magnet 7751 Paseo Del Rey St. | 53.3 |
| 11 | Westchester High School 7400 W. Manchester Ave. | 47.3 |
| 12 | St. Bernard High School 9100 Falmouth Ave. | 56.8 |
| 13 | St. Anastasia School 8631 S. Stanmoor Dr. | 45.1 |
| 14 | Playa Del Rey Care and Rehabilitation Center 7716 W. Manchester Ave. | 45.5 |
| 15 | El Segundo Public Library 111 W. Mariposa Ave. | 60.5 |
| 16 | Pacific Baptist Church 859 Main St. | 66.3 |
| 17 | United Methodist Church 54 Main St. | 60.4 |
| 18 | First Baptist Church 591 E. Palm Ave. | 63.3 |
| 19 | St. John's Lutheran Church 1611 E. Sycamore Ave. | 64.6 |
| 20 | Church of Christ of Latter Day Saints 1215 E. Mariposa Ave. | 61.6 |
| 21 | St. Anthony’s Catholic Church 720 E. Grand Ave. | 56.7 |
| 22 | St. Andrew Catholic Church 538 Concord St. | 59.9 |
| 23 | St. Michaels Episcopal Church 361 Richmond St. | 57.5 |
| 24 | El Segundo Christian Church Franklin Ave. and Concord St. | 55.2 |
| 25 | Kingdom Hall of Jehovah's Witnesses 608 E. Grand Ave. | 56.2 |
| 26 | St. Anastasia Catholic Church 7390 W. Manchester Ave. | 53.3 |
| 27 | Messiah Congregational Church W. Manchester Ave. and Rayford Dr. | 52.9 |
| 28 | Hope Chapel Del Rey Foursquare 7299 W. Manchester Ave. | 53.3 |
| 29 | Del Rey Hills Evangelical Free Church 8505 Saran Dr. | 51.0 |
| P-ESG1 | Roof of building at 770 West Imperial Ave. | 69.9 |
| P-ESG2 | Greenbelt across from 216 East Imperial Ave. | 69.1 |

Source: HMMH, SoundPLAN

**Table 5 Comparison of Aircraft High-Power Engine Run-up CNELs for Existing Conditions and Proposed Future Conditions with the WAMA by Location**

| ID # | Address/Location | Existing Conditions | Future with WAMA | Difference WAMA - Existing |
|---|---|---|---|---|
| | | CNEL (dB) | CNEL (dB) | Change in CNEL (dB) |
| 1 | El Segundo High School 640 Main St. | 61.7 | 61.7 | 0 |
| 2 | Center St. Elementary School 700 Center St. | 62.8 | 62.8 | 0 |
| 3 | Richmond Street Elementary 615 Richmond St. | 60.5 | 60.5 | 0 |
| 4 | Imperial School 540 E. Imperial Ave. | 69.1 | 69.0 | -0.1 |
| 5 | St. Anthony's Catholic School 233 Lomita St. | 51.3 | 51.5 | 0.2 |
| 6 | El Segundo Middle School 332 Center St. | 58.6 | 58.5 | -0.1 |
| 7 | El Segundo Pre-School 301 West Grand Ave. | 56.0 | 56.1 | 0.1 |
| 8 | Hilltop Christian School 777 E. Grand Ave. | 57.0 | 57.0 | 0 |
| 9 | Loyola Village Elementary School Villanova St. and Rayford Dr. | 58.0 | 58.0 | 0 |
| 10 | Paseo Del Rey Natural Science Magnet 7751 Paseo Del Rey St. | 53.3 | 53.3 | 0 |
| 11 | Westchester High School 7400 W. Manchester Ave. | 47.3 | 47.3 | 0 |
| 12 | St. Bernard High School 9100 Falmouth Ave. | 56.8 | 56.8 | 0 |
| 13 | St. Anastasia School 8631 S. Stanmoor Dr. | 45.1 | 45.1 | 0 |
| 14 | Playa Del Rey Care and Rehabilitation Center 7716 W. Manchester Ave. | 45.5 | 45.5 | 0 |
| 15 | El Segundo Public Library 111 W. Mariposa Ave. | 60.5 | 60.5 | 0 |
| 16 | Pacific Baptist Church 859 Main St. | 66.3 | 66.3 | 0 |
| 17 | United Methodist Church 54 Main St. | 60.4 | 60.4 | 0 |
| 18 | First Baptist Church 591 E. Palm Ave. | 63.3 | 63.2 | -0.1 |
| 19 | St. John's Lutheran Church 1611 E. Sycamore Ave. | 64.6 | 64.6 | 0 |
| 20 | Church of Christ of Latter Day Saints 1215 E. Mariposa Ave. | 61.6 | 61.6 | 0 |
| 21 | St. Anthony's Catholic Church 720 E. Grand Ave. | 56.7 | 56.7 | 0 |
| 22 | St. Andrew Catholic Church 538 Concord St. | 59.9 | 60.0 | 0.1 |
| 23 | St. Michaels Episcopal Church 361 Richmond St. | 57.5 | 57.6 | 0.1 |
| 24 | El Segundo Christian Church Franklin Ave. and Concord St. | 55.2 | 55.2 | 0 |
| 25 | Kingdom Hall of Jehovah's Witnesses 608 E. Grand Ave. | 56.2 | 56.2 | 0 |
| 26 | St. Anastasia Catholic Church 7390 W. Manchester Ave. | 53.3 | 53.3 | 0 |
| 27 | Messiah Congregational Church W. Manchester Ave. and Rayford Dr. | 52.9 | 52.9 | 0 |
| 28 | Hope Chapel Del Rey Foursquare 7299 W. Manchester Ave. | 53.3 | 53.3 | 0 |
| 29 | Del Rey Hills Evangelical Free Church 8505 Saran Dr. | 51.0 | 51.0 | 0 |
| P-ESG1 | Roof of building at 770 West Imperial Ave. | 69.9 | 70.0 | 0.1 |
| P-ESG2 | Greenbelt across from 216 East Imperial Ave. | 69.1 | 69.0 | -0.1 |

Source: HMMH, SoundPLAN

## 5.7 Single-Event Noise Levels

In addition to the CNEL analysis presented above, which provides the basis for evaluating whether implementation of the WAMA project would result in a significant impact associated with run-up activity, HMMH modeled, for general informational purposes, single-event noise levels from the six run-up locations (five existing run-up sites and the WAMA site). The task was to provide the maximum sound level (Lmax) emanating from each run-up site and how the noise levels propagate into the communities. For the existing run-up locations, aircraft types were determined from those aircraft using the specific run-up pads. The WAMA run-ups were those that would relocate to the WAMA. Table 6 lists the various aircraft engine run-ups from the existing sites and the resulting Lmax at each noise sensitive receiver. Table 7 lists the same results for the proposed WAMA scenario. The tables show that the single-event noise levels for those run-ups relocated to the WAMA may increase or decrease at the various locations based on the changes in distance or changes in shielding at the WAMA compared to the existing run-up location. The increases or decreases may or may not be perceptible based on the other noise source levels at the community sites.

As described above, long-distance ground-to-ground sound propagation is dependent upon weather conditions. The sound levels listed were computed in accordance with the General Prediction Method Standard and represent conservatively loud conditions. Under other weather conditions, sound levels in community locations due to on-airport noise sources could be substantially different than those listed. In most cases, however, actual sound levels would not be expected to be notably louder than those depicted.

The sound levels listed in Table 6 and Table 7 are for a single aircraft conducting a run-up at LAX. The values do not include noise from other aircraft events such as departures and arrivals, nor do they account for noise generated by traffic and other community noise sources.

**Table 6 Lmax for Existing Conditions High-Power Engine Run-ups by Aircraft and Location**

| ID # | Delta | | FedEx | American | | | | | USAir |
|---|---|---|---|---|---|---|---|---|---|
| | 767 | 757 | MD-11 | 767 | 757 | 737 | 777 | MD-80 | A320 |
| 1 | 61.4 | 58.1 | 55.2 | 69.6 | 66.2 | 70.4 | 72.7 | 74.5 | 65.9 |
| 2 | 60.6 | 57.2 | 71.1 | 72.6 | 69.2 | 73.4 | 75.9 | 77.6 | 68.9 |
| 3 | 60.3 | 57.0 | 55.7 | 68.4 | 65.0 | 69.0 | 71.4 | 73.2 | 64.7 |
| 4 | 64.8 | 61.7 | 77.4 | 79.5 | 76.6 | 79.9 | 82.1 | 84.1 | 75.8 |
| 5 | 41.0 | 38.0 | 48.6 | 59.3 | 55.8 | 59.9 | 63.1 | 64.2 | 55.6 |
| 6 | 54.2 | 50.9 | 59.2 | 67.7 | 64.2 | 68.7 | 71.1 | 72.8 | 64.0 |
| 7 | 57.1 | 53.8 | 52.8 | 63.8 | 60.4 | 64.7 | 67.1 | 68.9 | 60.1 |
| 8 | 61.3 | 57.9 | 53.0 | 64.6 | 61.2 | 65.5 | 68.1 | 69.8 | 60.9 |
| 9 | 51.2 | 47.7 | 82.5 | 68.8 | 65.0 | 69.7 | 72.0 | 73.9 | 65.1 |
| 10 | 47.5 | 44.3 | 74.3 | 39.2 | 36.2 | 39.6 | 42.5 | 43.9 | 35.5 |
| 11 | 50.6 | 46.9 | 67.5 | 53.4 | 49.9 | 53.9 | 57.1 | 58.1 | 49.7 |
| 12 | 50.9 | 47.3 | 79.4 | 44.5 | 41.3 | 44.6 | 47.9 | 48.9 | 40.8 |
| 13 | 43.2 | 40.2 | 71.0 | 54.1 | 50.5 | 54.7 | 57.7 | 58.9 | 50.4 |
| 14 | 37.9 | 35.0 | 64.3 | 39.4 | 36.7 | 39.8 | 42.9 | 44.1 | 35.7 |
| 15 | 60.4 | 57.1 | 53.7 | 68.4 | 65.0 | 69.1 | 71.5 | 73.3 | 64.7 |
| 16 | 61.7 | 58.4 | 58.1 | 73.8 | 70.5 | 74.2 | 76.5 | 78.4 | 70.1 |
| 17 | 60.8 | 57.4 | 53.8 | 68.3 | 64.9 | 69.1 | 71.5 | 73.3 | 64.6 |
| 18 | 64.2 | 60.9 | 56.8 | 71.8 | 68.6 | 72.8 | 75.1 | 76.9 | 68.2 |
| 19 | 58.0 | 54.5 | 62.5 | 75.8 | 72.7 | 76.6 | 79.4 | 80.7 | 72.1 |
| 20 | 57.5 | 54.1 | 70.3 | 71.3 | 67.9 | 72.2 | 74.7 | 76.3 | 67.6 |
| 21 | 56.6 | 53.2 | 50.2 | 65.5 | 62.2 | 66.7 | 68.9 | 70.9 | 61.8 |
| 22 | 59.5 | 56.1 | 54.3 | 67.9 | 64.5 | 68.6 | 71.0 | 72.8 | 64.2 |
| 23 | 58.8 | 55.5 | 52.5 | 65.5 | 62.1 | 66.3 | 68.8 | 70.5 | 61.8 |
| 24 | 57.8 | 54.5 | 51.8 | 63.7 | 60.2 | 64.5 | 67.1 | 68.7 | 60.0 |
| 25 | 59.9 | 56.5 | 50.9 | 63.5 | 60.1 | 64.5 | 67.0 | 68.8 | 59.8 |
| 26 | 49.1 | 45.7 | 78.5 | 63.1 | 59.6 | 63.9 | 66.6 | 68.1 | 59.5 |
| 27 | 50.8 | 47.3 | 77.3 | 63.5 | 59.9 | 64.4 | 66.9 | 68.7 | 59.8 |
| 28 | 49.2 | 45.5 | 77.6 | 64.1 | 60.5 | 65.0 | 67.5 | 69.4 | 60.4 |
| 29 | 51.3 | 48.0 | 73.9 | 43.4 | 40.0 | 43.5 | 46.9 | 47.9 | 39.7 |
| P-ESG1 | 59.0 | 55.8 | 56.1 | 71.3 | 68.2 | 71.6 | 74.0 | 75.7 | 67.6 |
| P-ESG2 | 64.9 | 61.9 | 59.8 | 76.5 | 73.4 | 77.0 | 79.2 | 81.1 | 72.8 |

Source: HMMH, SoundPLAN

**Table 6 (Continued) Lmax for Existing Conditions High-Power Engine Run-ups by Aircraft and Location**

| ID # | United (facing east) | | | | United (facing west) | | | | Qantas | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 737 | 757 | 777 | 787 | 737 | 757 | 777 | 787 | A380 | 747 |
| 1 | 69.3 | 65.3 | 71.7 | 68.7 | 73.6 | 69.3 | 75.9 | 72.6 | 69.9 | 79.6 |
| 2 | 65.9 | 62.2 | 68.4 | 65.5 | 73.9 | 69.9 | 76.9 | 73.1 | 70.9 | 79.7 |
| 3 | 69.5 | 65.4 | 72.0 | 68.8 | 71.7 | 67.5 | 74.0 | 70.8 | 68.1 | 77.8 |
| 4 | 71.4 | 68.4 | 73.7 | 71.3 | 79.9 | 75.8 | 82.2 | 78.9 | 76.2 | 85.8 |
| 5 | 58.8 | 54.5 | 61.8 | 58.2 | 63.1 | 59.0 | 66.3 | 62.6 | 60.4 | 69.0 |
| 6 | 63.6 | 59.4 | 66.1 | 62.9 | 70.1 | 66.2 | 72.9 | 69.4 | 66.9 | 75.9 |
| 7 | 66.2 | 61.8 | 68.6 | 65.2 | 66.4 | 62.0 | 68.8 | 65.4 | 62.8 | 72.3 |
| 8 | 61.9 | 57.7 | 64.6 | 61.2 | 69.3 | 65.1 | 72.0 | 68.5 | 66.0 | 75.1 |
| 9 | 49.3 | 45.4 | 52.4 | 48.8 | 48.0 | 44.3 | 50.9 | 47.4 | 44.9 | 54.2 |
| 10 | 67.6 | 63.2 | 70.0 | 66.6 | 41.9 | 38.0 | 44.5 | 41.3 | 38.5 | 48.1 |
| 11 | 60.1 | 55.7 | 63.0 | 59.2 | 36.4 | 32.4 | 39.6 | 35.7 | 33.7 | 42.4 |
| 12 | 70.6 | 66.2 | 73.2 | 69.8 | 46.5 | 42.4 | 49.2 | 45.9 | 43.2 | 52.5 |
| 13 | 46.4 | 43.3 | 50.2 | 46.0 | 38.5 | 34.3 | 41.2 | 37.6 | 35.4 | 44.6 |
| 14 | 59.9 | 55.7 | 62.9 | 59.0 | 34.8 | 31.0 | 38.0 | 34.2 | 32.1 | 40.8 |
| 15 | 69.2 | 65.1 | 71.6 | 68.5 | 71.9 | 67.6 | 74.2 | 70.9 | 68.2 | 77.9 |
| 16 | 73.8 | 70.2 | 76.1 | 73.4 | 78.5 | 74.5 | 80.8 | 77.8 | 74.8 | 84.8 |
| 17 | 68.5 | 64.3 | 70.9 | 67.8 | 72.0 | 67.7 | 74.4 | 71.0 | 68.4 | 78.0 |
| 18 | 68.9 | 65.0 | 71.3 | 68.3 | 75.1 | 71.0 | 77.6 | 74.3 | 71.6 | 81.0 |
| 19 | 64.2 | 60.5 | 66.8 | 63.7 | 73.8 | 70.5 | 77.4 | 73.3 | 71.4 | 79.8 |
| 20 | 65.1 | 61.3 | 67.6 | 64.6 | 72.8 | 68.9 | 75.8 | 72.0 | 69.8 | 78.6 |
| 21 | 63.3 | 58.8 | 65.6 | 62.3 | 68.2 | 63.7 | 70.5 | 67.1 | 64.5 | 73.9 |
| 22 | 69.4 | 65.2 | 71.9 | 68.6 | 70.8 | 66.5 | 73.1 | 69.9 | 67.1 | 76.8 |
| 23 | 67.0 | 62.8 | 69.6 | 66.2 | 68.2 | 63.9 | 70.6 | 67.2 | 64.6 | 74.1 |
| 24 | 63.8 | 59.5 | 66.3 | 62.9 | 66.0 | 61.7 | 68.5 | 65.1 | 62.6 | 71.9 |
| 25 | 61.7 | 57.5 | 64.4 | 61.0 | 68.6 | 64.3 | 71.2 | 67.7 | 65.2 | 74.4 |
| 26 | 53.8 | 50.2 | 57.4 | 53.4 | 47.0 | 42.5 | 49.7 | 46.1 | 43.8 | 52.9 |
| 27 | 45.8 | 42.3 | 49.0 | 45.3 | 43.9 | 39.8 | 46.4 | 43.1 | 40.5 | 50.1 |
| 28 | 43.4 | 40.1 | 46.5 | 42.9 | 45.0 | 40.4 | 47.1 | 43.8 | 41.2 | 51.1 |
| 29 | 64.5 | 60.2 | 67.1 | 63.5 | 44.4 | 40.2 | 46.8 | 43.5 | 42.0 | 51.4 |
| P-ESG1 | 83.7 | 79.8 | 86.1 | 83.1 | 77.2 | 74.0 | 79.6 | 77.2 | 73.6 | 84.1 |
| P-ESG2 | 75.1 | 72.2 | 77.5 | 75.2 | 81.6 | 77.9 | 83.9 | 80.9 | 77.9 | 87.9 |

Source: HMMH, SoundPLAN

**Table 7 Lmax for Proposed Future Conditions High-Power Engine Run-ups at the WAMA by Aircraft**

| ID # | WAMA | | |
|---|---|---|---|
| | A320 | A380 | 747 |
| 1 | 69.3 | 70.7 | 79.8 |
| 2 | 66.9 | 68.9 | 77.3 |
| 3 | 68.6 | 69.8 | 79.2 |
| 4 | 71.6 | 73.1 | 82.0 |
| 5 | 61.9 | 63.7 | 72.4 |
| 6 | 63.0 | 64.8 | 73.5 |
| 7 | 63.5 | 64.6 | 73.9 |
| 8 | 62.4 | 64.2 | 72.7 |
| 9 | 47.9 | 49.4 | 58.3 |
| 10 | 46.4 | 47.7 | 56.7 |
| 11 | 31.8 | 34.1 | 42.3 |
| 12 | 50.0 | 51.4 | 60.1 |
| 13 | 36.6 | 38.5 | 47.2 |
| 14 | 42.8 | 44.3 | 53.1 |
| 15 | 68.6 | 69.9 | 79.2 |
| 16 | 73.1 | 74.5 | 83.6 |
| 17 | 68.3 | 69.6 | 78.8 |
| 18 | 66.4 | 68.2 | 76.8 |
| 19 | 66.6 | 69.0 | 76.9 |
| 20 | 66.1 | 68.1 | 76.4 |
| 21 | 63.2 | 64.7 | 73.6 |
| 22 | 68.0 | 69.2 | 78.5 |
| 23 | 64.9 | 66.2 | 75.4 |
| 24 | 60.6 | 62.0 | 71.2 |
| 25 | 64.3 | 66.0 | 74.6 |
| 26 | 44.5 | 46.0 | 55.1 |
| 27 | 39.5 | 40.9 | 50.1 |
| 28 | 42.0 | 43.4 | 53.0 |
| 29 | 39.1 | 40.6 | 49.5 |
| P-ESG1 | 75.6 | 76.3 | 86.3 |
| P-ESG2 | 72.2 | 73.7 | 82.8 |

Source: HMMH, SoundPLAN

## 6. CONCLUSIONS

HMMH conducted this comprehensive noise assessment to determine the potential effects of aircraft noise caused by the moving of a limited number of high-power engine run-ups from the current airline leaseholds to the proposed WAMA. The process began with the collection of data, the measurement of aircraft source noise levels and community noise levels, and culminated in the modeling of two scenarios (existing conditions and future conditions with the using SoundPLAN® to determine any significant noise impacts.

The range of change in CNEL for the proposed WAMA scenario compared to the existing conditions was from -0.1 to 0.2 dB. To restate the criteria for determining significant impact:

***"A significant noise impact would occur if analysis shows that the proposed action will cause noise sensitive areas to experience an increase in noise of <u>DNL 1.5 dB or more</u> at or above DNL 65 dB noise exposure when compared to the no action alternative for the same timeframe."***

The results indicate that the there are no anticipated significant noise impacts associated with moving the expected number of high-power run-ups to the WAMA site.

**<u>List of Appendices:</u>**

**Appendix A – Noise Terminology**

**Appendix B – Description of Noise Exposure and Land Use Compatibility**

**Appendix C – Noise Measurements: One-Third Octave Band Data**

**Appendix D – Noise Measurement Site Photographs and Noise Measurement Data**

# APPENDIX A NOISE TERMINOLOGY

## A.1 Introduction

To assist reviewers in interpreting the complex noise metrics used in evaluating airport noise, this appendix introduces eight acoustical descriptors of noise, roughly in increasing degree of complexity:

Decibel, dB
A-Weighted Decibel
Maximum A-Weighted Sound Level, Lmax
Sound Exposure Level, SEL
Single Event Noise Exposure Level, SENEL
Equivalent A-Weighted Sound Level, Leq
Day-Night Average Sound Level, DNL or Ldn
Community Noise Equivalent Level, CNEL

These noise metrics form the basis for the majority of noise analysis conducted at airports in California and the U.S. as a whole.

## A.2 Decibel, dB

All sounds come from a sound source -- a musical instrument, a voice speaking, an airplane passing overhead. It takes energy to produce sound. The sound energy produced by any sound source is transmitted through the air in sound waves -- tiny, quick oscillations of pressure just above and just below atmospheric pressure. These oscillations, or sound pressures, impinge on the ear, creating the sound we hear.

Our ears are sensitive to a wide range of sound pressures. Although the loudest sounds that we hear without pain have about one million times more energy than the quietest sounds we hear, our ears are incapable of detecting small differences in these pressures. Thus, to better match how we hear this sound energy, we compress the total range of sound pressures to a more meaningful range by introducing the concept of sound pressure level.

Sound pressure levels are measured in decibels (or dB). Decibels are logarithmic quantities reflecting the ratio of the two pressures, the numerator being the pressure of the sound source of interest, and the denominator being a reference pressure (the quietest sound we can hear).

The logarithmic conversion of sound pressure to sound pressure level (SPL) means that the quietest sound that we can hear (the reference pressure) has a sound pressure level of about 0 dB, while the loudest sounds that we hear without pain have sound pressure levels of about 120 dB. Most sounds in our day-to-day environment have sound pressure levels on the order of 30 to 100 dB.

Because decibels are logarithmic quantities, combining decibels is unlike common arithmetic. For example, if two sound sources each produce 100 dB operating individually and they are then operated together, they produce 103 dB -- not the 200 decibels we might expect. Four equal sources operating simultaneously produce another three decibels of noise, resulting in a total sound pressure level of 106 dB. For every doubling of the number of equal sources, the sound pressure level goes up another three decibels. A tenfold increase in the number of sources makes the sound pressure level go up 10 dB. A hundredfold increase makes the level go up 20 dB, and it takes a thousand equal sources to increase the level 30 dB.

If one noise source is much louder than another, the two sources operating together will produce virtually the same sound pressure level (and sound to our ears) that the louder source would produce alone. For example, a 100 dB source plus an 80 dB source produce approximately 100 dB of noise when operating together (actually, 100.04 dB). The louder source "masks" the quieter one. But if the quieter source gets louder, it will have an increasing effect on the total sound pressure level such that, when the two sources are equal, as described above, they produce a level three decibels above the sound of either one by itself.

Conveniently, people also hear in a logarithmic fashion, which affects the manner in which we interpret, or perceive, Two useful rules of thumb to remember when comparing sound levels are: (1) a 6 to 10 dB increase in the sound pressure level is sometime described to be about a doubling of loudness, and (2) changes in sound pressure level of less than about three decibels are not readily detectable outside of a laboratory environment.

## A.3 A-Weighted Decibel

An important characteristic of sound is its frequency, or "pitch". This is the per-second rate of repetition of the sound pressure oscillations as they reach our ear, expressed in units known as Hertz (Hz), formerly called cycles per second.

When analyzing the total noise of any source, acousticians often break the noise into frequency components (or bands) to determine how much is low-frequency noise, how much is middle-frequency noise, and how much is high-frequency noise. This breakdown is important for two reasons:

- Our ear is better equipped to hear mid and high frequencies and is less sensitive to lower frequencies. Thus, we find mid- and high-frequency noise more annoying.
- Engineering solutions to a noise problem are different for different frequency ranges. Low-frequency noise is generally harder to control.

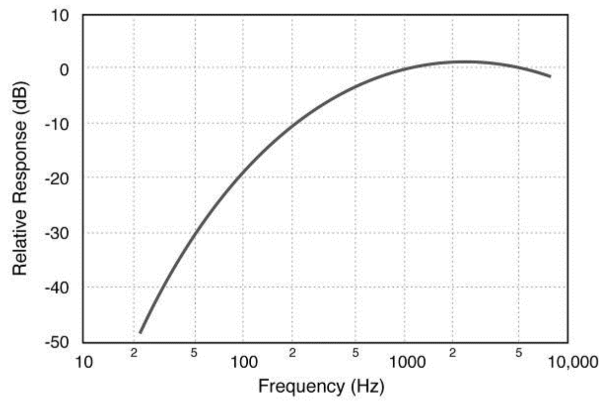
The normal frequency range of hearing for most people extends from a low of about 20 Hz to a high of about 10,000 to 15,000 Hz. People respond to sound most readily when the predominant frequency is in the range of normal conversation, typically around 1,000 to 2,000 Hz. The acoustical community has defined several “filters,” which approximate this sensitivity of our ear and thus, help us to judge the relative loudness of various sounds made up of many different frequencies.

The "A" filter (or “A weighting”) does this best for most environmental noise sources. A-weighted sound levels are measured in decibels, just like unweighted. To avoid ambiguity, A-weighted sound levels should be identified as such (e.g. "an A-weighted sound level of 85 dB") or stated up front that all noise levels presented in this document are A-weighted unless otherwise specified.

Government agencies in the U.S (and most governments worldwide) recommend or require the use of A-weighted sound levels for measuring, modeling, describing, and assessing aircraft sound levels (and sound levels from most other transportation and environmental sources).

Figure A-1 depicts A-weighting adjustments to sound from approximately 20 Hz to 10,000 Hz.

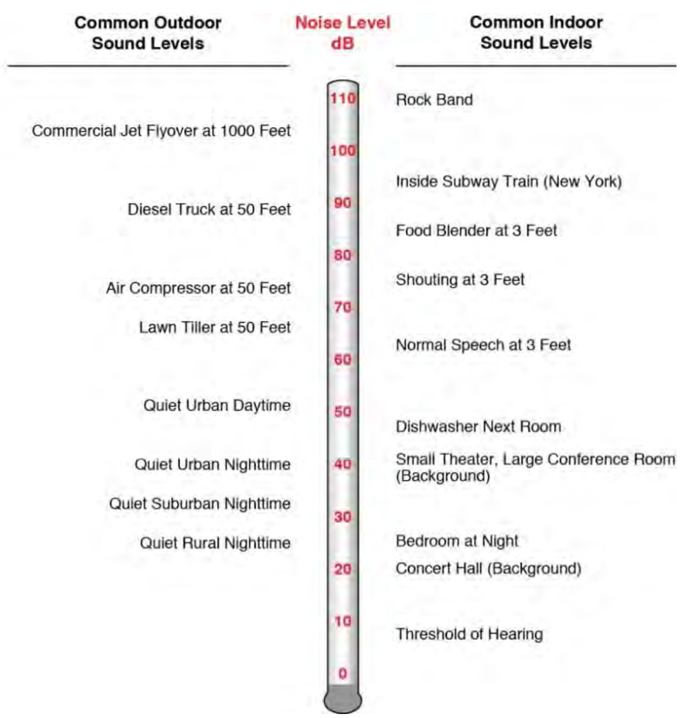
**Figure A-1 A-Weighting Frequency Response**
Source: HMMH




The A-weighted filter significantly de-emphasizes those parts of the total noise at lower and higher frequencies (below about 500 Hz and above about 10,000 Hz) where we do not hear as well. The filter has very little effect, or is nearly "flat", in the middle range of frequencies between 500 and 10,000 Hz where we hear quite easily. Because this filter generally matches our ears' sensitivity, sounds having higher A-weighted sound levels are usually judged to be louder than those with lower A-weighted sound levels, a relationship which otherwise might not be true. It is for this reason that acousticians normally use A-weighted sound levels to evaluate environmental noise sources.

Figure A-2 depicts representative A-weighted sound levels for a variety of common sounds.

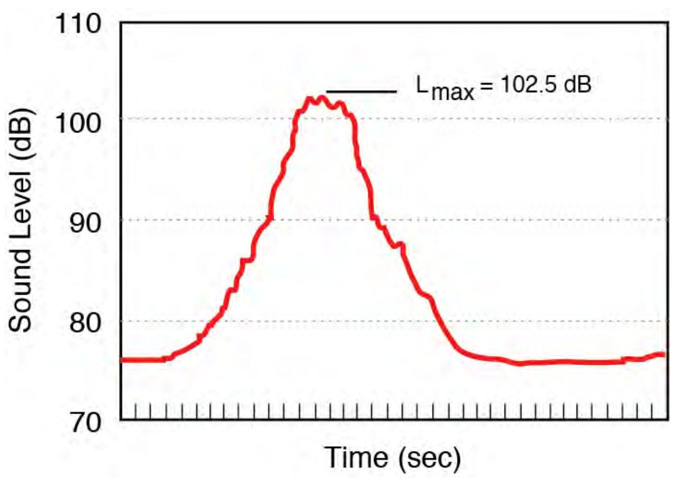
**Figure A-2 Representative A-Weighted Sound Levels**
Source: HMMH



## A.4 Maximum A-Weighted Sound Level, Lmax

An additional dimension to environmental noise is that A-weighted levels vary with time. For example, the sound level increases as an aircraft approaches, then falls and blends into the background as the aircraft recedes into the distance (though even the background varies as birds chirp, the wind blows, or a vehicle passes by). This is illustrated in Figure A-3.

**Figure A-3 Variation in the A-Weighted Sound Level over Time**
Source: HMMH




Because of this variation, it is often convenient to describe a particular noise "event" by its maximum sound level, abbreviated as Lmax. In Figure A-3 the Lmax is approximately 102.5 dB.

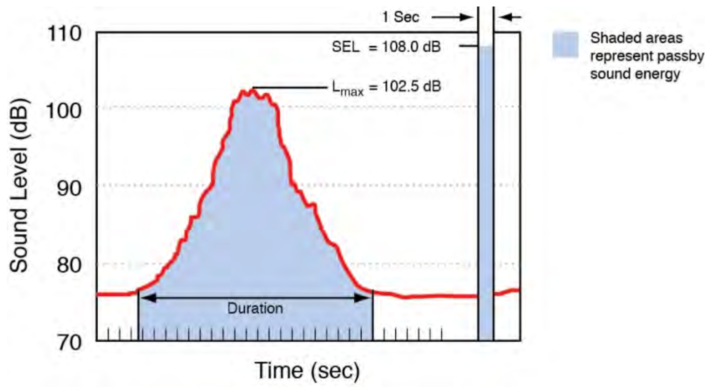
While the maximum level is easy to understand, it suffers from a serious drawback when used to describe the relative “noisiness” of an event such as an aircraft flyover; i.e., it describes only one dimension of the event and provides no information on the event’s overall, or cumulative, noise exposure. In fact, two events with identical maximum levels may produce very different total exposures. One may be of very short duration, while the other may continue for an extended period and be judged much more annoying. The next sections introduce two closely related measures that account for this concept of a noise "dose," or the cumulative exposure associated with an individual “noise event” such as an aircraft flyover.

## A.5 Sound Exposure Level, SEL

The most commonly used measure of cumulative noise exposure for an individual noise event, such as an aircraft flyover, is the Sound Exposure Level, or SEL. SEL is a summation of the A-weighted sound energy over the entire duration of a noise event. SEL expresses the accumulated energy in terms of the one-second-long steady-state sound level that would contain the same amount of energy as the actual time-varying level. In simple terms, SEL “compresses” the energy into a single second.

Figure A-4 depicts this compression.

**Figure A-4 Graphical Depiction of Sound Exposure Level**
Source: HMMH



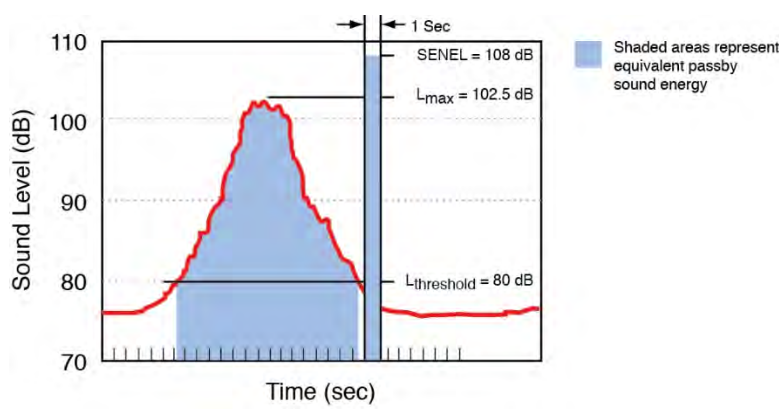

Note that because SEL is normalized to one second, it almost always will be a higher value than the event's Lmax. In fact, for most aircraft flyovers, SEL is on the order of five to 12 dB higher than Lmax.

## A.6 Single Event Noise Exposure Level, SENEL

Caltrans Division of Aeronautics noise standards regulations (discussed in Appendix F) require use of a measure called the Single Event Noise Exposure Level, or SENEL, to describe the cumulative noise exposure for an individual noise event, such as an aircraft flyover. SENEL is a very slight variation on SEL. Just like SEL, it is the one-second-long steady-state level that contains the same amount of energy as the actual time-varying level. However, unlike SEL, it is calculated only over the period when the level exceeds a selected threshold.

Figure A-5 depicts the SENEL concept for the noise event used in the Figure A-4 SEL example, but with an 80 dB SENEL threshold value. Note that even though the SENEL is calculated over a shorter duration, both metrics have the value of 108 dB. This situation is typical for most noise events; for all but very unusual noise events, as long as the threshold is at least 10 dB below the maximum level, the SEL and SENEL values will be within 0.1 dB.

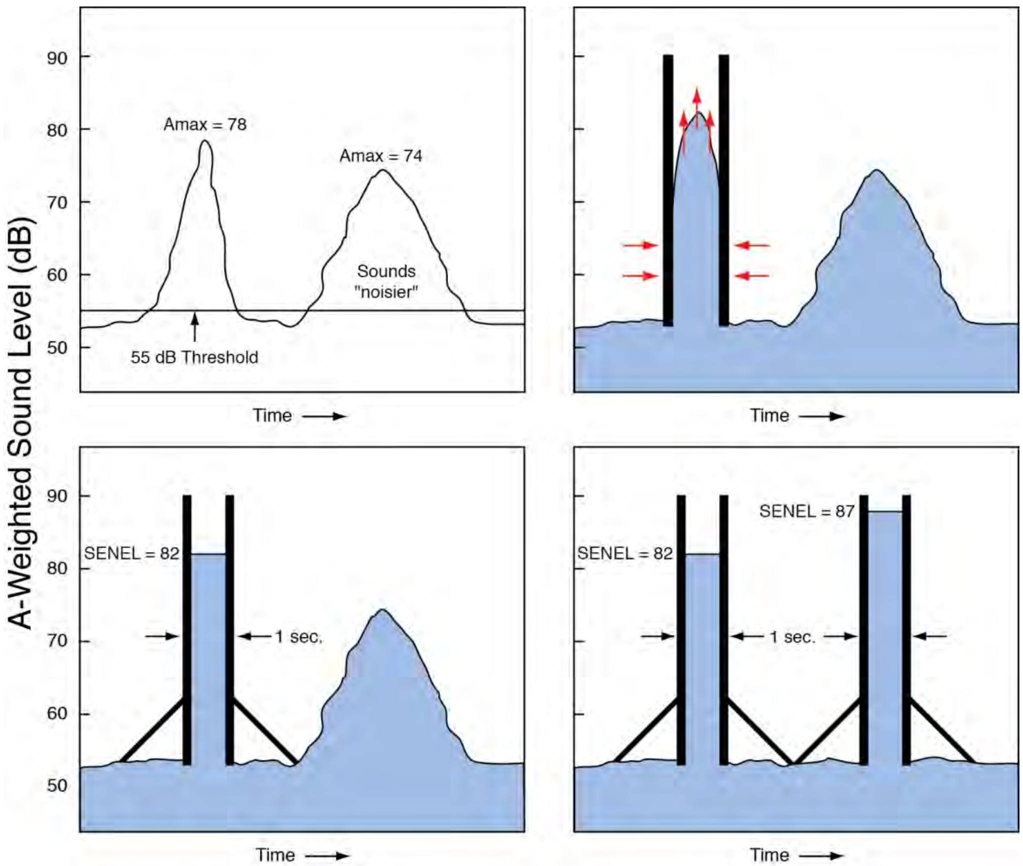
**Figure A-5 Graphical Depiction of Single Event Noise Exposure Level**
Source: HMMH



Because SENEL is a cumulative measure, a higher SENEL can result from either a louder or longer event, or some combination. Figure A-6 provides a representative example: The longer duration noise event on the right results in a higher SENEL than the event on the left, even though it has a lower Lmax.

**Figure A-6 Graphical Depiction of Single Event Noise Exposure Level for Two Noise Events with Different Maximums and Durations**

Source: HMMH



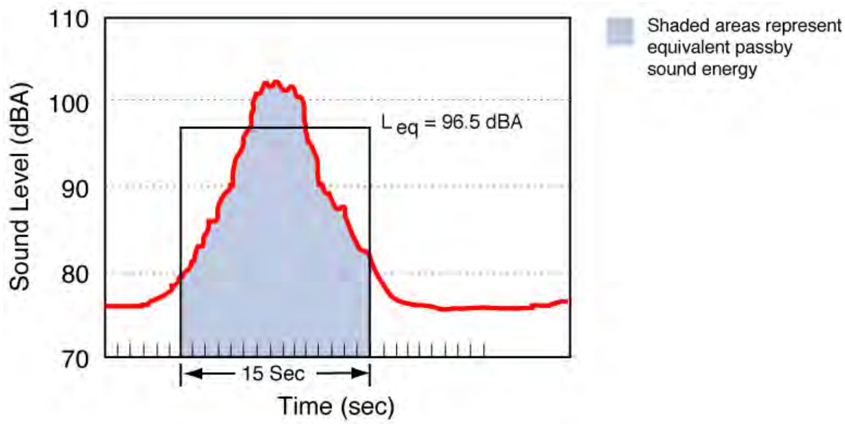

SEL and SENEL provide bases for comparing noise events that generally match our impression of their overall “noisiness,” including the effects of both duration and level; the higher the SEL or SENEL, the more annoying a noise event is likely to be.

## A.7 Equivalent A-Weighted Sound Level, Leq

The Equivalent Sound Level, abbreviated Leq, is a measure of the exposure resulting from the accumulation of sound levels over a particular period of interest; e.g., an hour, an eight-hour school day, nighttime, or a full 24-hour day. The applicable period should always be identified or clearly understood when discussing the metric.

Leq may be thought of as a constant sound level over the period of interest that contains as much sound energy as the actual varying level. It is a way of assigning a single number to a time-varying sound level. This is illustrated in Figure A-7.

**Figure A-7 Example of a One-Minute Equivalent Sound Level**
Source: HMMH




In airport noise applications, Leq is often presented for consecutive one-hour periods to illustrate how the hourly noise dose rises and falls throughout a 24-hour period as well as how certain hours are significantly affected by a few loud aircraft.

## A.8 Day-Night Average Sound Level, DNL or Ldn

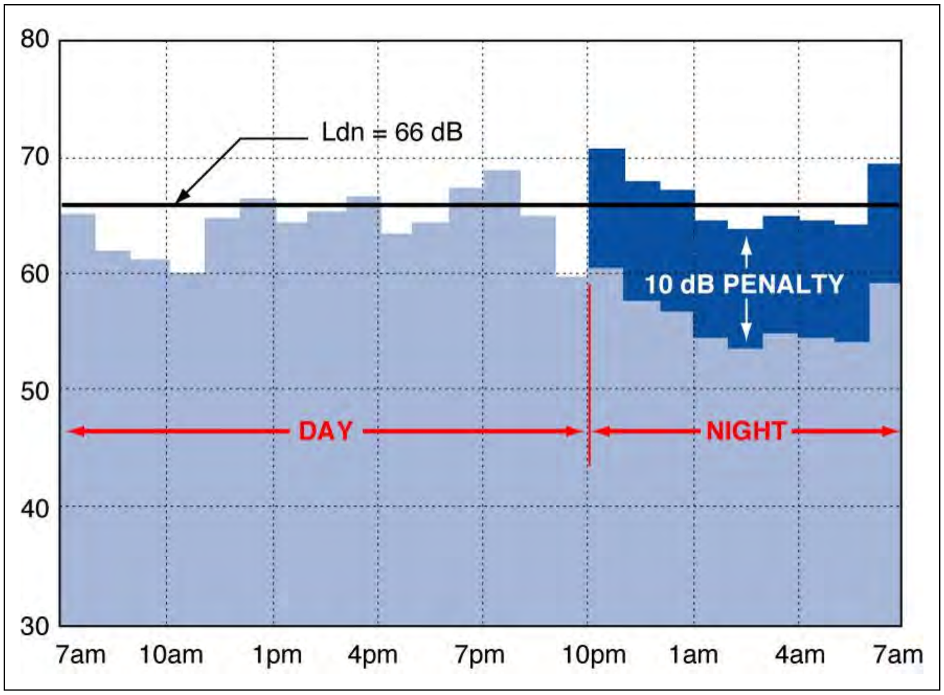
The previous sections address noise measures that account for short term fluctuations in A-weighted levels as sound sources come and go affecting the overall noise environment. The Day-Night Average Sound Level (DNL or Ldn) represents a 24-hour A-weighted noise dose. DNL is essentially equal to the 24-hour A-weighted Leq, with one important adjustment: noise occurring at night – from 10 pm through 7 am – is “factored up.” The factoring up can be made in one of two ways:

- Weighting, by counting each nighttime noise contribution 10 times; e.g., if DNL is calculated by summing the SEL of aircraft operations over a 24-hour period, each nighttime operation is represented by 10 identical daytime operations.
- Penalizing, by adding 10 dB to all nighttime noise contributions; e.g., if DNL is calculated from the SEL of aircraft operations occurring over a 24-hour period, 10 dB are added to the SEL values for nighttime operations.

The 10 dB adjustment accounts for our greater sensitivity to nighttime noise and the fact lower ambient levels at night tend to make noise events, such as aircraft flyovers, more intrusive.

Figure A-8 depicts this adjustment graphically.

**Figure A-8 Example of a Day-Night Average Sound Level Calculation**
Source: HMMH




Most aircraft noise studies utilize computer-generated estimates of DNL, determined by adding up the energy from the SELs from each event, with the 10 dB penalty / weighting applied to night operations. Computed values of DNL are often depicted as noise contours reflecting lines of equal exposure around an airport (much as topographic maps indicate contours of equal elevation). The contours usually reflect long-term (annual average) operating conditions, taking into account the average flights per day, how often each runway is used throughout the year, and where over the surrounding communities the aircraft normally fly. Alternative time frames may also be helpful in understanding shorter term aspects of a noise environment.

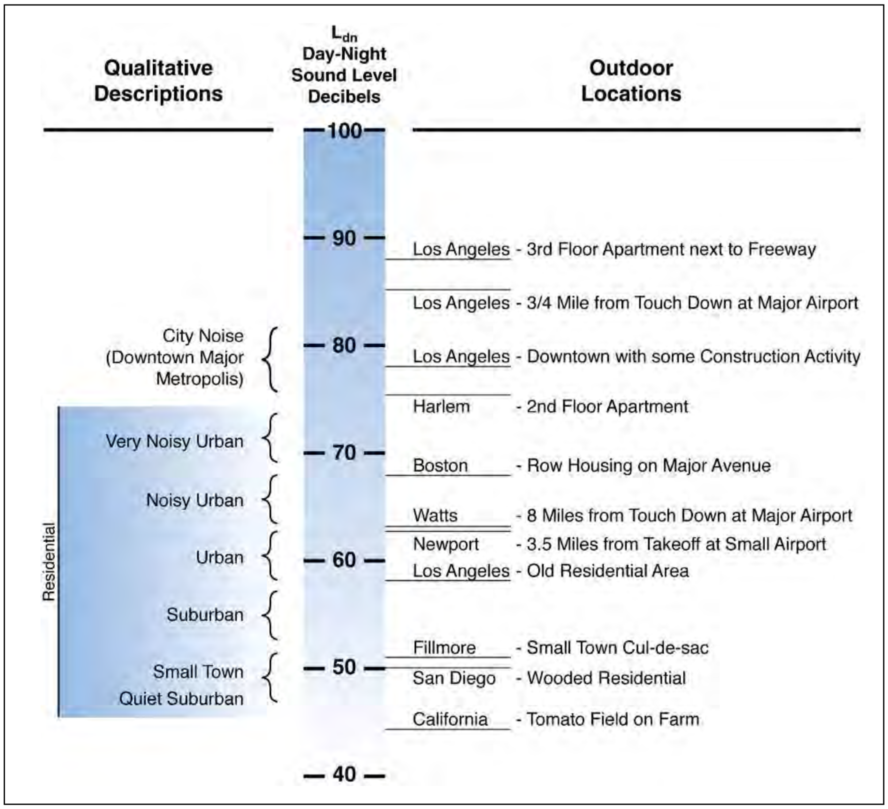
Why is DNL used to describe noise around airports? The U.S. Environmental Protection Agency identified DNL as the most appropriate measure of evaluating airport noise based on the following considerations:

- It is applicable to the evaluation of pervasive long-term noise in various defined areas and under various conditions over long periods of time.
- It correlates well with known effects of noise on individuals and the public.
- It is simple, practical, and accurate. In principal, it is useful for planning as well as for enforcement or monitoring purposes.
- The required measurement equipment, with standard characteristics, is commercially available.
- It was closely related to existing methods currently in use.

Representative values of DNL range from a low of 40 to 45 dB in extremely quiet, isolated locations, to highs of 80 or 85 dB immediately adjacent to a busy truck route. DNL would typically be in the range of

50 to 55 dB in a quiet residential community and 60 to 65 dB in an urban residential neighborhood. Figure A-9 presents representative outdoor DNL values measured at various U.S. locations.

**Figure A-9 Examples of Measured Day-Night Average Sound Levels**
Source: USEPA 1974, p.14.




When preparing environmental noise analyses, the FAA considers a change of 1.5 dB within the DNL 65 dB contour to be "significant". If a change of 1.5 dB is observed, analysts should look between the 60 and 65 dB contours to see if there are areas of change of 3 dB or more; this is also considered "significant impact".

The previous discussion in this appendix provided rules of thumb for interpreting moment-to-moment changes in sound level; the following guidelines address interpreting changes in cumulative exposure:

**Table A-1 Guidelines for Interpreting Changes in Cumulative Exposure**
Source: HMMH

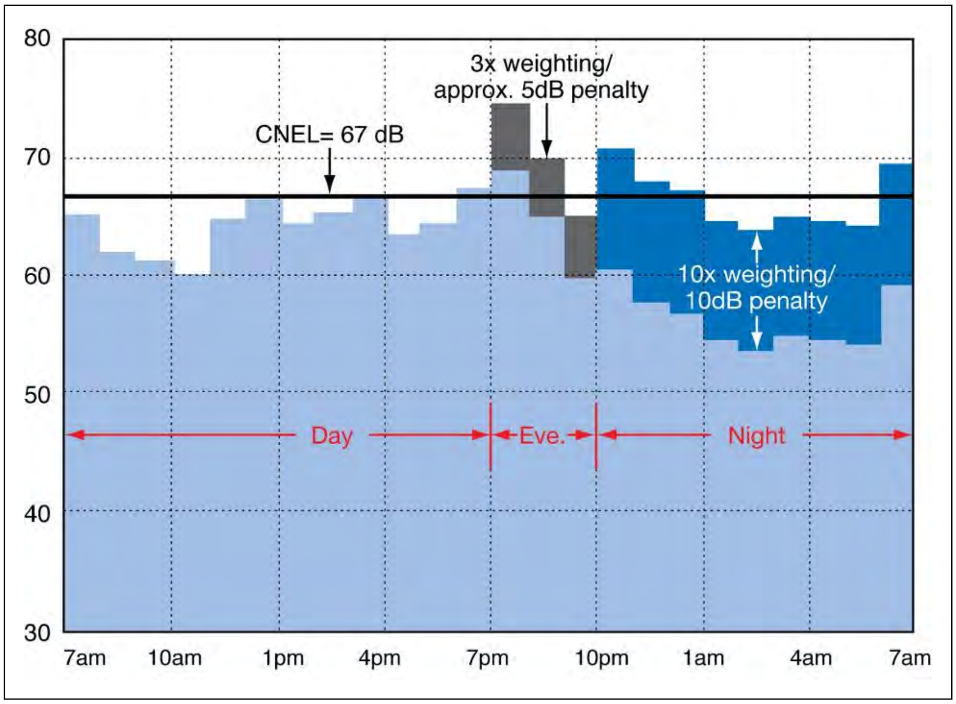
| DNL Change | Community Response | Mitigation |
|---|---|---|
| 0 – 2 dB | May be noticeable | Abatement may be beneficial |
| 2 – 5 dB | Generally noticeable | Abatement should be beneficial |
| Over 5 dB | A change in community reaction is likely | Abatement definitely beneficial |

Most public agencies dealing with noise exposure, including the Federal Aviation Administration (FAA), Department of Defense, and Department of Housing and Urban Development (HUD), have adopted DNL in their guidelines and regulations. As noted in the following section, the state of California requires the use of a variant of DNL for use in airport noise assessments.

## A.9 Community Noise Equivalent Level, CNEL

California Division of Aeronautics noise standards regulations (discussed in Appendix F) require use of a slight variation of DNL to express cumulative A-weighted noise exposure over any number of days – the Community Noise Equivalent Level (CNEL). CNEL differs from DNL in one way: It adds an "evening" (7 pm – 10 pm) period during which noise events are weighted by a factor of three, which is mathematically equivalent to adding approximately a 4.77 dB penalty. Figure A-10 depicts this adjustment graphically.

**Figure A-10 Example of a Community Noise Equivalent Level Calculation**
Source: HMMH




Unless noise exposure is calculated for an unlikely situation where there is no noise-producing activity during the evening period (an unlikely situation) CNEL will always be greater than DNL. However, from a practical standpoint this difference is rarely more than one decibel. For this reason, the DNL values shown in Figure A-9 are reasonably representative of CNEL values for the same environments, as are guidelines for interpreting changes in exposure discussed in the previous section. FAA applies the same criteria for thresholds of significant change in CNEL that they have set for DNL.

## A.10 Effects of Weather on Outdoor Sound Propagation

Atmospheric effects that can influence the propagation of sound include (in roughly increasing order of importance) humidity and precipitation, temperature and wind gradients, and turbulence (or gustiness). The effects of wind, and in particular, of turbulence, generally are of more importance than other factors, however, the importance of temperature gradients is enhanced under calm wind conditions, and, under unusual conditions, can be extreme. Attenuation caused by humidity is generally of small relative importance to the other effects.

*Influence of Humidity and Precipitation*

In general, humidity and precipitation have little effect on the propagation of sound. Attenuation due to humidity only becomes important with high-frequency noise under fairly calm wind conditions. Rain, snow, and fog also have little, if any noticeable effect on sound propagation. A substantial body of empirical data supports these conclusions[1].

*Influence of Temperature*

The velocity of sound in the atmosphere is dependent upon the air temperature[2], and if the temperature varies at different heights above the ground, the sound will travel in curved paths rather than straight lines. Normally, during the daytime, the temperature decreases with increasing height; this condition, characterized by a negative temperature gradient, is known as temperature lapse. In temperature lapse conditions, sound waves are refracted upwards and an acoustical shadow zone may exist at some distance from the noise source.

Under certain weather conditions, a layer of cool air may be trapped beneath a layer of warmer air. This condition, known as a temperature inversion, is prevalent throughout many regions in the evening, at night, and early in the morning when heat absorbed by the ground during the day is released into the night sky through radiation[3]. The effect of an inversion is just the opposite of lapse conditions; sound propagating through the atmosphere refracts downward. Under inversion conditions, no shadow zones can be formed, and, barring effects due to terrain or other obstructions, sound levels at observer locations are not affected.

Often, however, the downward refraction caused by temperature inversions allows sound rays with originally upward-sloping paths to bypass obstructions and ground effects. As a result, audibility of distant sounds is often somewhat better at night (during the most common time for temperature inversions) than in the daytime[4]. Under extreme conditions, one study found that noise from ground-borne aircraft may be amplified 15 to 20 dB by a temperature inversion. In a similar study, noise caused by an aircraft on the ground registered a higher level at an observer location 1.8 miles away than at a second observer location only 0.2 miles from the aircraft[5].

*Influence of Wind*

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[1]Ingard, Uno. "A Review of the Influence of Meteorological conditions on Sound Propagation," *Journal of the Acoustical Society of America*, Vol. 25, No. 3, May 1953, p. 407.

[2]In dry air, the approximate velocity of sound can be obtained from the relationship:

$c = 331 + 0.6T_c$ (c in meters per second, $T_c$ in degrees Celsius). Pierce, Allan D., *Acoustics: An Introduction to its Physical Principles and Applications.* McGraw-Hill. 1981. p. 29.

[3]Embleton, T.F.W., G.J. Thiessen, and J.E. Piercy, "Propagation in an inversion and reflections at the ground," *Journal of the Acoustical Society of America*, Vol. 59, No. 2, February 1976, p. 278.

[4]Ingard, p. 407.

[5]Dickinson, P.J., "Temperature Inversion Effects on Aircraft Noise Propagation," (Letters to the Editor) *Journal of Sound and Vibration.* Vol. 47, No. 3, 1976, p. 442.

Just as there is a temperature gradient in the atmosphere, there is also a wind gradient; typically, higher wind speeds exist at greater heights above the ground. The wind gradient affects sound propagation similarly to the temperature gradient by causing upward or downward refraction of sound. Because temperature is a scalar quantity (i.e., described by magnitude alone with no regard for direction), the refraction of sound caused by variations in the vertical gradient is the same in all horizontal (compass) directions[6]. Wind, on the other hand, is a vector quantity (described by both magnitude and direction) and affects sound propagation differently in various directions. Wind results in downward refraction downwind and upward refraction upwind with a shadow zone formed in the upwind direction. Receivers in a predominately downwind direction will experience higher sound levels, and those upwind will experience lower sound levels. Sound propagating perpendicular to the wind direction will not be affected.

The refraction caused by vertical gradients of wind is additive to the refraction due to temperature gradients[7]. One study suggests that for frequencies greater than 500 Hz, the combined effects of these gradients tends towards two extreme values: approximately 0 dB in conditions of downward refraction (inversion or downwind propagation) and -20 dB in upward refraction conditions (lapse or upwind propagation). At lower frequencies, the effects of refraction due to wind and temperature gradients are less pronounced[8].

The preceding discussion of the influence of wind is somewhat idealized due to the assumption of laminar conditions (i.e., the assumption of no turbulence). In reality, a wind is generally “gusty,” and sound levels heard at remote receiver locations will fluctuate with gustiness. In addition, gustiness can cause considerable attenuation of sound through the effects of eddies traveling with the wind. The attenuation due to eddies is essentially the same in all directions, with or against the flow of the wind, and can often mask the refractive effects discussed above[9].

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[6]Piercy, J.E. and T.F.W. Embleton, “Review of noise propagation in the atmosphere,” *Journal of the Acoustical Society of America*, Vol. 61, No. 6, June 1977, p. 141.

[7]Piercy and Embleton, p. 1412. Note, in addition, that as a result of the scalar nature of temperature and the vector nature of wind, the following is true: under lapse conditions, the refractive effects of wind and temperature add in the upwind direction and cancel each other in the downwind direction. Under inversion conditions, the opposite is true.

[8]Piercy and Embleton, p. 1413.

[9]Ingard, pp. 409-410.

# APPENDIX B DESCRIPTION OF NOISE EXPOSURE AND LAND USE COMPATIBILITY

Based on the relationships between noise and the collective response of people to their environment, the cumulative exposure metrics "Day-Night Average Sound Level" (DNL) and "Community Noise Equivalent Level" (CNEL) have become accepted standards for land use compatibility.[10] In their application to airport noise in particular, DNL and CNEL projections have two principal functions:

- To provide a quantitative basis for assessing land use compatibility with aircraft noise exposure.
- To provide a means for determining the significance of changes in noise exposure that might result from changes in airport layout, operations, or activity levels.

Both functions require application of objective criteria. Government agencies dealing with environmental noise have devoted significant attention to this issue, and have developed noise / land use compatibility guidelines to help federal, state, and local officials with this evaluation process.

The degree of annoyance people experience from aircraft noise varies depending on their activities and physical location at any given time. For example, people are usually less disturbed by aircraft noise when they are shopping, working, or driving than when they are at home. Similarly, hotel and motel guests are generally less sensitive to noise exposure than are permanent residents of the same geographic area, with identical or similar noise exposure. The concept of "land use compatibility" has arisen from this type of systematic variation in reaction to noise.

While the federal government, through the Federal Aviation Administration (FAA), has preempted control of aircraft noise at the source (i.e., certification of aircraft for operation in the U.S.), the federal government defers to local land use jurisdictions to determine formal compatibility standards and any associated regulations. Therefore, FAA presents compatibility *guidelines* in Part 150. Section B.1 presents those guidelines. Section B.2 summarizes formal California standards, and Section B.3 presents LAWA-adopted standards.

## B.1 FAA Guidelines

Part 150 Appendix A states "[t]he yearly day-night average sound level (YDNL) must be employed for the analysis and characterization of multiple aircraft noise events and for determining the cumulative exposure of individuals to noise around airports" [11] and sets forth FAA-recommended guidelines for noise land use compatibility, based on DNL. Table B-1 reproduces these guidelines.

[10] Appendix A of this report introduces DNL, CNEL, and other noise terminology.

[11] Ibid., § A150.3 "Noise descriptors," paragraph (b) "Airport Noise Exposure."

**Table B-1 FAA Noise / Land-Use Compatibility Guidelines**
Source: 14 C.F.R. Part 150, Airport Noise Compatibility Planning, Appendix A, Table 1

| Land Use | Yearly Day-Night Average Sound Level, Ldn, in Decibels (Key and notes on following page) | | | | | |
|---|---|---|---|---|---|---|
| | <65 | 65–70 | 70–75 | 75–80 | 80–85 | >85 |
| *Residential Use* | | | | | | |
| Residential other than mobile homes and transient lodgings | Y | N(1) | N(1) | N | N | N |
| Mobile home park | 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 |
| Governmental 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 and retail- building materials, hardware, and farm equipment | 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* | | | | | | |
| 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 | Y | Y | Y |
| Golf courses, riding stables, water recreation | Y | Y | 25 | 30 | N | N |

| Key to Table B-1 | |
|---|---|
| Y(Yes) | Land use and related structures compatible without 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 generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure. |

**Notes for Table B-1**

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.

(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 dB 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 of 30 dB 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 dB 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 an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.

The FAA's Part 150 guidelines represent a compilation of the results of scientific research into noise-related activity interference and attitudinal response. The guidelines indicate that all uses normally are compatible with aircraft noise at exposure levels below 65 dB DNL. This limit is supported in a formal way by standards adopted by the U. S. Department of Housing and Urban Development (HUD). The HUD standards set forth in 24 C.F.R. Part 51, "Environmental Criteria and Standards", §103, define areas with exterior DNL exposure not exceeding 65 dB as acceptable. Areas exposed to noise levels between 65 dB and 75 dB DNL are "normally unacceptable," and require special abatement measures and review. Those at 75 dB and above are "unacceptable" except under very limited circumstances. HUD assistance, subsidy, or insurance "for the construction of new noise sensitive uses is prohibited generally for projects with unacceptable noise exposures and is discouraged for projects with normally unacceptable noise exposure”.[12]

## B.2 California Department of Transportation Division of Aeronautics Noise Standards

The State of California has established airport noise standards and land use planning guidelines that fall under the jurisdiction of the California Department of Transportation Division of Aeronautics (Caltrans) and the Los Angeles County Airport Land Use Commission.

### *B.2.1 Caltrans Division of Aeronautics Noise Standards*

For airport noise studies, the California Department of Transportation Division of Aeronautics (Caltrans) has adopted noise standards that require airports to describe cumulative exposure in terms of CNEL. Those standards state, in part:[13]

> The following rules and regulations are promulgated in accordance with Article 3, Chapter 4, Part 1, Division 9, Public Utilities Code (Regulation of Airports) to provide noise standards governing the operation of aircraft and aircraft engines for all airports operating under a valid permit issued by the Department of Transportation. These standards are based upon two separate legal grounds: (1) the power of airport proprietors to impose noise ceilings and other limitations on the use of the airport, and (2) the power of the state to act to an extent not prohibited by federal law. The regulations are designed to cause the airport proprietor, aircraft operator, local governments, pilots, and the department to work cooperatively to diminish noise problems. The regulations accomplish these ends by controlling and reducing the noise impact area in communities in the vicinity of airports. [14]
>
> The level of noise acceptable to a reasonable person residing in the vicinity of an airport is established as a CNEL value of 65 dB for purposes of these regulations. This criterion level has been chosen for reasonable persons residing in urban residential areas where houses are of typical California construction and may have windows partially open. It has been selected with reference to speech, sleep, and community reaction.[15]

The Division of Aeronautics noise standards further define land uses that are incompatible with aircraft noise as follow:[16]

- Residences, including but not limited to, detached single-family dwellings, multi-family dwellings, high-rise apartments, condominiums and mobile homes, unless:
  - an avigation easement for aircraft noise has been acquired by the airport proprietor;
  - the dwelling unit was in existence at the same location prior to January 1, 1989, and has adequate acoustic insulation to ensure an interior CNEL due to aircraft noise of 45 dB or less in all habitable rooms. However, acoustic treatment alone does not convert residences

[12] Title 24 C.F.R. Part 51, “Environmental Criteria and Standards”, § 51.101, (a)(3). 44 FR 40861, July 12, 1979, as amended at 50 FR 9268, Mar. 7, 1985, 61 FR 13333, Mar. 26, 1996.

[13] California Code of Regulations (CCR). 1990. Title 21, Subchapter 6, Noise Standards. Register 90. No. 10, 3/10/90. California Division of Aeronautics, Department of Transportation. Sacramento, CA.

[14] Ibid., §5000, “Preamble,” p. 219.

[15] Ibid., §5006, “Findings,” p. 224.

[16] Ibid., §5014, “Incompatible Land Uses within the Noise Impact Boundary, p. 225–226.

having an exterior CNEL of 75 dB or greater due to aircraft noise to a compatible land use if the residence has an exterior normally occupiable private habitable area such as a backyard, patio or balcony;
  - the residence is a high rise apartment or condominium having an interior CNEL of 45 dB or less in all habitable rooms due to aircraft noise, and an air circulation or air conditioning system, as appropriate;
  - the airport proprietor has made a genuine effort as determined by the department in accordance with adopted land use compatibility plans and appropriate laws and regulations to acoustically treat residences exposed to an exterior CNEL less than 80 dB (75 dB if the residence has an exterior normally occupiable private habitable area such as a backyard, patio, or balcony) or acquire avigation easements, or both, for the residences involved, but the property owners have refused to take part in the program; or
  - the residence is owned by the airport proprietor.
- Public and private schools of standard construction for which an avigation easement for noise has not been acquired by the airport proprietor, or that do not have adequate acoustic performance to ensure an interior CNEL of 45 dB or less in all classrooms due to aircraft noise;
- Hospitals and convalescent homes for which an avigation easement for noise has not been acquired by the airport proprietor, or that do not have adequate acoustic performance to provide an interior CNEL of 45 dB or less due to aircraft noise in all rooms used for patient care; and
- Churches, synagogues, temples, and other places of worship for which an avigation easement for noise has not been acquired by the airport proprietor, or that do not have adequate acoustic performance to ensure an interior CNEL of 45 dB or less due to aircraft noise.

The regulation sets the following "Airport Noise Standard," which establishes a requirement related to addressing airport noise impacts that is far more specific and stringent than faced by airport proprietors in any other state:[17]

- The standard for the acceptable level of aircraft noise for persons living in the vicinity of airports is hereby established to be a community noise equivalent level of 65 decibels. This standard forms the basis for the following limitation.

- No airport proprietor of a noise problem airport shall operate an airport with a noise impact area based on the standard of 65 dB CNEL unless the operator has applied for or received a variance as prescribed in Article 5 of this subchapter.

The Division of Aeronautics noise standards include a provision stating that "[a]ny county may, at any time, in accordance with the procedure herein, declare any airport within its boundaries to have a noise problem, by adopting a resolution to this effect and forwarding it to this department.[18] LAX is one of ten airports that county governments have designated as "noise problem airports."[19]

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[17] Ibid., §5012, "Airport Noise Standard," p. 225.

[18] Ibid., §5020, "Designating Noise Problem Airport." § 5001(n) provides the following related definition: "Noise Problem Airport: 'Noise problem airport' is an airport that the county in which the airport is located has declared to have a noise problem under section 5020."

[19] The other nine airports are: Bob Hope Airport, John Wayne Airport-Orange County, Long Beach-Daugherty Field-Airport, Metropolitan Oakland International Airport, Norman Y. Mineta-San Jose International Airport, Ontario International Airport, San Diego International Airport, San Francisco International Airport, and Van Nuys Airport.

### *B.2.2 California Airport Land Use Commission Regulations*

With limited exceptions, California state statutes require each county in the state to establish an airport land use commission (ALUC). The statutes specify that the Regional Planning Commission will fill the ALUC role in Los Angeles County.[20] In practice, the commission refers to itself as the ALUC when addressing airport land use compatibility matters. The commission has published a document that defines review procedures and other implementation policies.[21] That document states that:

> [T]he fundamental purpose of ALUCs to promote land use compatibility around airports has remained unchanged. As expressed in the present statutes, this purpose is:
>
> "…to protect public health, safety, and welfare by ensuring the orderly expansion of airports and the adoption of land use measures that minimize the public's exposure to excessive noise and safety hazards within areas around public airports to the extent that these areas are not already devoted to incompatible uses."

The statutes give ALUCs two principal powers by which to accomplish this objective. First, ALUCs must prepare and adopt an airport land use compatibility plan [ALUCP]. Secondly, they must review the plans, regulations, and other actions of local agencies and airport operators for consistency with that plan.

The procedures document calls out two limitations on ALUCs' powers: "Specifically, ALUCs have no authority over existing land uses (Section 21674(a)) or over the operation of airports (Section 21674(e))."[22]

The commission last revised the Los Angeles County ALUCP on December 1, 2004.[23] The ALUCP includes the following "policies related to noise:"

- N-1 Use the Community Noise Equivalent Level (CNEL) method for measuring noise impacts near airports in determining suitability for various types of land uses.
- N-2 Require sound insulation to insure a maximum interior 45 db [sic] CNEL in new residential, educational, and health-related uses in areas subject to exterior noise levels of 65 CNEL or greater.
- N-3 Utilize the Table Listing Land Use Compatibility for Airport Noise Environments in evaluating projects within the planning boundaries.
- N-4 Encourage local agencies to adopt procedures to ensure that prospective property owners in aircraft noise exposure areas above a current or anticipated 60 db [sic] CNEL are

[20] Ibid. § 21670.2.

[21] "Los Angeles County Airport Land Use Commission Review Procedures," prepared by the Los Angeles County Department of Regional Planning, December 2004, available on line at http://planning.lacounty.gov/assets/upl/project/aluc_review-procedures.pdf

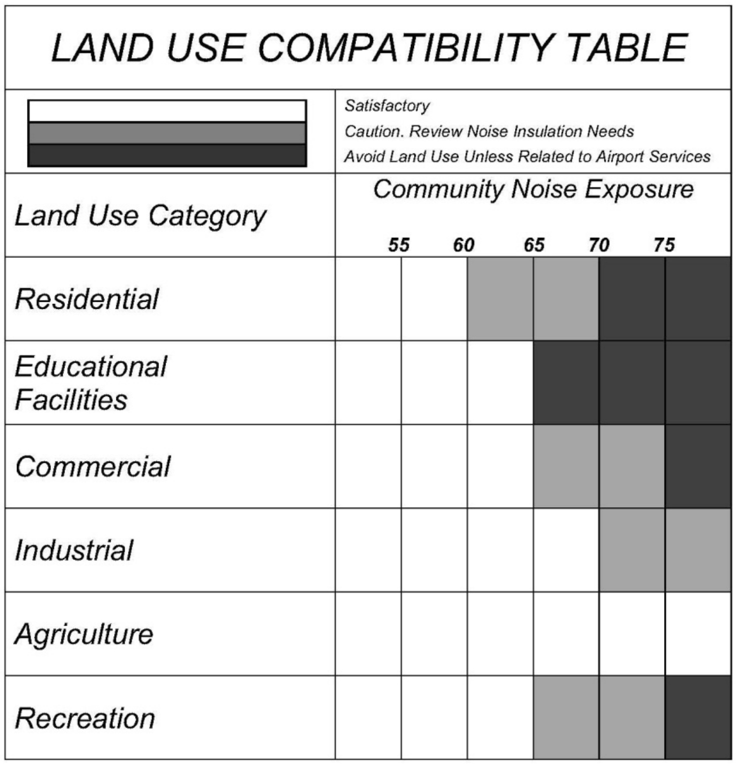
[22] Ibid.

[23] "Los Angeles County Airport Land Use Commission Comprehensive Land Use Plan," prepared by the Department of Regional Planning, adopted December 19, 1991, revised December 1, 2004, available on line at http://planning.lacounty.gov/assets/upl/data/pd_alup.pdf

informed of those noise levels and of any land use restrictions associated with high noise exposure

Table B-2 reproduces the land use compatibility table to which policy N-3 refers.

**Table B-2 Los Angeles County Land Use Compatibility for Airport Noise Environments**
Source: Los Angeles County Airport Land Use Compatibility Plan, prepared by the Los Angeles County Department of Regional Planning, Revised December 1, 2004




Note: Consider FAR Part 150 for commercial and recreational uses above the 75 CNEL.

## B.3 Los Angeles Land Use Compatibility Standards

In the 1984 Part 150 submission for LAX to the FAA, the City of Los Angeles officially adopted the FAA Part 150 guidelines as the basis for determining the compatibility of surrounding land uses with noise exposure associated with operations at the airport, with the exception that annual noise exposure was presented in terms of CNEL, rather than DNL, for consistency with state statutes setting airport noise standards and land use planning guidelines

Based on the clearly defined and consistently applied statewide requirement to use CNEL, the FAA considers CNEL to be the functional equivalent of DNL, for Part 150 and other federal environmental studies conducted in California, and accepts application of Part 150 land use compatibility guidelines to CNEL values, without adjustment for the normally minor differences between CNEL and DNL.

***Table B-1, previously shown, presents the LAWA-adopted land use compatibility standards, in terms of CNEL, that were used to determine land use compatibility.***

These standards are consistent with the Caltrans airport noise standards and the Los Angeles ALUCP land use compatibility policies.

# Appendix C Noise Measurements: One-Third Octave Band Data

Run 1 - Aircraft Boeing 757-223 N696AN - American Pad facing west - 28 February 2013, 0649 – 0652

Measurements opposite side of engine run-up – 80% full power; all distances at 83 feet except for 180-degree measurement (120 feet); measurement duration 10 seconds each at each angle measured from in front of the run-up engine

Run 1 - Metrics and percentiles

| Angle | Leq | SEL | LMin | LMax | L1 | L5 | L50 | L90 | L95 | L99 |
|---|---|---|---|---|---|---|---|---|---|---|
| 000 | 111.8 | 121.8 | 110.7 | 115.3 | 112.9 | 112.7 | 111.6 | 111.1 | 110.8 | 110.7 |
| 010 | 111.7 | 121.7 | 111.3 | 113.5 | 112.9 | 112.7 | 111.6 | 111.3 | 111.3 | 111.3 |
| 020 | 111.2 | 121.2 | 110.7 | 111.7 | 111.7 | 111.7 | 111.4 | 110.7 | 110.7 | 110.7 |
| 030 | 111.3 | 121.3 | 109.5 | 111.8 | 111.8 | 111.8 | 111.4 | 110.5 | 110.2 | 110.0 |
| 040 | 111.6 | 121.6 | 110.5 | 112.8 | 112.8 | 112.8 | 111.5 | 110.5 | 110.5 | 110.5 |
| 050 | 111.0 | 121.0 | 108.7 | 112.5 | 112.5 | 112.5 | 110.7 | 109.0 | 108.7 | 108.7 |
| 060 | 110.6 | 120.6 | 108.7 | 114.9 | 114.0 | 113.6 | 110.2 | 109.2 | 109.0 | 108.7 |
| 070 | 109.9 | 120.0 | 108.3 | 111.8 | 111.8 | 111.8 | 110.2 | 108.7 | 108.3 | 108.3 |
| 080 | 107.5 | 117.5 | 106.3 | 109.1 | 108.9 | 108.8 | 107.4 | 106.3 | 106.3 | 106.3 |
| 090 | 105.4 | 115.4 | 104.6 | 106.8 | 106.8 | 106.8 | 105.5 | 104.7 | 104.7 | 104.7 |
| 100 | 106.2 | 116.2 | 105.7 | 106.8 | 106.8 | 106.8 | 106.3 | 105.7 | 105.7 | 105.7 |
| 110 | 106.4 | 116.4 | 105.9 | 108.2 | 107.0 | 107.0 | 106.5 | 106.1 | 106.0 | 105.9 |
| 120 | 109.7 | 119.7 | 109.5 | 111.0 | 110.7 | 110.0 | 109.5 | 109.5 | 109.5 | 109.5 |
| 130 | 110.8 | 120.9 | 110.6 | 112.7 | 111.9 | 111.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| 140 | 111.6 | 121.6 | 111.3 | 112.0 | 112.0 | 112.0 | 111.5 | 111.3 | 111.3 | 111.3 |
| 150 | 113.2 | 123.2 | 112.6 | 113.4 | 113.4 | 113.4 | 113.4 | 113.1 | 113.0 | 112.6 |
| 180 | 104.0 | 114.0 | 103.3 | 104.7 | 104.7 | 104.7 | 104.1 | 103.3 | 103.3 | 103.3 |

Run 1 - One-third octave band data

| Angle | Hz | | | | | | | | | | | | | | | | | | | kHz | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12.5 | 16 | 20 | 25 | 31.5 | 40 | 50 | 63 | 80 | 100 | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 | 800 | 1 | 1.25 | 1.6 | 2 | 2.5 | 3.15 | 4 | 5 | 6.3 | 8 | 10 | 12.5 | 16 | 20 |
| 000 | 87.9 | 89.7 | 91.0 | 92.0 | 92.3 | 93.7 | 94.2 | 95.9 | 97.1 | 100.0 | 100.9 | 102.6 | 99.5 | 97.8 | 97.4 | 97.3 | 96.3 | 94.5 | 95.7 | 102.1 | 106.7 | 101.5 | 99.0 | 100.4 | 99.0 | 96.6 | 95.6 | 94.3 | 93.0 | 91.5 | 89.4 | 85.5 | 79.1 |
| 010 | 88.7 | 91.0 | 91.6 | 92.3 | 91.3 | 92.9 | 94.2 | 96.4 | 98.1 | 100.2 | 100.6 | 101.5 | 99.0 | 97.4 | 97.1 | 97.6 | 96.7 | 94.2 | 95.5 | 100.8 | 105.1 | 103.2 | 99.5 | 101.1 | 99.6 | 97.4 | 98.4 | 95.2 | 93.7 | 92.4 | 90.2 | 86.4 | 80.0 |
| 020 | 87.1 | 89.9 | 92.3 | 92.6 | 93.2 | 93.3 | 94.6 | 96.7 | 97.0 | 99.6 | 100.0 | 100.2 | 98.1 | 97.5 | 97.4 | 97.1 | 96.6 | 94.1 | 95.3 | 100.1 | 104.2 | 101.9 | 99.5 | 101.1 | 99.6 | 97.5 | 97.2 | 95.2 | 93.6 | 92.1 | 90.0 | 86.6 | 80.3 |
| 030 | 89.0 | 91.0 | 91.4 | 91.7 | 93.3 | 94.5 | 94.6 | 95.6 | 96.0 | 98.2 | 98.5 | 98.3 | 97.8 | 97.6 | 96.4 | 97.1 | 97.6 | 93.9 | 94.8 | 100.5 | 105.1 | 101.0 | 99.4 | 102.0 | 98.6 | 96.2 | 96.8 | 95.0 | 93.4 | 91.9 | 89.9 | 86.4 | 80.2 |
| 040 | 88.2 | 89.7 | 91.5 | 92.2 | 93.8 | 93.2 | 93.8 | 95.9 | 96.1 | 98.0 | 97.0 | 98.9 | 98.1 | 96.6 | 96.6 | 96.1 | 97.3 | 94.6 | 94.7 | 100.8 | 106.2 | 100.1 | 99.1 | 102.5 | 98.8 | 95.9 | 96.6 | 94.5 | 93.0 | 91.5 | 89.4 | 85.9 | 79.8 |
| 050 | 89.1 | 91.0 | 91.8 | 92.6 | 93.7 | 93.4 | 94.4 | 94.8 | 96.5 | 96.6 | 97.3 | 98.1 | 96.9 | 96.5 | 96.3 | 96.6 | 97.1 | 94.1 | 94.2 | 101.3 | 106.6 | 98.4 | 97.6 | 99.1 | 97.6 | 94.5 | 95.0 | 94.0 | 92.4 | 90.7 | 88.8 | 85.5 | 79.4 |
| 060 | 89.1 | 90.4 | 91.9 | 92.5 | 92.6 | 92.7 | 95.1 | 96.4 | 96.3 | 96.4 | 96.5 | 97.1 | 96.4 | 96.7 | 95.8 | 95.7 | 96.6 | 93.9 | 93.6 | 100.9 | 106.6 | 97.7 | 96.8 | 98.9 | 95.8 | 92.8 | 93.3 | 92.7 | 91.0 | 89.0 | 87.1 | 83.7 | 77.7 |
| 070 | 88.7 | 91.3 | 91.5 | 92.0 | 94.3 | 95.1 | 95.8 | 96.9 | 96.3 | 95.0 | 94.8 | 94.0 | 94.8 | 95.5 | 95.1 | 94.5 | 95.0 | 94.1 | 93.0 | 100.2 | 106.2 | 96.8 | 95.5 | 98.1 | 95.8 | 91.8 | 92.1 | 91.5 | 89.4 | 87.5 | 85.4 | 81.9 | 75.8 |
| 080 | 89.3 | 91.4 | 91.5 | 93.5 | 95.5 | 95.3 | 96.1 | 97.4 | 97.4 | 96.6 | 96.9 | 97.0 | 96.2 | 96.4 | 96.2 | 95.1 | 95.3 | 94.0 | 93.5 | 96.6 | 103.8 | 93.3 | 92.3 | 95.8 | 91.5 | 88.6 | 89.1 | 88.9 | 87.1 | 85.1 | 82.9 | 79.5 | 73.4 |
| 090 | 90.0 | 93.5 | 92.9 | 94.7 | 96.6 | 97.2 | 98.5 | 99.2 | 100.0 | 98.5 | 96.4 | 93.0 | 92.5 | 93.0 | 94.5 | 96.0 | 96.2 | 94.4 | 93.2 | 96.0 | 99.7 | 92.3 | 91.6 | 93.3 | 90.3 | 87.9 | 88.0 | 88.0 | 87.1 | 85.5 | 83.2 | 80.4 | 74.5 |
| 100 | 90.6 | 93.2 | 94.1 | 95.5 | 97.9 | 97.3 | 100.2 | 100.3 | 99.6 | 98.2 | 97.9 | 97.6 | 97.2 | 95.4 | 95.7 | 97.1 | 98.4 | 94.9 | 94.2 | 95.8 | 98.4 | 94.3 | 93.5 | 94.4 | 91.7 | 90.5 | 90.8 | 91.7 | 92.0 | 90.8 | 88.2 | 85.8 | 80.2 |
| 110 | 92.3 | 93.2 | 95.2 | 96.1 | 98.9 | 99.3 | 100.9 | 101.9 | 100.4 | 98.1 | 97.0 | 98.1 | 99.8 | 100.9 | 99.2 | 97.3 | 96.5 | 96.8 | 96.0 | 96.4 | 98.9 | 94.2 | 92.8 | 93.2 | 91.0 | 90.0 | 90.0 | 91.6 | 90.5 | 89.4 | 87.2 | 84.8 | 79.6 |
| 120 | 94.1 | 94.7 | 97.0 | 97.8 | 98.9 | 100.6 | 102.0 | 103.0 | 104.2 | 105.0 | 105.7 | 105.3 | 105.2 | 102.9 | 100.8 | 101.3 | 99.6 | 99.2 | 98.7 | 99.3 | 100.9 | 97.8 | 96.3 | 96.1 | 94.8 | 95.1 | 95.0 | 96.7 | 95.9 | 94.9 | 92.3 | 89.4 | 83.9 |
| 130 | 95.1 | 96.9 | 98.5 | 99.3 | 101.4 | 102.6 | 102.0 | 103.1 | 107.5 | 106.6 | 107.0 | 107.5 | 105.0 | 106.0 | 105.4 | 103.3 | 103.2 | 101.9 | 101.5 | 102.3 | 102.0 | 97.2 | 95.0 | 94.7 | 93.5 | 93.4 | 93.7 | 94.1 | 93.4 | 92.6 | 90.3 | 88.0 | 83.4 |
| 140 | 96.2 | 98.8 | 99.0 | 101.8 | 103.1 | 103.3 | 104.8 | 106.9 | 107.1 | 107.9 | 108.5 | 108.6 | 108.2 | 106.7 | 106.5 | 104.7 | 102.7 | 102.5 | 101.6 | 101.6 | 101.8 | 100.1 | 98.7 | 97.6 | 95.8 | 94.0 | 93.4 | 93.5 | 93.3 | 92.3 | 89.4 | 85.9 | 80.4 |
| 150 | 97.7 | 100.7 | 100.6 | 104.3 | 104.6 | 105.7 | 106.7 | 109.0 | 109.0 | 110.9 | 110.3 | 110.2 | 110.2 | 108.3 | 107.8 | 107.5 | 105.4 | 105.5 | 104.1 | 102.9 | 102.4 | 101.0 | 99.6 | 98.3 | 96.7 | 94.6 | 93.3 | 92.7 | 92.3 | 91.2 | 88.2 | 84.1 | 78.2 |
| 180 | 102.7 | 102.9 | 104.2 | 105.3 | 107.5 | 108.6 | 109.7 | 108.5 | 109.8 | 106.1 | 101.8 | 101.6 | 100.6 | 99.6 | 99.0 | 97.9 | 97.5 | 96.8 | 95.1 | 93.9 | 92.2 | 90.7 | 89.8 | 87.8 | 85.7 | 83.4 | 81.2 | 79.0 | 77.0 | 75.1 | 72.6 | 69.2 | 63.8 |

Run 2 - Aircraft Boeing 757-223 N696AN - American Pad facing west - 28 February 2013, 0655 – 0658

Measurements same side as engine run-up – 96% full power; all distances at 83 feet except for 180-degree measurement (120 feet); measurement duration 10 seconds each at each angle measured from in front of the run-up engine

Run 2 - Metrics and percentiles

| Angle | Leq | SEL | LMin | LMax | L1 | L5 | L50 | L90 | L95 | L99 |
|---|---|---|---|---|---|---|---|---|---|---|
| 000 | 113.1 | 123.1 | 111.8 | 115.0 | 114.9 | 114.7 | 112.9 | 111.8 | 111.8 | 111.8 |
| 010 | 112.6 | 122.6 | 111.7 | 114.3 | 114.0 | 113.0 | 112.4 | 111.7 | 111.7 | 111.7 |
| 020 | 113.1 | 123.1 | 111.9 | 116.3 | 115.9 | 115.4 | 113.2 | 111.9 | 111.9 | 111.9 |
| 030 | 113.7 | 123.7 | 111.7 | 115.6 | 115.6 | 115.4 | 113.4 | 112.2 | 112.1 | 112.0 |
| 040 | 112.4 | 122.4 | 111.6 | 114.6 | 113.0 | 112.9 | 112.5 | 112.0 | 111.6 | 111.6 |
| 050 | 111.8 | 121.8 | 111.1 | 114.0 | 112.9 | 112.8 | 111.6 | 111.2 | 111.2 | 111.2 |
| 060 | 111.7 | 121.7 | 110.9 | 112.5 | 112.5 | 112.5 | 111.7 | 111.1 | 111.0 | 110.9 |
| 070 | 109.8 | 119.9 | 109.0 | 110.2 | 110.2 | 110.2 | 109.6 | 109.1 | 109.0 | 109.0 |
| 080 | 109.2 | 119.2 | 108.8 | 111.2 | 110.0 | 109.9 | 109.4 | 108.8 | 108.8 | 108.8 |
| 090 | 108.8 | 118.8 | 108.1 | 109.0 | 109.0 | 109.0 | 108.5 | 108.1 | 108.1 | 108.1 |
| 100 | 111.6 | 121.7 | 111.0 | 112.4 | 112.4 | 112.4 | 111.6 | 111.1 | 111.1 | 111.0 |
| 110 | 111.3 | 121.3 | 110.4 | 111.7 | 111.7 | 111.7 | 111.5 | 111.1 | 111.0 | 110.4 |
| 120 | 116.4 | 126.4 | 116.0 | 117.0 | 117.0 | 117.0 | 116.5 | 116.1 | 116.1 | 116.0 |
| 130 | 116.2 | 126.2 | 116.0 | 117.2 | 117.0 | 117.0 | 116.5 | 116.1 | 116.1 | 116.0 |
| 140 | 116.4 | 126.4 | 115.8 | 120.7 | 117.0 | 116.9 | 116.4 | 115.9 | 115.8 | 115.8 |
| 150 | 116.0 | 126.0 | 115.5 | 117.6 | 117.0 | 116.9 | 116.1 | 115.5 | 115.5 | 115.5 |
| 180 | 106.6 | 116.6 | 104.2 | 110.2 | 109.0 | 108.7 | 106.7 | 104.9 | 104.4 | 104.2 |

Run 2 - One-third octave band data

| Angle | Hz | | | | | | | | | | | | | | | | | | | kHz | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12.5 | 16 | 20 | 25 | 31.5 | 40 | 50 | 63 | 80 | 100 | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 | 800 | 1 | 1.25 | 1.6 | 2 | 2.5 | 3.15 | 4 | 5 | 6.3 | 8 | 10 | 12.5 | 16 | 20 |
| 000 | 90.3 | 89.8 | 91.1 | 93.0 | 95.0 | 96.4 | 97.9 | 97.4 | 98.1 | 100.1 | 99.3 | 99.6 | 100.5 | 98.8 | 97.4 | 96.9 | 98.8 | 97.0 | 97.9 | 101.2 | 102.4 | 108.3 | 102.7 | 99.4 | 101.3 | 97.8 | 95.8 | 93.5 | 91.1 | 89.4 | 86.1 | 81.7 | 75.0 |
| 010 | 89.7 | 89.4 | 92.7 | 94.6 | 95.3 | 95.1 | 95.0 | 96.5 | 101.1 | 102.7 | 101.1 | 102.2 | 101.5 | 100.0 | 99.0 | 96.8 | 97.0 | 98.1 | 99.6 | 100.4 | 103.2 | 106.1 | 103.6 | 99.7 | 101.3 | 97.6 | 96.3 | 93.8 | 91.9 | 90.5 | 87.8 | 83.6 | 77.2 |
| 020 | 94.2 | 92.4 | 92.8 | 93.1 | 92.7 | 93.3 | 96.9 | 99.5 | 99.2 | 100.2 | 101.5 | 101.2 | 101.7 | 100.1 | 98.9 | 96.5 | 98.9 | 98.1 | 102.4 | 101.8 | 102.5 | 107.2 | 102.9 | 100.1 | 101.5 | 98.1 | 96.1 | 94.2 | 92.1 | 90.4 | 87.3 | 83.0 | 76.4 |
| 030 | 92.2 | 89.7 | 91.3 | 92.6 | 93.8 | 96.0 | 96.9 | 98.5 | 99.0 | 101.1 | 101.5 | 102.0 | 102.4 | 101.0 | 99.7 | 97.8 | 97.9 | 98.7 | 101.9 | 102.9 | 103.2 | 108.1 | 103.4 | 100.5 | 102.0 | 98.2 | 96.3 | 94.5 | 92.2 | 90.3 | 87.1 | 82.6 | 75.9 |
| 040 | 89.9 | 90.3 | 92.2 | 93.4 | 94.6 | 95.2 | 96.4 | 97.8 | 99.0 | 100.8 | 102.3 | 101.1 | 101.7 | 100.8 | 99.7 | 97.9 | 96.3 | 97.1 | 99.0 | 99.9 | 101.6 | 107.4 | 101.8 | 99.5 | 100.9 | 96.9 | 95.3 | 93.2 | 91.1 | 89.2 | 85.8 | 81.3 | 74.5 |
| 050 | 90.6 | 90.0 | 91.8 | 93.2 | 95.6 | 96.5 | 96.4 | 97.7 | 98.8 | 100.6 | 102.0 | 100.2 | 103.1 | 101.7 | 100.6 | 97.9 | 97.9 | 97.9 | 100.3 | 101.2 | 100.5 | 105.6 | 101.5 | 99.0 | 100.2 | 96.3 | 95.0 | 93.0 | 90.9 | 89.0 | 85.9 | 81.4 | 74.6 |
| 060 | 91.8 | 90.2 | 92.8 | 94.4 | 95.8 | 93.7 | 97.3 | 98.4 | 99.4 | 99.8 | 101.5 | 101.8 | 103.1 | 101.8 | 100.1 | 99.2 | 97.7 | 98.6 | 100.2 | 100.5 | 100.5 | 105.8 | 101.2 | 98.8 | 99.8 | 95.7 | 94.3 | 92.4 | 90.4 | 88.4 | 85.5 | 81.0 | 74.5 |
| 070 | 90.7 | 91.6 | 91.8 | 95.8 | 96.5 | 96.4 | 98.1 | 99.8 | 100.8 | 98.9 | 98.4 | 98.7 | 99.8 | 100.0 | 100.2 | 97.9 | 97.4 | 97.9 | 98.4 | 98.5 | 98.2 | 104.0 | 98.9 | 97.0 | 97.6 | 94.0 | 92.6 | 91.2 | 89.4 | 87.5 | 84.7 | 80.2 | 73.8 |
| 080 | 91.3 | 91.1 | 92.0 | 96.3 | 96.4 | 97.6 | 99.1 | 100.8 | 100.8 | 100.1 | 101.5 | 100.9 | 101.1 | 101.3 | 100.9 | 99.8 | 98.4 | 97.9 | 98.9 | 99.1 | 98.7 | 101.6 | 97.7 | 96.2 | 96.4 | 93.4 | 91.8 | 91.2 | 89.9 | 87.5 | 84.5 | 80.2 | 73.7 |
| 090 | 92.2 | 93.1 | 94.1 | 97.5 | 97.8 | 100.2 | 101.1 | 102.4 | 103.0 | 101.5 | 100.2 | 98.4 | 97.9 | 97.6 | 99.8 | 100.0 | 99.1 | 98.0 | 98.8 | 99.0 | 98.7 | 100.4 | 97.4 | 96.0 | 95.1 | 93.4 | 91.8 | 91.9 | 91.8 | 89.8 | 86.1 | 82.3 | 76.1 |
| 100 | 93.6 | 94.1 | 96.0 | 98.5 | 99.5 | 100.9 | 103.2 | 103.2 | 103.3 | 102.8 | 103.2 | 102.4 | 101.6 | 99.5 | 101.6 | 102.5 | 100.6 | 99.3 | 100.7 | 101.4 | 101.3 | 103.2 | 100.1 | 99.2 | 98.2 | 96.9 | 97.2 | 97.0 | 98.4 | 97.2 | 93.1 | 89.6 | 83.9 |
| 110 | 95.7 | 94.6 | 97.3 | 100.0 | 101.4 | 104.1 | 105.4 | 106.4 | 105.3 | 102.5 | 100.9 | 101.8 | 104.3 | 106.0 | 104.0 | 101.4 | 100.8 | 101.0 | 101.0 | 101.2 | 100.5 | 102.5 | 98.8 | 97.8 | 97.2 | 95.6 | 96.3 | 95.9 | 97.3 | 97.2 | 93.0 | 89.3 | 83.6 |
| 120 | 96.8 | 97.1 | 99.9 | 101.1 | 103.3 | 103.8 | 105.3 | 106.8 | 108.3 | 110.3 | 110.7 | 110.3 | 110.9 | 108.6 | 105.6 | 105.8 | 104.4 | 105.6 | 105.6 | 105.8 | 105.3 | 107.7 | 103.4 | 102.2 | 103.4 | 101.2 | 102.9 | 102.9 | 103.1 | 103.7 | 99.7 | 95.3 | 89.3 |
| 130 | 99.0 | 99.9 | 101.8 | 103.6 | 106.1 | 106.8 | 107.5 | 107.9 | 112.2 | 113.0 | 111.0 | 114.5 | 110.4 | 111.1 | 109.6 | 106.7 | 106.3 | 107.8 | 107.6 | 107.0 | 104.7 | 105.3 | 102.6 | 101.6 | 101.3 | 99.3 | 99.5 | 99.3 | 99.3 | 99.3 | 96.6 | 92.6 | 87.1 |
| 140 | 103.5 | 102.8 | 103.6 | 105.1 | 108.0 | 110.2 | 111.9 | 114.0 | 115.0 | 115.1 | 115.7 | 114.7 | 113.7 | 112.2 | 111.1 | 108.9 | 106.2 | 106.5 | 107.1 | 106.7 | 105.7 | 105.3 | 103.3 | 101.9 | 101.0 | 99.2 | 98.4 | 97.8 | 97.5 | 97.2 | 95.0 | 91.0 | 85.5 |
| 150 | 105.6 | 107.4 | 108.0 | 108.8 | 110.5 | 113.3 | 115.6 | 116.8 | 117.4 | 118.3 | 117.4 | 116.0 | 114.3 | 111.5 | 110.5 | 109.2 | 107.6 | 107.2 | 106.7 | 105.2 | 103.8 | 103.4 | 101.6 | 100.3 | 99.1 | 97.4 | 96.2 | 95.3 | 94.7 | 94.0 | 91.9 | 88.1 | 83.0 |
| 180 | 106.6 | 105.3 | 104.4 | 104.1 | 102.5 | 100.5 | 101.2 | 101.2 | 101.4 | 100.1 | 99.7 | 101.0 | 101.6 | 102.2 | 101.8 | 99.4 | 99.5 | 98.4 | 98.9 | 97.2 | 95.3 | 93.8 | 93.5 | 91.6 | 89.5 | 87.2 | 84.2 | 81.9 | 80.3 | 78.3 | 75.7 | 71.2 | 64.4 |

Run 3 - Aircraft Boeing 757-223 N696AN - United Pad facing east - 28 February 2013, 0811 – 0813

Measurements same side as engine run-up –full power; all distances at 83 feet; measurement duration 10 seconds each at each angle measured from in front of the run-up engine

Run 3 - Metrics and percentiles

| Angle | Leq | SEL | LMin | LMax | L1 | L5 | L50 | L90 | L95 | L99 |
|---|---|---|---|---|---|---|---|---|---|---|
| 000 | 113.4 | 123.4 | 112.6 | 114.7 | 114.7 | 114.0 | 113.4 | 112.6 | 112.6 | 112.6 |
| 010 | 112.5 | 122.5 | 111.9 | 113.7 | 113.7 | 113.2 | 112.5 | 112.1 | 112.0 | 111.9 |
| 020 | 114.9 | 124.9 | 112.5 | 117.3 | 117.3 | 117.3 | 114.2 | 112.5 | 112.5 | 112.5 |
| 030 | 112.8 | 122.8 | 112.1 | 113.7 | 113.7 | 113.7 | 112.8 | 112.2 | 112.1 | 112.1 |
| 040 | 112.0 | 122.0 | 111.2 | 112.6 | 112.6 | 112.6 | 112.0 | 111.2 | 111.2 | 111.2 |
| 050 | 112.7 | 122.7 | 111.7 | 113.7 | 113.7 | 113.7 | 112.6 | 111.7 | 111.7 | 111.7 |
| 060 | 110.6 | 120.6 | 110.0 | 111.2 | 111.2 | 111.2 | 110.6 | 110.1 | 110.0 | 110.0 |
| 070 | 109.1 | 119.1 | 108.7 | 110.1 | 110.1 | 110.0 | 109.2 | 108.7 | 108.7 | 108.7 |
| 080 | 109.0 | 119.0 | 108.5 | 114.4 | 110.9 | 110.4 | 108.8 | 108.5 | 108.5 | 108.5 |
| 090 | 110.4 | 120.4 | 109.4 | 111.0 | 111.0 | 110.9 | 110.4 | 109.5 | 109.4 | 109.4 |
| 100 | 111.7 | 121.7 | 111.1 | 112.4 | 112.4 | 112.4 | 111.6 | 111.1 | 111.1 | 111.1 |
| 110 | 113.1 | 123.1 | 112.3 | 115.3 | 114.8 | 114.2 | 113.2 | 112.3 | 112.3 | 112.3 |
| 120 | 115.2 | 125.2 | 114.9 | 116.0 | 116.0 | 115.9 | 115.4 | 114.9 | 114.9 | 114.9 |
| 130 | 115.6 | 125.6 | 115.1 | 115.9 | 115.9 | 115.9 | 115.5 | 115.1 | 115.1 | 115.1 |
| 140 | 115.7 | 125.7 | 114.9 | 116.7 | 116.7 | 116.7 | 115.7 | 115.1 | 115.0 | 114.9 |
| 150 | 116.0 | 126.0 | 115.8 | 116.6 | 116.6 | 116.6 | 116.0 | 115.8 | 115.8 | 115.8 |

Run 3 - One-third octave band data

| Angle | Hz | | | | | | | | | | | | | | | | | | | kHz | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12.5 | 16 | 20 | 25 | 31.5 | 40 | 50 | 63 | 80 | 100 | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 | 800 | 1 | 1.25 | 1.6 | 2 | 2.5 | 3.15 | 4 | 5 | 6.3 | 8 | 10 | 12.5 | 16 | 20 |
| 000 | 94.7 | 97.0 | 97.0 | 98.7 | 99.7 | 99.7 | 98.2 | 97.4 | 100.3 | 100.2 | 99.9 | 98.6 | 98.9 | 98.0 | 97.1 | 95.7 | 100.4 | 97.7 | 96.9 | 100.1 | 99.4 | 109.3 | 102.9 | 100.0 | 101.5 | 98.6 | 96.8 | 95.1 | 93.4 | 91.3 | 88.2 | 83.9 | 77.3 |
| 010 | 96.3 | 96.7 | 97.3 | 100.2 | 101.2 | 98.3 | 96.8 | 99.2 | 101.0 | 101.7 | 100.2 | 100.6 | 101.2 | 98.9 | 97.6 | 95.7 | 96.1 | 97.6 | 98.5 | 99.0 | 100.8 | 107.5 | 102.2 | 99.4 | 101.0 | 98.3 | 96.8 | 95.5 | 94.4 | 92.8 | 89.9 | 86.1 | 79.9 |
| 020 | 94.4 | 96.2 | 97.0 | 99.0 | 97.5 | 97.5 | 98.6 | 100.3 | 100.1 | 101.1 | 100.4 | 100.8 | 100.7 | 99.8 | 98.7 | 96.4 | 97.1 | 100.6 | 103.0 | 103.4 | 108.1 | 107.0 | 103.5 | 103.7 | 102.6 | 101.1 | 99.0 | 97.4 | 96.2 | 94.2 | 91.5 | 87.4 | 80.5 |
| 030 | 97.4 | 97.9 | 100.5 | 100.7 | 100.1 | 99.2 | 97.7 | 98.9 | 99.9 | 101.5 | 102.2 | 101.9 | 103.3 | 101.4 | 100.0 | 99.4 | 97.6 | 97.0 | 100.5 | 99.9 | 101.8 | 107.5 | 102.1 | 99.7 | 101.1 | 98.1 | 96.5 | 94.9 | 93.3 | 91.6 | 88.2 | 83.8 | 77.0 |
| 040 | 95.8 | 97.2 | 97.0 | 99.6 | 98.2 | 97.8 | 97.0 | 98.2 | 98.6 | 101.0 | 101.3 | 100.2 | 102.1 | 100.2 | 100.2 | 98.4 | 97.4 | 96.0 | 98.0 | 98.6 | 99.7 | 106.0 | 103.0 | 100.3 | 100.3 | 98.0 | 96.8 | 95.3 | 93.6 | 91.6 | 88.4 | 84.5 | 77.6 |
| 050 | 96.6 | 95.6 | 98.1 | 99.0 | 98.0 | 95.9 | 97.8 | 98.5 | 99.4 | 100.1 | 101.1 | 100.2 | 105.7 | 100.4 | 99.6 | 98.3 | 98.6 | 96.9 | 100.4 | 101.2 | 101.6 | 106.9 | 102.3 | 100.3 | 100.8 | 98.2 | 96.7 | 95.1 | 93.4 | 91.0 | 87.9 | 83.9 | 76.9 |
| 060 | 97.6 | 97.3 | 97.8 | 99.3 | 97.8 | 98.9 | 99.8 | 99.7 | 101.8 | 101.0 | 101.6 | 101.4 | 103.2 | 100.9 | 100.2 | 99.4 | 98.1 | 96.6 | 97.4 | 98.7 | 98.9 | 104.6 | 99.7 | 97.5 | 99.4 | 95.9 | 94.4 | 92.9 | 91.3 | 89.1 | 86.2 | 81.8 | 74.9 |
| 070 | 97.7 | 97.7 | 98.4 | 97.5 | 100.1 | 100.5 | 99.7 | 100.8 | 102.2 | 101.8 | 102.1 | 102.6 | 101.5 | 101.2 | 100.1 | 99.0 | 97.5 | 97.3 | 97.3 | 97.7 | 98.3 | 102.0 | 98.2 | 96.4 | 96.8 | 94.0 | 93.2 | 92.1 | 90.8 | 88.7 | 85.9 | 81.7 | 75.1 |
| 080 | 97.4 | 96.8 | 98.0 | 98.8 | 100.4 | 100.7 | 101.3 | 102.2 | 102.7 | 102.9 | 103.4 | 102.7 | 102.5 | 101.3 | 101.1 | 99.9 | 98.4 | 97.4 | 97.7 | 98.2 | 98.4 | 101.2 | 97.5 | 96.3 | 96.2 | 93.9 | 92.7 | 92.4 | 91.7 | 89.3 | 86.5 | 82.5 | 76.0 |
| 090 | 95.6 | 98.8 | 100.3 | 101.5 | 101.3 | 101.8 | 102.7 | 103.2 | 104.9 | 104.8 | 104.8 | 105.0 | 104.8 | 103.7 | 102.4 | 100.4 | 99.8 | 99.7 | 99.5 | 100.0 | 100.2 | 101.5 | 98.4 | 97.3 | 96.7 | 95.1 | 94.3 | 94.4 | 95.4 | 93.1 | 89.5 | 86.0 | 80.0 |
| 100 | 96.6 | 99.0 | 101.1 | 102.4 | 102.1 | 103.1 | 104.9 | 104.8 | 105.6 | 106.3 | 106.9 | 106.6 | 106.0 | 103.4 | 103.3 | 103.5 | 102.0 | 100.0 | 101.4 | 101.9 | 102.4 | 102.5 | 99.8 | 98.7 | 97.6 | 95.8 | 95.2 | 94.4 | 95.7 | 94.4 | 90.4 | 86.9 | 80.9 |
| 110 | 97.9 | 99.1 | 102.4 | 103.3 | 103.5 | 104.7 | 105.4 | 105.3 | 106.7 | 107.2 | 107.4 | 107.2 | 106.9 | 104.8 | 104.4 | 104.0 | 102.8 | 101.6 | 102.8 | 103.4 | 103.2 | 104.6 | 100.8 | 99.7 | 99.0 | 97.3 | 97.5 | 96.4 | 97.5 | 97.4 | 93.2 | 89.2 | 83.1 |
| 120 | 100.1 | 100.2 | 104.1 | 104.2 | 106.3 | 106.5 | 106.2 | 106.6 | 108.5 | 108.9 | 109.7 | 109.8 | 109.4 | 107.4 | 105.9 | 105.3 | 104.3 | 105.1 | 104.7 | 105.9 | 105.4 | 105.8 | 102.8 | 102.0 | 101.8 | 99.4 | 100.0 | 99.7 | 99.2 | 99.5 | 95.9 | 91.6 | 85.2 |
| 130 | 101.0 | 102.8 | 104.8 | 104.2 | 108.4 | 107.8 | 108.5 | 110.5 | 111.3 | 112.5 | 112.9 | 112.7 | 112.2 | 109.7 | 108.3 | 107.0 | 104.9 | 103.5 | 105.6 | 106.6 | 105.9 | 105.9 | 103.1 | 102.0 | 100.9 | 98.6 | 97.7 | 97.2 | 96.6 | 96.7 | 94.0 | 89.9 | 83.8 |
| 140 | 103.5 | 102.8 | 105.5 | 108.2 | 109.6 | 110.0 | 112.1 | 113.4 | 113.9 | 115.0 | 114.6 | 114.4 | 114.2 | 111.6 | 108.7 | 108.2 | 106.3 | 105.4 | 106.6 | 106.6 | 105.2 | 104.7 | 102.7 | 101.1 | 99.7 | 97.4 | 95.8 | 94.9 | 94.1 | 93.9 | 91.7 | 87.7 | 81.9 |
| 150 | 107.0 | 107.2 | 106.9 | 110.1 | 111.0 | 114.1 | 116.1 | 117.0 | 118.4 | 118.4 | 117.7 | 116.6 | 115.3 | 112.2 | 109.9 | 108.6 | 107.1 | 107.2 | 107.3 | 105.6 | 104.3 | 103.2 | 101.6 | 100.1 | 98.5 | 96.5 | 94.7 | 93.5 | 92.5 | 91.9 | 89.7 | 86.1 | 81.0 |

Run 4 - Aircraft Boeing 757-223 N696AN - United Pad facing east - 28 February 2013, 0817 – 0819

Measurements same side as engine run-up –full power; all distances at 83 feet; measurement duration 10 seconds each at each angle measured from in front of the run-up engine

Run 4 - Metrics and percentiles

| Angle | Leq | SEL | LMin | LMax | L1 | L5 | L50 | L90 | L95 | L99 |
|---|---|---|---|---|---|---|---|---|---|---|
| 000 | 109.3 | 119.3 | 108.8 | 110.5 | 110.0 | 109.9 | 109.4 | 108.8 | 108.8 | 108.8 |
| 010 | 109.9 | 119.9 | 109.6 | 111.0 | 111.0 | 110.9 | 109.9 | 109.6 | 109.6 | 109.6 |
| 020 | 110.3 | 120.3 | 109.7 | 112.3 | 111.0 | 110.9 | 110.4 | 109.7 | 109.7 | 109.7 |
| 030 | 110.3 | 120.3 | 110.1 | 112.1 | 111.7 | 111.0 | 110.5 | 110.1 | 110.1 | 110.1 |
| 040 | 110.6 | 120.6 | 109.5 | 112.3 | 112.0 | 111.8 | 110.6 | 109.6 | 109.5 | 109.5 |
| 050 | 110.2 | 120.2 | 109.8 | 110.5 | 110.5 | 110.5 | 110.4 | 109.8 | 109.8 | 109.8 |
| 060 | 109.1 | 119.1 | 109.0 | 111.8 | 110.0 | 109.9 | 109.4 | 109.0 | 109.0 | 109.0 |
| 070 | 108.6 | 118.6 | 108.3 | 109.1 | 109.0 | 109.0 | 108.5 | 108.3 | 108.3 | 108.3 |
| 080 | 108.3 | 118.4 | 108.1 | 108.8 | 108.8 | 108.8 | 108.5 | 108.1 | 108.1 | 108.1 |
| 090 | 109.2 | 119.2 | 109.0 | 110.0 | 110.0 | 110.0 | 109.5 | 109.1 | 109.0 | 109.0 |
| 100 | 110.0 | 120.0 | 109.5 | 110.5 | 110.5 | 110.5 | 110.0 | 109.5 | 109.5 | 109.5 |
| 110 | 112.4 | 122.5 | 112.3 | 113.2 | 113.0 | 113.0 | 112.5 | 112.3 | 112.3 | 112.3 |
| 120 | 113.8 | 123.8 | 113.7 | 115.9 | 114.0 | 114.0 | 113.7 | 113.7 | 113.7 | 113.7 |
| 130 | 115.0 | 125.0 | 114.7 | 115.5 | 115.5 | 115.5 | 115.2 | 114.7 | 114.7 | 114.7 |
| 140 | 115.4 | 125.4 | 115.1 | 116.6 | 116.0 | 116.0 | 115.5 | 115.1 | 115.1 | 115.1 |
| 150 | 116.1 | 126.1 | 115.6 | 120.2 | 117.0 | 116.9 | 116.4 | 115.6 | 115.6 | 115.6 |

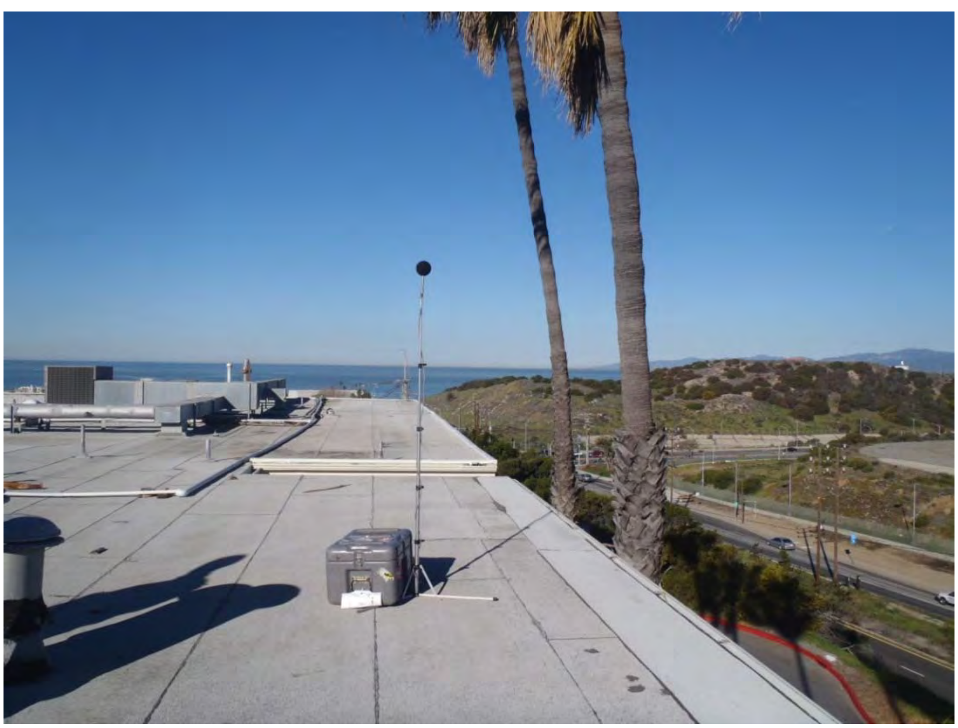
Run 4 - One-third octave band data

| Angle | Hz | | | | | | | | | | | | | | | | | | | kHz | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12.5 | 16 | 20 | 25 | 31.5 | 40 | 50 | 63 | 80 | 100 | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 | 800 | 1 | 1.25 | 1.6 | 2 | 2.5 | 3.15 | 4 | 5 | 6.3 | 8 | 10 | 12.5 | 16 | 20 |
| 000 | 95.4 | 97.7 | 99.9 | 100.5 | 103.3 | 103.4 | 99.4 | 98.6 | 100.4 | 100.3 | 99.8 | 99.9 | 99.6 | 98.3 | 95.9 | 95.3 | 96.9 | 95.9 | 95.5 | 98.3 | 97.1 | 102.3 | 99.3 | 95.6 | 99.0 | 95.2 | 94.8 | 93.0 | 92.1 | 91.2 | 88.8 | 85.6 | 79.9 |
| 010 | 96.9 | 98.9 | 101.1 | 102.9 | 103.6 | 103.4 | 98.6 | 99.7 | 102.6 | 101.9 | 100.8 | 101.9 | 99.9 | 99.0 | 98.2 | 96.7 | 96.5 | 97.6 | 96.4 | 99.2 | 99.0 | 101.9 | 100.4 | 97.7 | 98.4 | 96.2 | 96.1 | 94.0 | 92.9 | 92.1 | 90.3 | 87.3 | 81.4 |
| 020 | 97.3 | 99.3 | 100.9 | 103.1 | 102.3 | 101.1 | 100.0 | 100.1 | 101.8 | 101.2 | 101.9 | 102.3 | 101.3 | 100.2 | 99.1 | 97.2 | 97.0 | 97.8 | 96.2 | 98.9 | 100.2 | 103.4 | 100.4 | 97.5 | 98.0 | 95.8 | 95.3 | 94.0 | 92.5 | 91.1 | 89.0 | 86.1 | 80.2 |
| 030 | 97.6 | 97.7 | 99.6 | 100.1 | 102.5 | 100.5 | 97.3 | 97.1 | 100.3 | 101.3 | 102.0 | 101.5 | 101.5 | 100.1 | 99.1 | 98.5 | 100.6 | 96.3 | 96.2 | 97.7 | 97.8 | 103.7 | 100.7 | 98.3 | 98.2 | 95.7 | 95.7 | 93.4 | 91.8 | 90.0 | 87.6 | 84.3 | 78.1 |
| 040 | 96.8 | 97.4 | 98.9 | 99.3 | 101.5 | 98.5 | 97.8 | 98.3 | 100.3 | 101.7 | 101.5 | 100.9 | 101.2 | 100.4 | 100.3 | 99.0 | 102.6 | 97.0 | 96.7 | 97.3 | 97.8 | 104.4 | 101.3 | 97.8 | 97.6 | 95.4 | 95.0 | 92.9 | 91.4 | 89.4 | 86.6 | 83.3 | 77.1 |
| 050 | 96.2 | 96.9 | 98.5 | 98.8 | 98.6 | 97.7 | 98.9 | 99.9 | 100.3 | 100.4 | 102.3 | 102.1 | 101.9 | 100.4 | 100.9 | 99.6 | 104.7 | 97.2 | 96.6 | 97.4 | 97.3 | 103.0 | 100.3 | 98.0 | 96.3 | 94.0 | 93.9 | 92.1 | 90.6 | 88.5 | 85.7 | 82.3 | 76.1 |
| 060 | 97.9 | 97.8 | 97.6 | 98.7 | 97.4 | 98.8 | 100.6 | 99.9 | 100.3 | 100.9 | 101.9 | 102.1 | 102.7 | 100.5 | 101.1 | 100.4 | 105.5 | 97.2 | 96.8 | 96.7 | 96.1 | 98.8 | 98.8 | 96.8 | 95.5 | 93.0 | 93.0 | 92.0 | 89.7 | 87.3 | 84.3 | 80.8 | 74.5 |
| 070 | 95.8 | 97.5 | 97.3 | 96.6 | 96.5 | 99.1 | 101.6 | 101.3 | 100.4 | 100.6 | 102.4 | 102.0 | 101.7 | 100.6 | 100.8 | 99.9 | 103.5 | 97.8 | 96.5 | 97.8 | 96.4 | 99.6 | 97.9 | 96.0 | 94.4 | 92.5 | 91.9 | 91.3 | 89.7 | 87.2 | 84.0 | 80.5 | 74.4 |
| 080 | 97.2 | 97.1 | 97.4 | 97.6 | 98.6 | 99.8 | 100.6 | 101.5 | 102.2 | 102.4 | 102.9 | 103.1 | 102.3 | 101.0 | 101.1 | 100.1 | 102.7 | 97.7 | 96.8 | 96.2 | 96.5 | 99.0 | 97.1 | 95.8 | 94.7 | 92.7 | 91.7 | 91.4 | 90.3 | 87.3 | 83.9 | 80.3 | 74.2 |
| 090 | 96.8 | 96.9 | 97.7 | 98.1 | 101.0 | 101.2 | 101.6 | 101.8 | 102.7 | 103.7 | 103.7 | 103.4 | 104.3 | 102.0 | 101.7 | 100.8 | 101.8 | 98.6 | 98.3 | 98.0 | 98.4 | 99.5 | 97.0 | 96.3 | 95.0 | 94.0 | 92.8 | 93.8 | 94.5 | 91.2 | 86.7 | 83.2 | 77.3 |
| 100 | 96.6 | 97.0 | 99.0 | 98.8 | 99.5 | 102.3 | 103.6 | 103.9 | 103.8 | 105.1 | 106.1 | 105.8 | 105.4 | 103.5 | 102.3 | 102.3 | 103.3 | 100.3 | 98.9 | 99.0 | 99.5 | 100.2 | 97.8 | 97.2 | 95.5 | 93.4 | 92.4 | 92.1 | 93.2 | 91.0 | 86.9 | 83.1 | 77.5 |
| 110 | 96.3 | 98.7 | 99.6 | 101.2 | 102.3 | 105.2 | 104.5 | 105.5 | 105.9 | 106.6 | 107.7 | 107.5 | 106.0 | 104.8 | 105.4 | 104.9 | 105.1 | 100.8 | 101.1 | 101.3 | 102.2 | 103.0 | 100.0 | 99.4 | 97.9 | 96.8 | 96.3 | 96.4 | 98.4 | 97.7 | 92.8 | 88.6 | 83.2 |
| 120 | 97.7 | 98.9 | 101.4 | 102.9 | 103.7 | 106.1 | 106.3 | 106.8 | 107.8 | 108.9 | 109.7 | 109.6 | 108.3 | 106.9 | 106.8 | 106.2 | 104.5 | 102.2 | 103.2 | 104.1 | 104.5 | 103.7 | 101.3 | 100.4 | 99.2 | 97.5 | 96.5 | 96.4 | 97.3 | 97.4 | 93.1 | 88.6 | 82.8 |
| 130 | 100.6 | 100.8 | 103.5 | 103.9 | 105.5 | 108.4 | 108.2 | 110.1 | 110.9 | 111.9 | 112.0 | 112.1 | 110.1 | 108.5 | 108.5 | 106.5 | 102.8 | 103.7 | 105.5 | 106.1 | 105.0 | 105.1 | 102.5 | 101.1 | 100.5 | 98.4 | 97.9 | 97.8 | 98.5 | 98.6 | 95.1 | 90.6 | 85.1 |
| 140 | 102.9 | 101.8 | 104.4 | 105.2 | 108.3 | 109.8 | 111.7 | 112.7 | 113.6 | 114.3 | 114.3 | 113.8 | 112.6 | 110.8 | 109.5 | 107.9 | 104.8 | 105.1 | 106.4 | 106.6 | 105.1 | 103.7 | 102.4 | 100.9 | 99.4 | 97.4 | 95.7 | 95.0 | 95.1 | 95.1 | 92.3 | 88.0 | 82.4 |
| 150 | 107.1 | 106.8 | 106.4 | 110.5 | 109.8 | 114.7 | 115.5 | 117.0 | 118.0 | 117.9 | 117.2 | 115.7 | 115.2 | 112.8 | 111.1 | 109.0 | 106.8 | 106.6 | 106.7 | 106.1 | 104.4 | 103.3 | 102.0 | 100.2 | 98.7 | 96.8 | 94.9 | 94.0 | 93.4 | 92.9 | 90.6 | 86.8 | 81.9 |

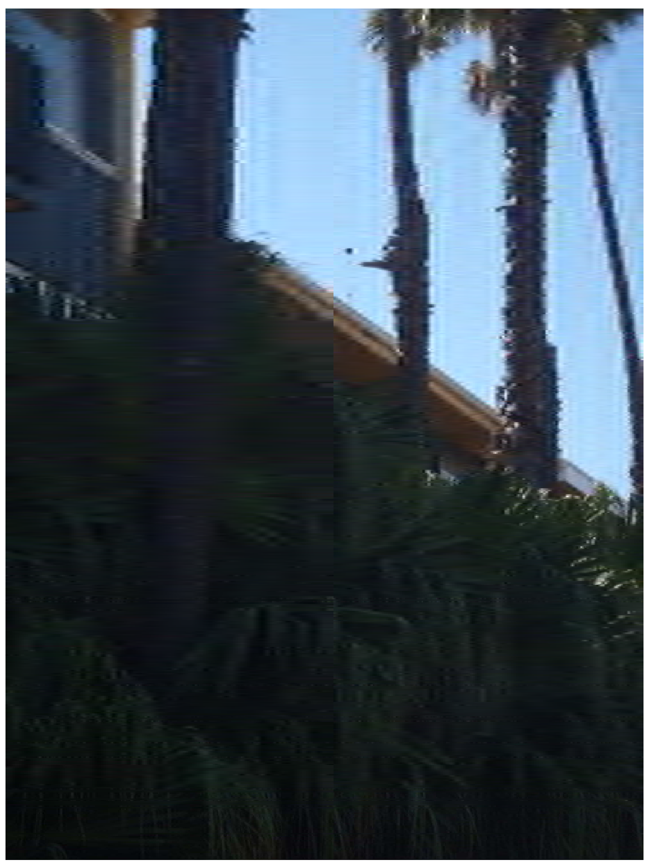
## Appendix D Noise Measurement Site Photographs and Noise Measurement Data

### Photographs of Short-Term Measurement Sites

**Site P-ESG1 – Roof of 770 West Imperial Ave.**



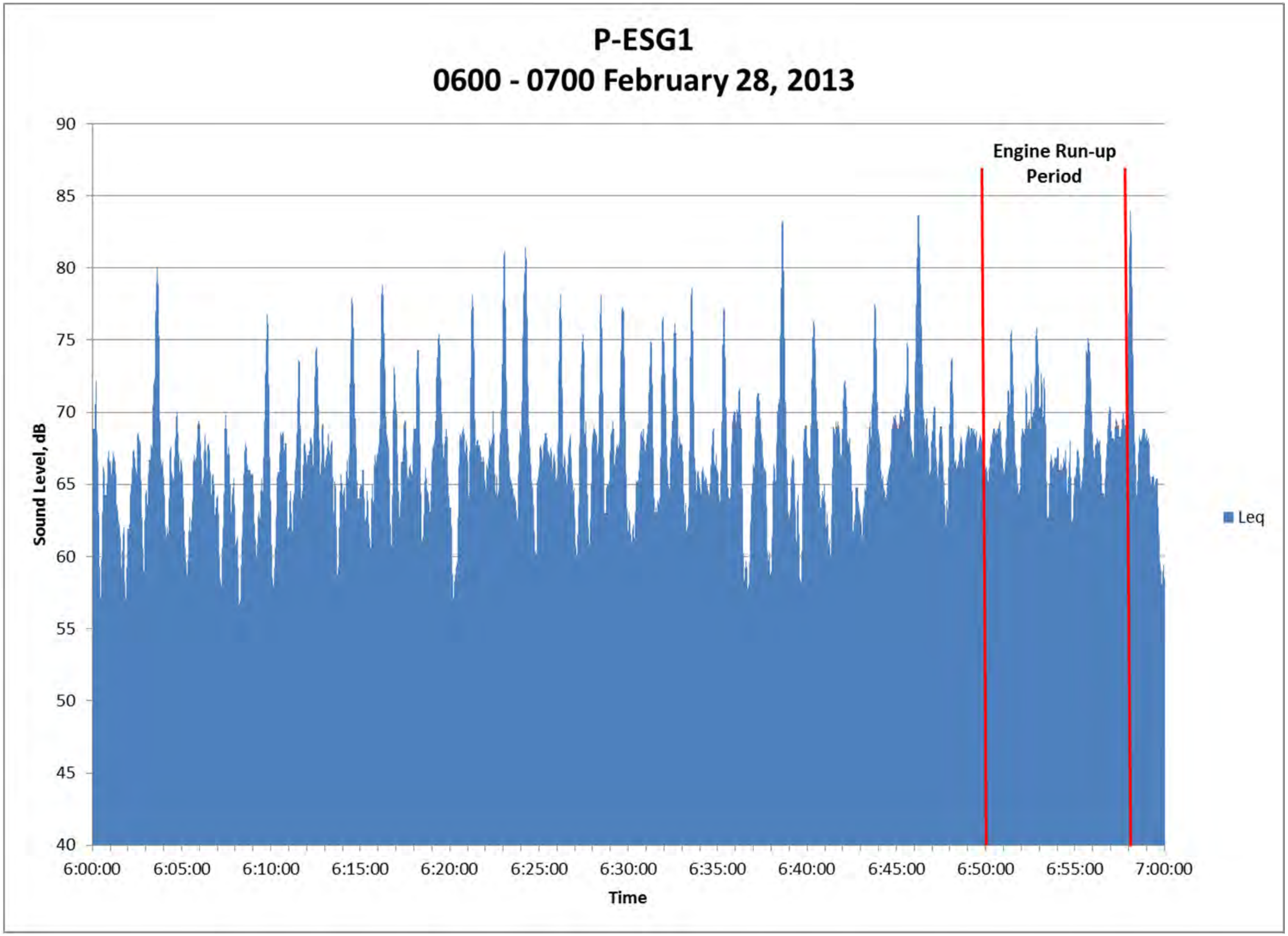
**Site P-ESG1 – Roof of 770 West Imperial Ave. (Continued)**

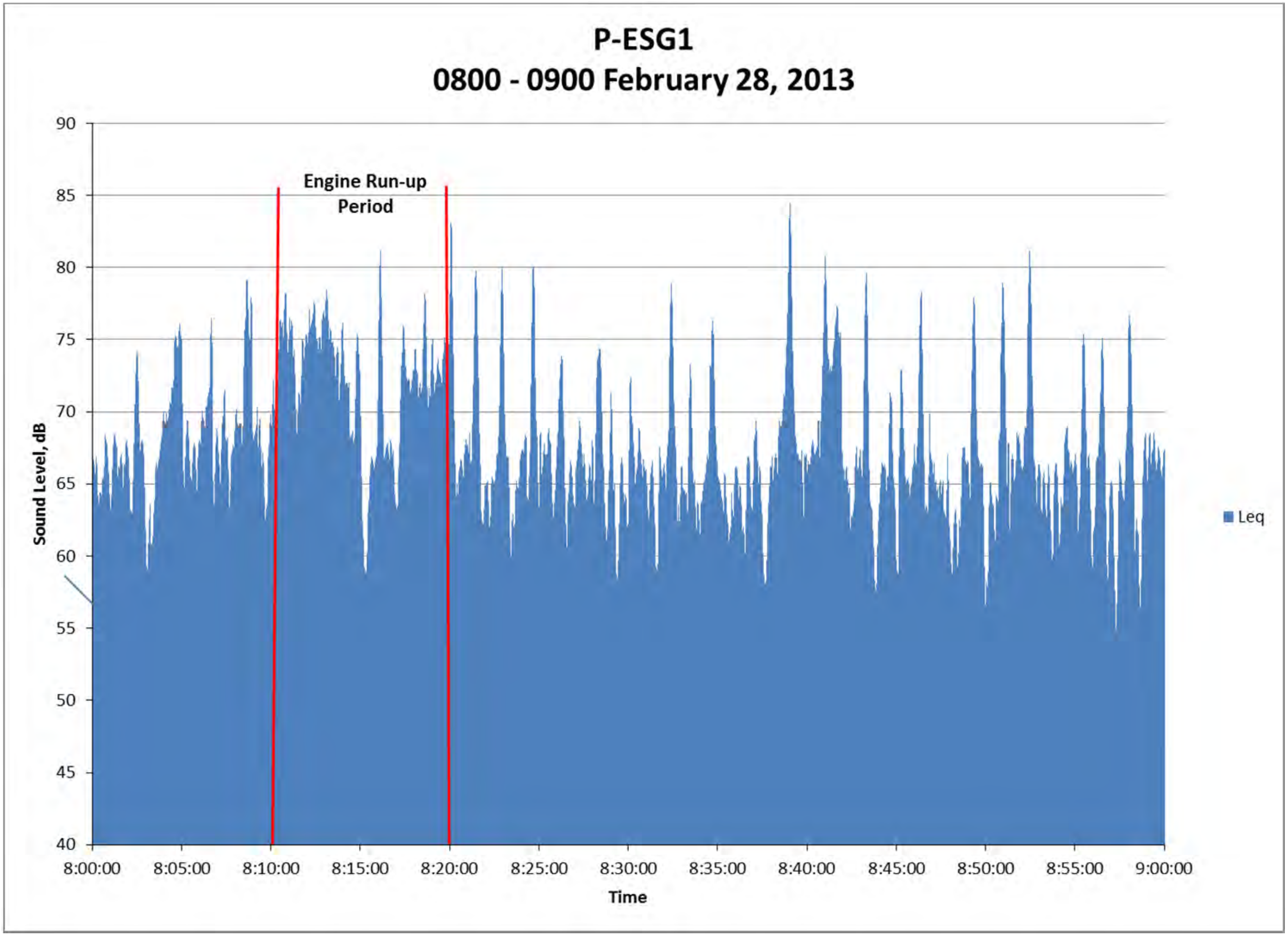


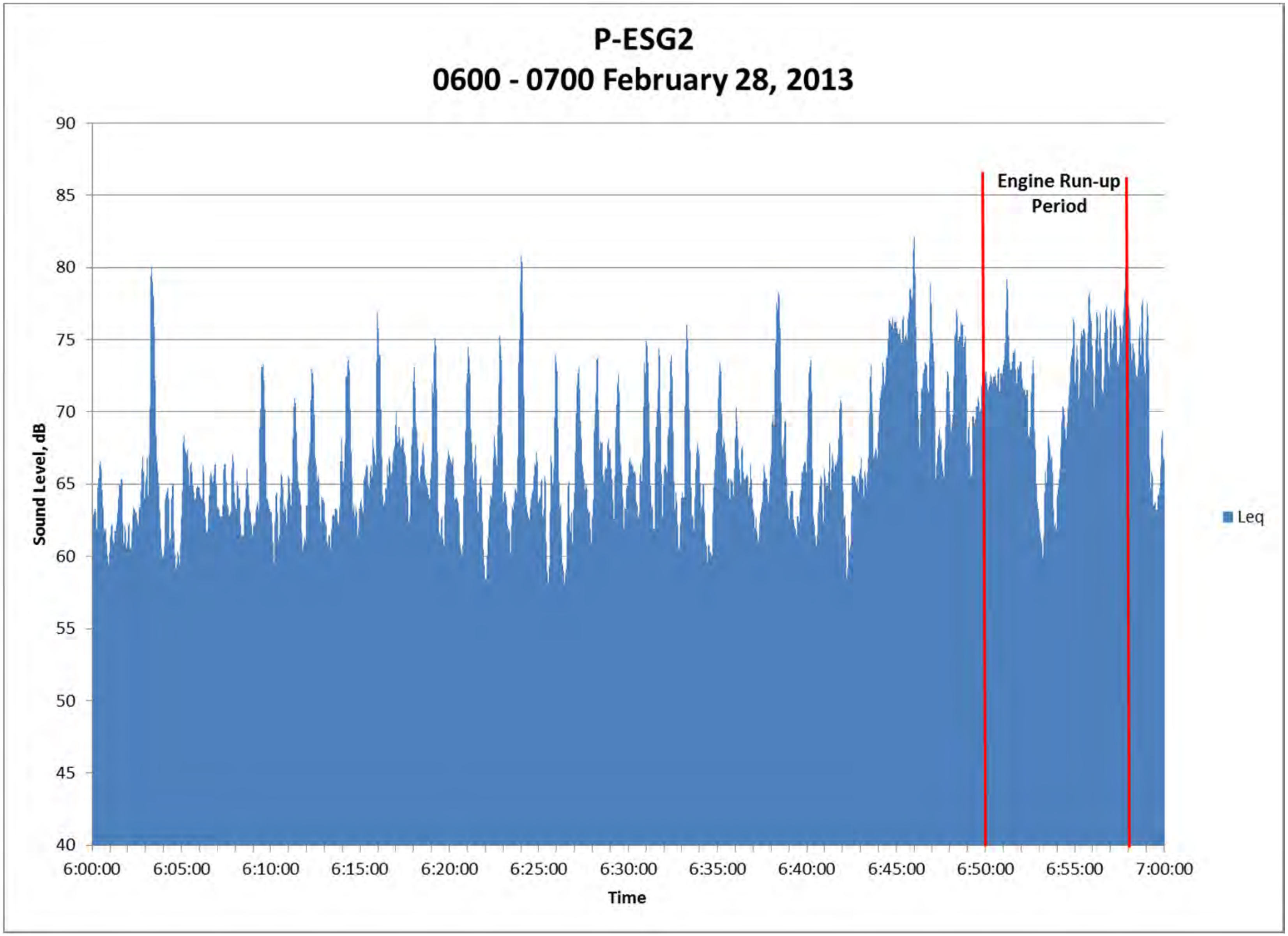
**Site P-ESG2 – Greenbelt across from 216 East Imperial Ave.**

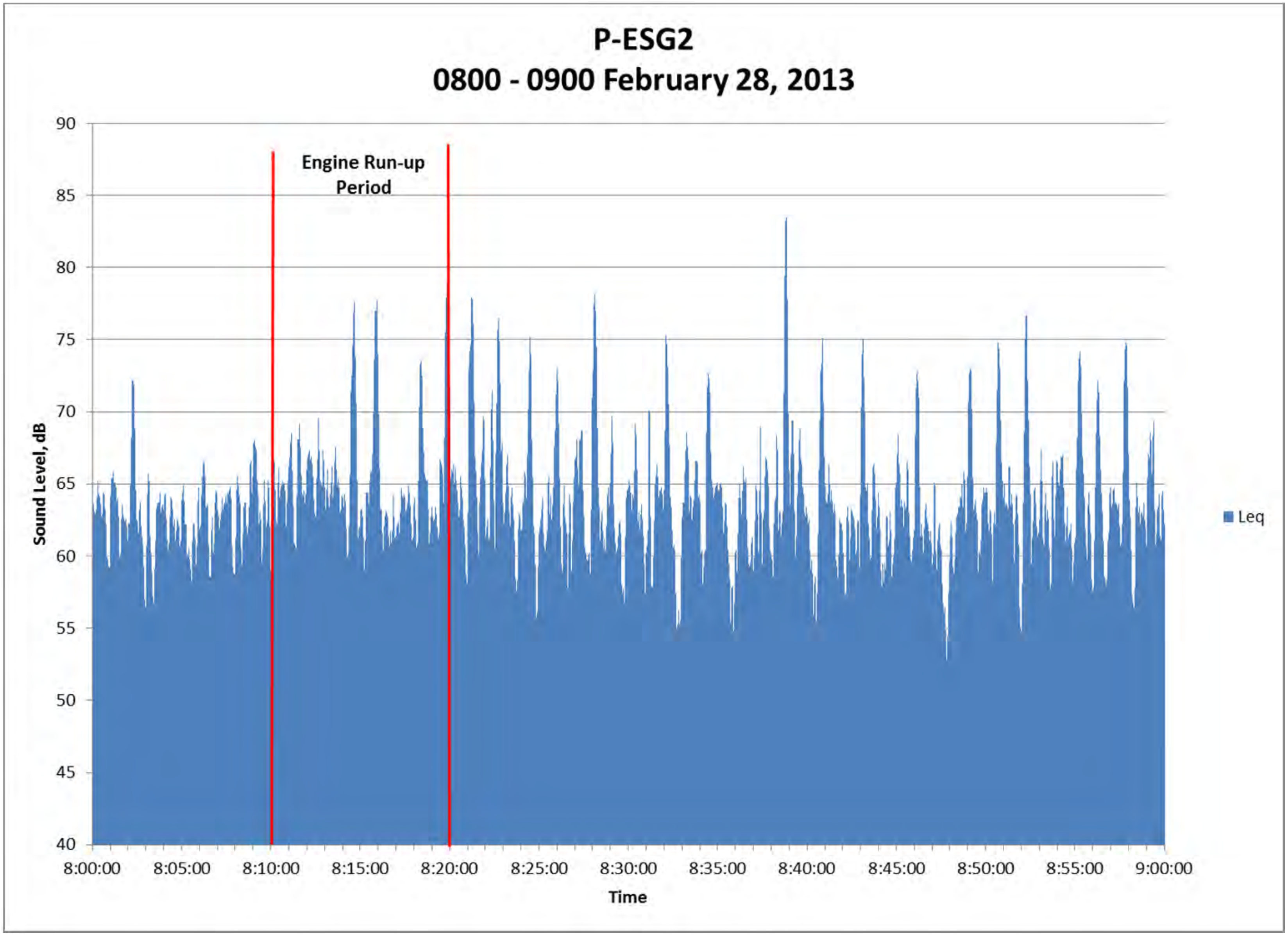
**Site P-ESG2 – Greenbelt across from 216 East Imperial Ave. (Continued)**

**Snap-Shot of Noise Data by Site**




P-ESG1
0800 - 0900 February 28, 2013
Engine Run-up Period
Sound Level, dB
90
85
80
75
70
65
60
55
50
45
40
8:00:00
8:05:00
8:10:00
8:15:00
8:20:00
8:25:00
8:30:00
8:35:00
8:40:00
8:45:00
8:50:00
8:55:00
9:00:00
Time
Leq


P-ESG2
0600 - 0700 February 28, 2013
Engine Run-up
Period
Sound Level, dB
90
85
80
75
70
65
60
55
50
45
40
6:00:00
6:05:00
6:10:00
6:15:00
6:20:00
6:25:00
6:30:00
6:35:00
6:40:00
6:45:00
6:50:00
6:55:00
7:00:00
Time
Leq


P-ESG2
0800 - 0900 February 28, 2013
Engine Run-up Period
Sound Level, dB
90
85
80
75
70
65
60
55
50
45
40
8:00:00
8:05:00
8:10:00
8:15:00
8:20:00
8:25:00
8:30:00
8:35:00
8:40:00
8:45:00
8:50:00
8:55:00
9:00:00
Time
Leq

# Appendix C.3

## West Aircraft Maintenance Area – Taxi Noise

## Ricondo & Associates, September 16, 2013.

MEMORANDUM **VIA EMAIL**

Date: September 16, 2013

To: Dorothy Meyers
CDM Smith

From: Stephen Culberson and Dharma Thapa

Subject: WEST AIRCRAFT MAINTENANCE AREA – TAXI NOISE

Ricondo & Associates, Inc. (R&A) analyzed the potential noise associated with taxi operations to the proposed West Aircraft Maintenance Area (WAMA or Project) site. Assumptions associated with aircraft movement to and from the proposed Project site were taken from the draft Project Description prepared for the Project. These assumptions are:

Morning (AM) – 13 total aircraft movements

- Seven aircraft arrive at the Project site from early arrival flights and remain all day awaiting their return to gates for same day PM departure flights; servicing/light maintenance checks may occur while aircraft are parked. These aircraft are assumed to include the four wide-body aircraft that currently use the aircraft parking area at the former TWA Hangar area, and three wide-body aircraft that might typically park at the remain overnight (RON)/remain all-day (RAD) positions adjacent to Taxiway R.
- Four aircraft that arrived at the Project site the prior PM leave to go to gates for AM departure flights. These include three narrow-body aircraft that might otherwise park overnight at one of the northern concourses in the CTA and one narrow-body aircraft that might otherwise park overnight at one of the southern concourses in the CTA.
- On average, one aircraft arrives each AM for maintenance that will last more than one day (i.e., would go to a maintenance hangar/bay and stay there for several days - assumes that between the total hangar positions and adjacent bays, one position/bay would, on average, be available each day).
- On average, one aircraft leaves each AM after having completed maintenance. This includes the departure of aircraft that have been at the Project site for several days of maintenance, or the departure of aircraft that arrived at the site the previous PM.

Afternoon/Evening (PM) – 13 total aircraft movements

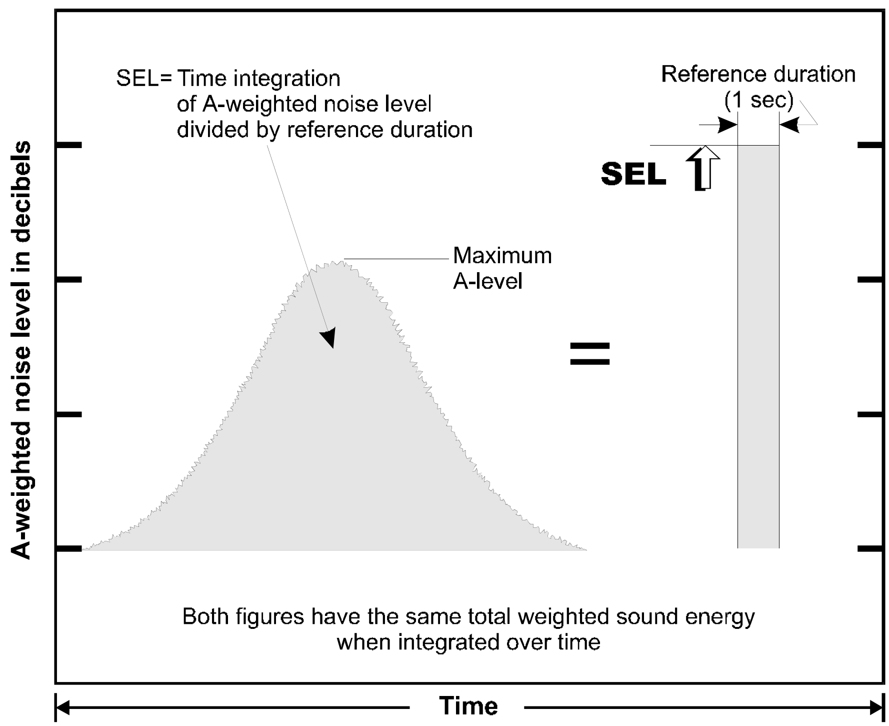
- Seven aircraft that arrived at the Project site in the AM return to gates for same day PM departure flights.
- Four aircraft arrive at the Project site and stay overnight (until next AM, awaiting AM departure flights); servicing/light maintenance checks may occur while the aircraft are parked.
- On average, one aircraft leaves each PM after having completed maintenance that occurred at the Project site over an extended period (i.e., more than one day).
- On average, one aircraft arrives each PM for maintenance that will last more than one day.

Based on the above, it is estimated that a maximum of 26 aircraft would travel to or from the Project site on a daily basis.

Airlines utilizing RON/RAD spaces at LAX today typically have their aircraft towed from an aircraft passenger gate located in the Central Terminal Area (CTA) or the West Remote Gates to a RON/RAD space, and then have them towed back to an aircraft passenger gate when the aircraft is ready for passenger boarding. According to LAWA Operations staff, nearly all large aircraft utilizing RON/RAD spaces at LAX (Airplane Design Group V and VI aircraft) are towed to and from RON/RAD spaces; however, some smaller aircraft (Airplane Design Group III and IV aircraft) are taxied to RON/RAD spaces. Thus, aircraft traveling to and from the Project site would mostly be towed with high-speed tugs, but some aircraft may be under power (taxi). Once leaving the Project site, aircraft would be towed back or taxi to a passenger gate or cargo ramp area to resume normal operation. It is assumed that approximately 80 percent of the aircraft (or 20 per day) that would utilize the WAMA would be towed to and from the Project site, while approximately 20 percent (or 6 per day) would taxi to and from the site on a daily basis.

R&A prepared sound exposure level (SEL) noise footprints for a typical ADG III (Boeing 737-300) and ADG IV (Boeing 767-300) aircraft. SEL is a time integrated measure, expressed in decibels, of the sound energy of a single noise event to a reference duration of one second. The sound level is integrated over the period that the level exceeds a threshold. Therefore, SEL accounts for both the maximum sound level and the duration of the sound. The standardization of discrete noise events into an one-second duration allows the calculation of the cumulative noise exposure of a series of noise events that occur over a period of time. Because of this compression of sound energy, the SEL of an aircraft noise event is typically 7 to 12 dBA greater than the maximum noise level ($L_{max}$) of the event. SEL values for aircraft noise events depend on the location of the aircraft relative to the noise receptor, the type of operation (landing, takeoff, or overflight), and the type of aircraft. The SEL concept is depicted on **Exhibit 1**.

**Exhibit 1 Sound Exposure Level Concept**




Source: Brown-Buntin Associates, Inc.,
Prepared by: Ricondo & Associates, Inc.

SEL contours were developed for the Boeing 737-300 and Boeing 767-300 aircraft using the following methodology:

- Taxi paths representing aircraft traveling to and from the CTA and the Delta Airlines/United Airlines maintenance facilities to and from the WAMA site were defined. These taxi paths were chosen because they are representative of the taxiing operations that are believed to occur with implementation of the proposed Project and they also represent conservative assumptions (longer taxi paths and noise associated with those operations). Three sets of taxi paths were created as follows:

- Terminal 2, representing the approximate mid-point of northern concourses at the CTA, utilizing Taxiway AA and Taxilane C traveling to and from the WAMA site for RON/RAD parking;
- Terminal 2, again representing the approximate mid-point of northern concourses at the CTA, utilizing Taxiway R and Taxiway/Taxilane C traveling to and from the WAMA site for RON/RAD parking; and
- Delta Airlines/United Airlines maintenance facilities utilizing Taxiway/Taxilane C traveling to and from the WAMA site for maintenance activities – this route would also encompass the travel path of passenger aircraft at Terminal 6, as the approximate mid-point of southern concourses at the CTA, traveling to and from WAMA for RON/RAD parking.

- A taxi profile was created in the Federal Aviation Administration (FAA) Integrated Noise Model (INM), Version 7.0d by approximating an overflight track and a fixed-point overflight profile to represent a taxi operation. The altitude was assumed to be the average engine-installation height; a constant taxi speed of 15 knots was assumed.
- Thrust setting assumed to be 10 percent of the maximum thrust value in the noise power distance (NPD) curves associated with the aircraft.

The following exhibits were created:

- **Exhibit 2** shows the SEL noise exposure contour for a single Boeing 737-300 taxi operation from Terminal 2 to the WAMA site utilizing Taxiway E, Taxiway AA and Taxilane C;
- **Exhibit 3** shows the SEL noise exposure contour for a single Boeing 767-300 taxi operation from Terminal 2 to the WAMA site utilizing Taxiway E, Taxiway AA and Taxilane C;
- **Exhibit 4** shows the SEL noise exposure contour for a single Boeing 737-300 taxi operation from Terminal 2 to the WAMA site utilizing Taxiway E, Taxiway R, and Taxiway/Taxilane C;
- **Exhibit 5** shows the SEL noise exposure contour for a single Boeing 767-300 taxi operation from Terminal 2 to the WAMA site utilizing Taxiway E, Taxiway R and Taxiway/Taxilane C;
- **Exhibit 6** shows the SEL noise exposure contour for a single Boeing 737-300 taxi operation from the Delta Airlines and United Airlines maintenance facilities to the WAMA site utilizing Taxiway/Taxilane C;

- **Exhibit 7** shows the SEL noise exposure contour for a single Boeing 767-300 taxi operation from the Delta Airlines and United Airlines maintenance facilities to the WAMA site utilizing Taxiway/Taxilane C.

A noise level of 80 dBA is equivalent to the noise of a busy street. Thus at the airport boundary, the noise associated with the taxi operation may be perceptible if the ambient noise levels are lower than the noise associated with the taxi operation. However, noise levels associated with aircraft departures and arrivals at LAX will overshadow the minimal noise associated with these few aircraft taxi events. The following analysis was conducted to determine whether the noise associated with the taxiing operations resulting from the proposed Project would result in a significant noise impact for purposes of California Environmental Quality Act (CEQA) analysis.

The Los Angeles CEQA Thresholds Guide defines the significance threshold relative to aircraft taxiing noise as follows:

> A significant impact on ambient noise levels would normally occur if noise levels at a noise sensitive use attributable to airport operations exceed 65 dB CNEL and the project increases ambient noise levels by 1.5 dB CNEL or greater

To relate the SEL values associated with the taxiing operations identified above, CNEL values were calculated based on the number and time of day operations were estimated to occur[1] and added to the existing ambient CNELs in residential areas to the north and south of the airport, to determine whether the project-related aircraft taxiing noise would result in a 1.5 dB CNEL or greater increase at a noise sensitive use. Information regarding existing CNEL values was obtained from LAWA's California State Airport Noise Standards Quarterly Report, Fourth Quarter 2012 (Available: http://lawa.org/uploadedFiles/LAX/pdf/4Q12 QuarterlyReport map.pdf, accessed September 16, 2013).

The total average daytime noise level associated with Project operations, defined as occurring between 7:00 am and 7:00 pm, and the total average nighttime noise level associated with project operations,

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1 Of the six total daily aircraft taxiing operations associated with the proposed Project, half are assumed to occur during daytime hours (i.e., between 7am and 7pm) and half are assumed to occur during nighttime hours (i.e., between 7pm and 7am). Relative to calculating CNEL values associated with such operations, it is unknown whether or how many nighttime operations would occur between 7 pm and 10 pm, which would be assigned a noise penalty of approximately 4.77 dB, or between 10 pm and 7 am, which would be assigned a noise penalty of 10 dB. To provide a conservative (worst-case) analysis, it is assumed that all nighttime taxiing operations would occur between 10 pm and 7 am, therefore incurring the 10 dB noise penalty. To the extent that some or all nighttime taxiing operations would occur between 7 pm and 10pm, the resultant noise impact, in terms of CNEL, would be less than indicated in this analysis.

defined as occurring between 7:00 pm and 7:00 am, were calculated. Those noise levels were compared, for informational purposes only, to the existing daytime ambient noise level and existing nighttime ambient noise levels that occur in residential areas to the north and south of the airport, being the community of Westchester and the City of El Segundo, respectively. Information regarding existing daytime and nighttime ambient noise levels in those areas was obtained from Section 4.10.3.3 of the LAX Specific Plan Amendment Study (SPAS) Draft EIR (July 2012).

**Existing Conditions**

As indicated on page 4-951 of the SPAS Draft EIR, existing ambient noise levels in the southern portion of Westchester, nearest to LAX, are estimated to be approximately 63 to 64 dBA during the daytime and 59 to 60 dBA during the nighttime. As also indicated on that page, existing ambient noise levels in El Segundo adjacent to the airport are estimated to be approximately 65 dBA or greater during the daytime and 60 dBA or greater during the nighttime.

Existing ambient noise levels in terms of airport-related CNEL within the southern portion of Westchester are estimated to be between approximately 65 dBA and 70 dBA. Existing ambient noise levels in terms of airport-related CNEL along the northern edge of El Segundo range between approximately 68 dBA to 75 dBA, with the higher noise levels occurring as one moves from east to west.

**<u>Average Hourly Ambient Daytime and Nighttime Noise Levels</u>**

The average hourly noise levels associated with Project-related taxiing operations in the daytime and taxiing operations at nighttime were estimated assuming one 737-300 aircraft taxiing between the WAMA site and the north CTA concourses in the daytime and one 737-300 aircraft taxiing on that route at night, and two 737-300 aircraft taxiing between the WAMA site and the south concourses or the Delta Airlines/United Airlines aircraft maintenance area in the daytime and two 737-300 aircraft taxiing on that route at night.[2] The resultant Project-related taxiing noise levels at the southern edge of Westchester directly north of the nearest taxi route were estimated to be approximately 39.0 dBA in the daytime and 38.4 dBA at night. As indicated above in Existing Conditions, existing ambient noise levels in the southern

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[2] While the taxiing noise analysis considered both the Boeing 737-300 aircraft and the Boeing 767-300 aircraft, the ambient noise level and CNEL estimates presented herein are based on only the Boeing 737-300, in order to provide a conservative (worst-case) analysis. As indicated in the SEL noise contour figures presented above, the taxiing noise levels associated with the 737-300 aircraft are comparatively greater than those of the 767-300 aircraft.

portion of Westchester are approximately 63-64 dBA in the day and 59-60 dBA at night. The project-related aircraft taxiing noise would be substantially less than existing ambient noise levels, and when added to existing ambient noise levels, would increase the existing ambient noise levels by approximately 0.01 dB in the daytime and 0.03 dB at night.[3]

At the northern edge of El Segundo directly south of the nearest taxi route the project-related taxiing noise levels are estimated to be approximately 42.8 dBA in the daytime and 42.2 dBA at night. Existing ambient noise levels in the northern portion of El Segundo near LAX are approximately 65 dBA or greater in the day and 60 dBA or greater at night. The project-related aircraft taxiing noise would be substantially less than existing ambient noise levels, and when added to existing ambient noise levels, would increase the existing ambient noise levels by approximately 0.03 dB in the daytime and 0.07 dB at night.

CNEL

Based on the number of taxiing operations and the day/night split described above in the discussion of ambient noise levels, the CNEL value associated with Project-related taxiing was estimated. The resultant CNEL values would be 44.6 dBA at the southern edge of Westchester north of the nearest taxi route, and 48.3 dBA at the northern edge of El Segundo south of the nearest taxi route. When added to the existing CNELs in Westchester and El Segundo, these project-related CNEL values would increase the existing CNEL in Westchester by approximately 0.04 dB and increase the existing CNEL in El Segundo by approximately 0.07 dB. In both cases, the increase would be substantially less than the threshold of significance of a 1.5 dB increase; hence, the increased Project-related taxiing noise impact would be less than significant.

ENCLOSURES

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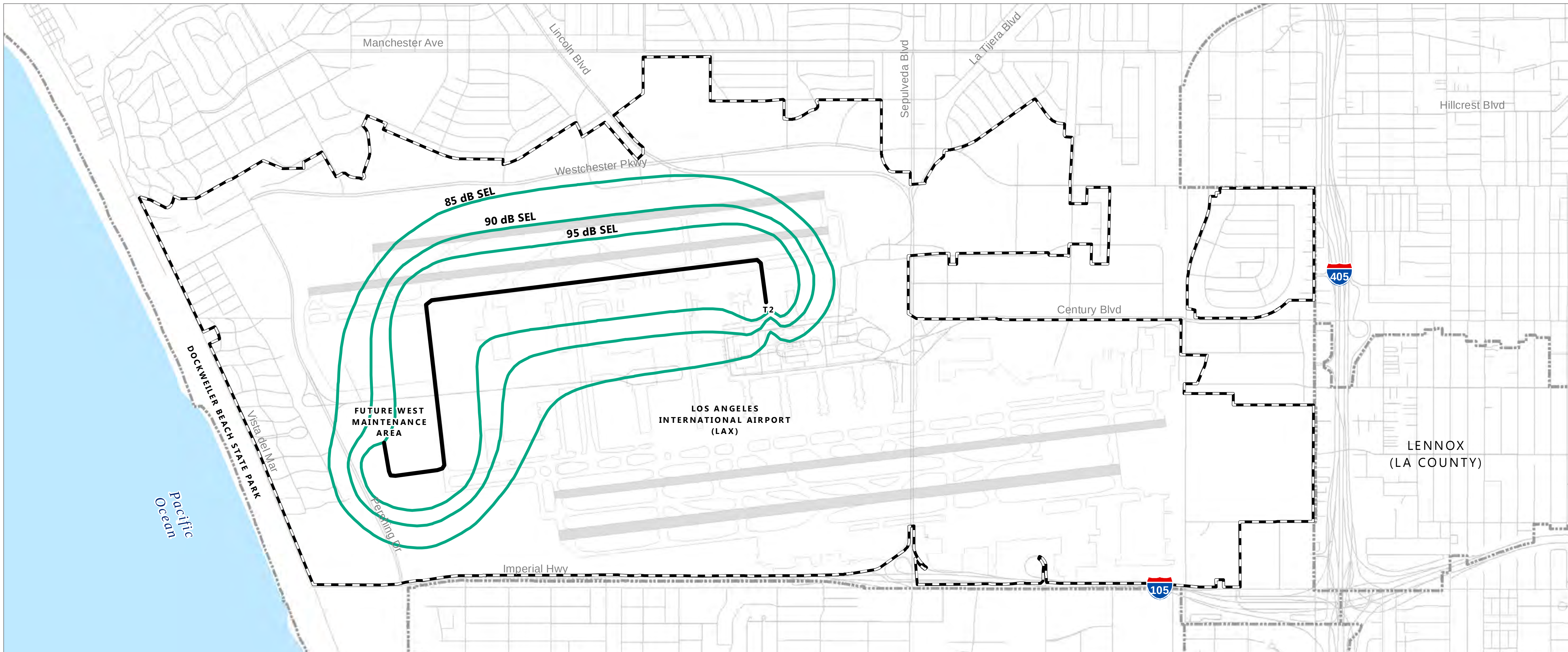
[3] Sound levels are expressed in decibels and are based on a logarithmic scale. Sound levels cannot be added directly (i.e., 60 dB + 60 dB does not equal 120 dB; instead it equates to 63 dB). The addition of noise decibels can be computed by the following equation: (10 Log10 (10^(P1/10) + 10^(P2/10))).

[Preliminary Draft for Discussion Purposes Only]

**LEGEND**

Airport Property Boundary
Taxiway SEL Noise Contour
Municipal Boundary
Existing Runway

NOTE: Based on 1 taxi operation at 15 knots constant speed from T2 to West Maintenance Area via Taxiway AA




SOURCES: Los Angeles County, 2010, 2011 (municipal boundaries, streets); Ricondo & Associates, Inc., 2013 (noise contour).
PREPARED BY: Ricondo & Associates, Inc., August 2013.

**EXHIBIT 2**

NORTH 0 2,000 ft.

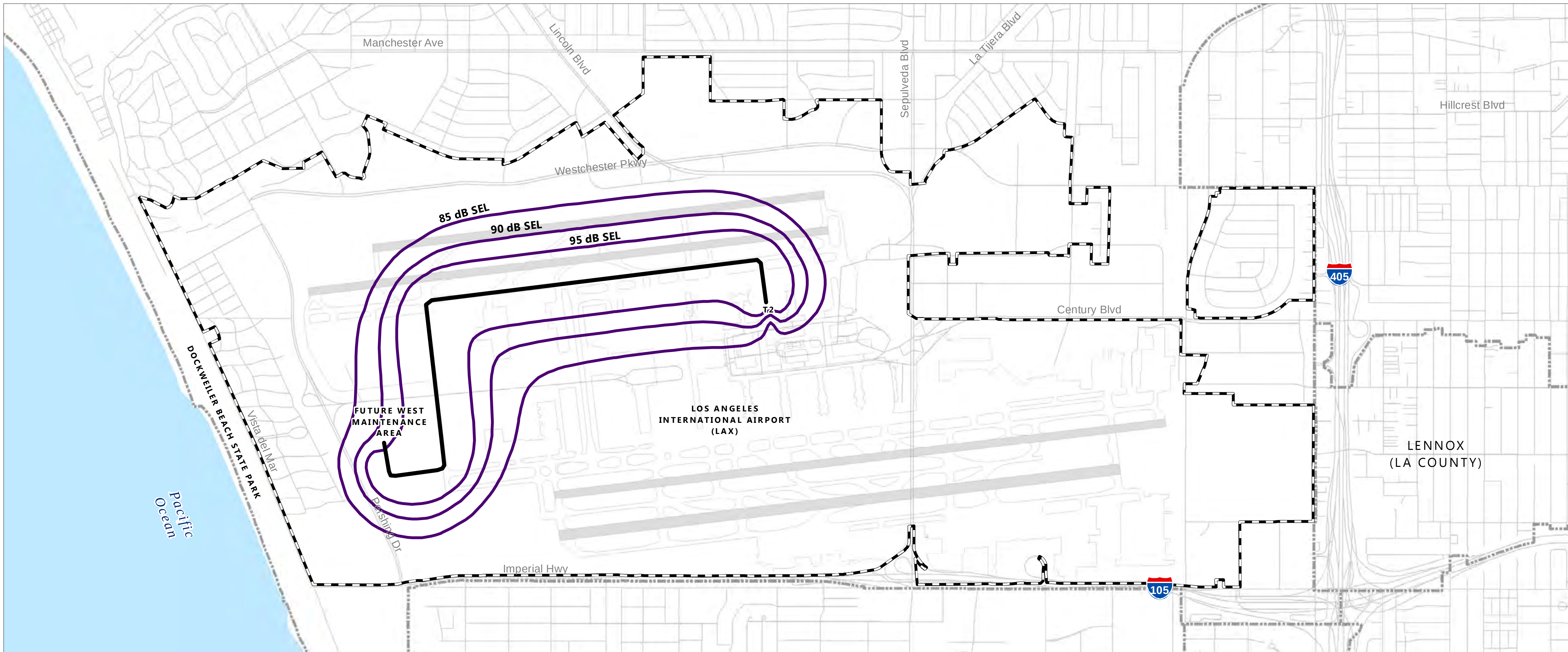
Boeing 737-300 Taxi
Single Event Footprint

[Preliminary Draft for Discussion Purposes Only]

**LEGEND**

- Airport Property Boundary
- Taxiway SEL Noise Contour
- Municipal Boundary
- Existing Runway

NOTE: Based on 1 taxi operation at 15 knots constant speed from T2 to West Maintenance Area via Taxiway AA




SOURCES: Los Angeles County, 2010, 2011 (municipal boundaries, streets); Ricondo & Associates, Inc., 2013 (noise contour).
PREPARED BY: Ricondo & Associates, Inc., August 2013.

NORTH 0 2,000 ft.

**EXHIBIT 3**

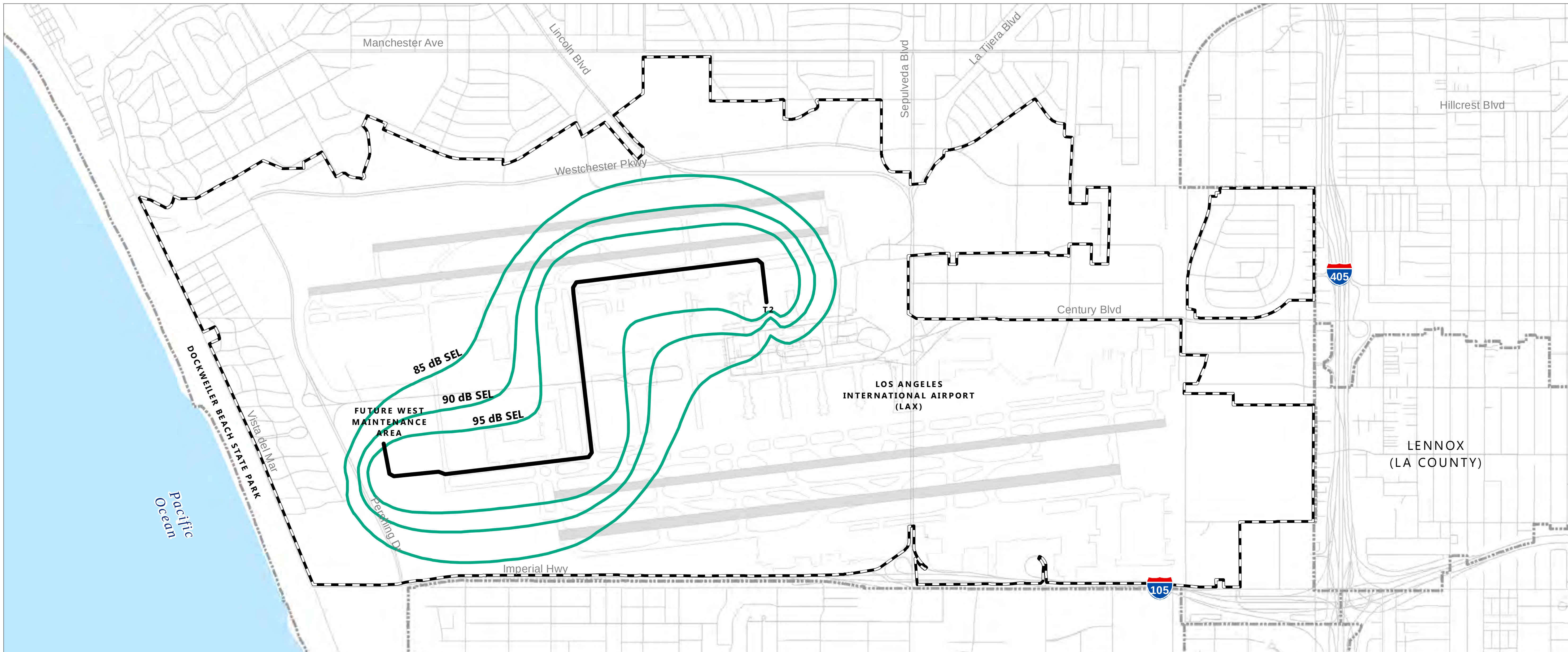
Boeing 767-300 Taxi
Single Event Footprint

[Preliminary Draft for Discussion Purposes Only]

**LEGEND**

Airport Property Boundary
Municipal Boundary
Taxiway SEL Noise Contour
Existing Runway

NOTE: Based on 1 taxi operation at 15 knots constant speed from T2 to West Maintenance Area via Taxiway R




SOURCES: Los Angeles County, 2010, 2011 (municipal boundaries, streets); Ricondo & Associates, Inc., 2013 (noise contour).
PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 4

NORTH
0 2,000 ft.

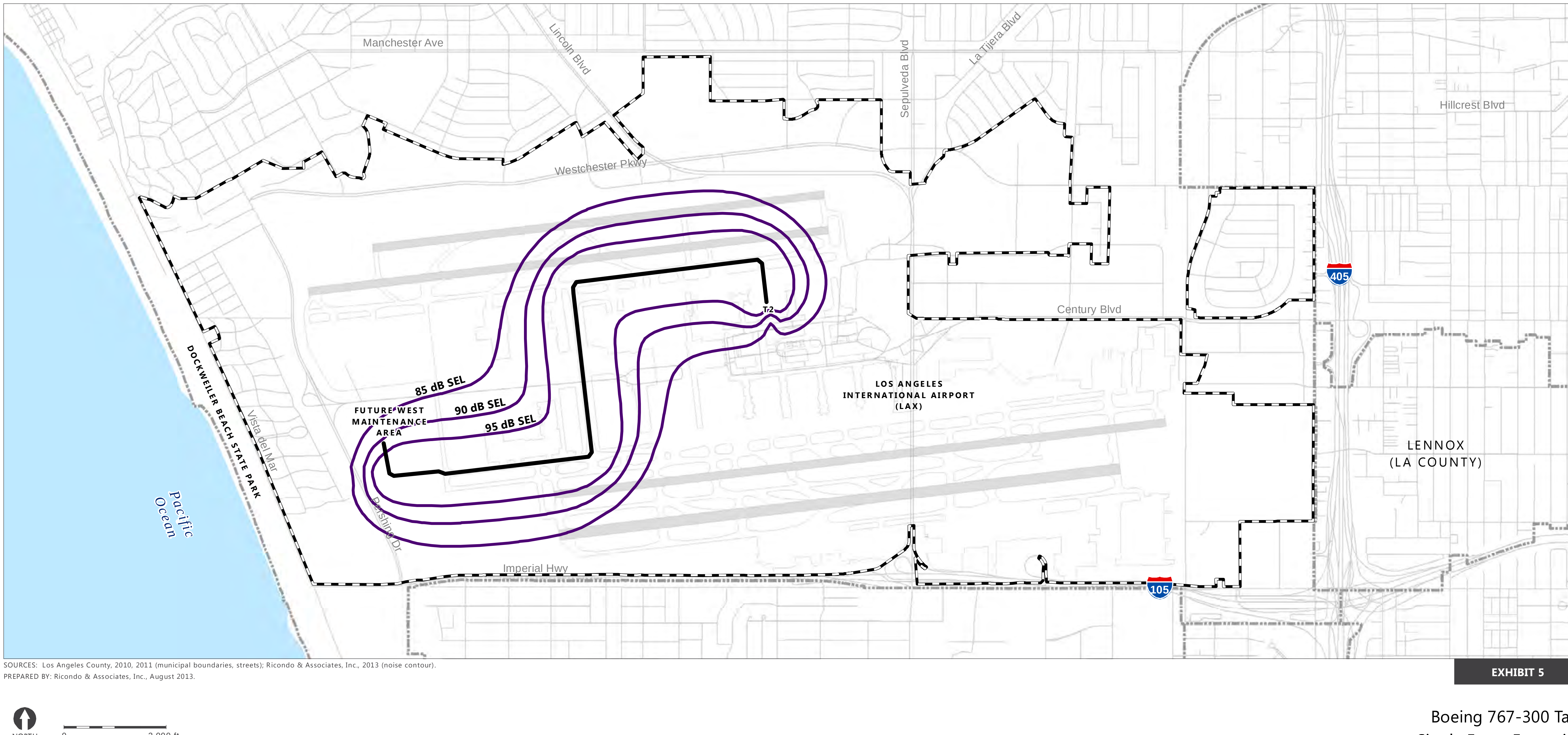
Boeing 737-300 Taxi
Single Event Footprint

[Preliminary Draft for Discussion Purposes Only]

**LEGEND**

Airport Property Boundary
Taxiway SEL Noise Contour
Municipal Boundary
Existing Runway

NOTE: Based on 1 taxi operation at 15 knots constant speed from T2 to West Maintenance Area via Taxiway R




SOURCES: Los Angeles County, 2010, 2011 (municipal boundaries, streets); Ricondo & Associates, Inc., 2013 (noise contour).
PREPARED BY: Ricondo & Associates, Inc., August 2013.

**EXHIBIT 5**

Boeing 767-300 Taxi
Single Event Footprint

[Preliminary Draft for Discussion Purposes Only]

**LEGEND**

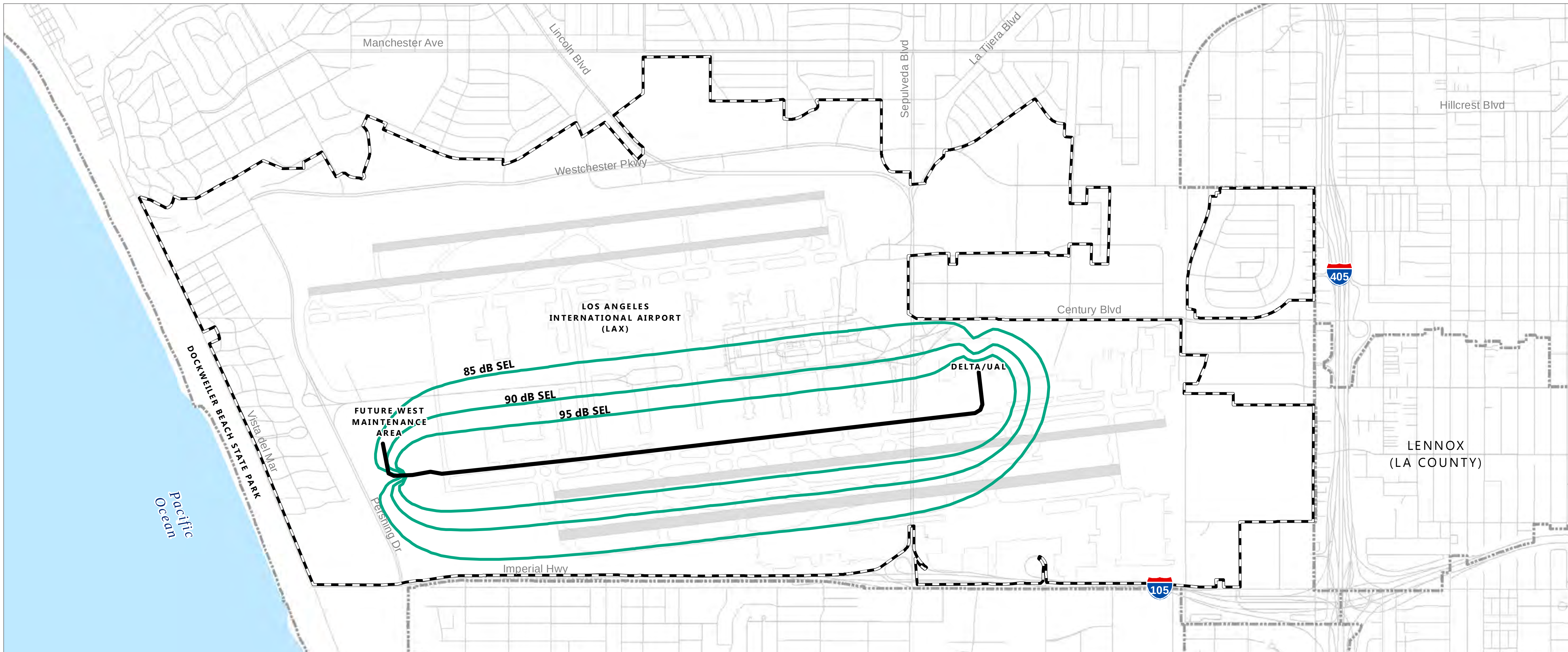
Airport Property Boundary

Municipal Boundary

Taxiway SEL Noise Contour

Existing Runway

NOTE: Based on 1 taxi operation at 15 knots constant speed from DELTA/UAL to West Maintenance Area via Taxiway C




SOURCES: Los Angeles County, 2010, 2011 (municipal boundaries, streets); Ricondo & Associates, Inc., 2013 (noise contour).
PREPARED BY: Ricondo & Associates, Inc., August 2013.

**EXHIBIT 6**

NORTH

0 2,000 ft.

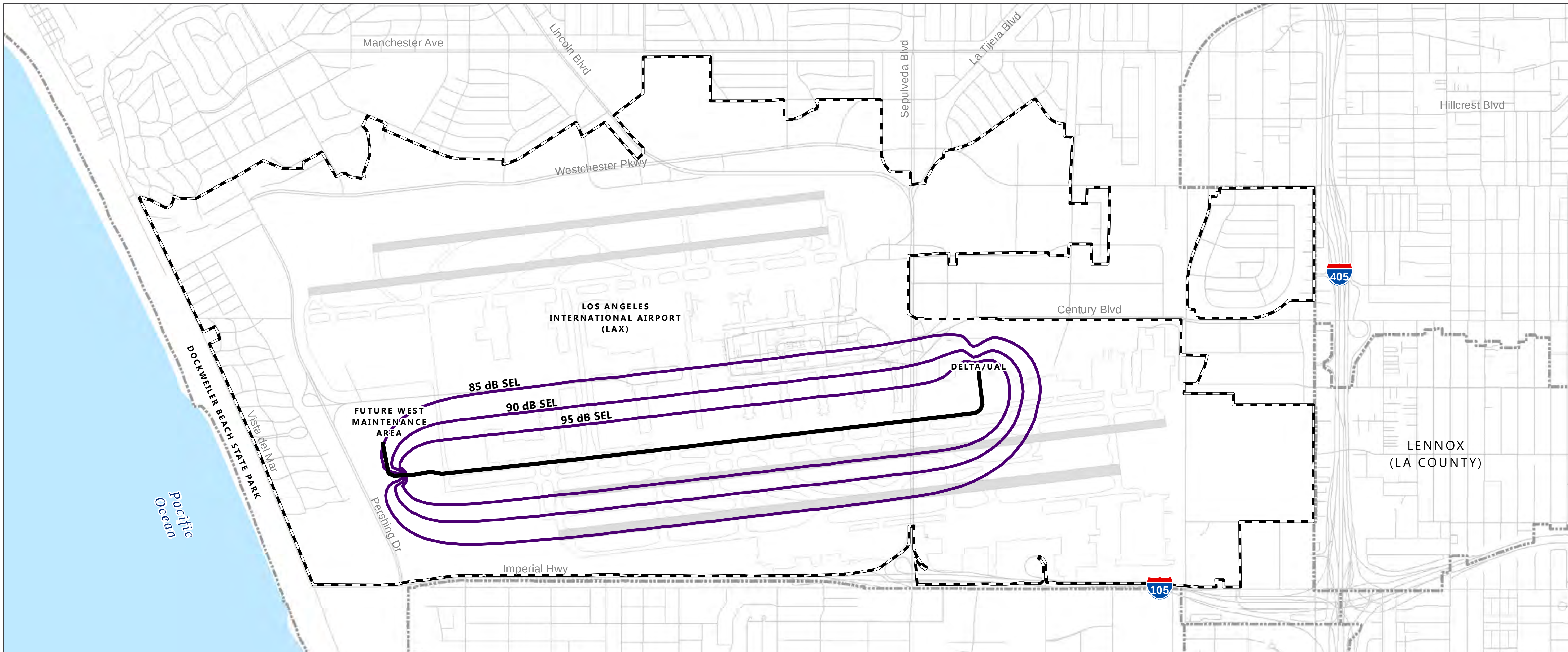
Boeing 737-300 Taxi
Single Event Footprint

[Preliminary Draft for Discussion Purposes Only]

**LEGEND**

Airport Property Boundary
Taxiway SEL Noise Contour
Municipal Boundary
Existing Runway

NOTE: Based on 1 taxi operation at 15 knots constant speed from DELTA/UAL to West Maintenance Area via Taxiway C




SOURCES: Los Angeles County, 2010, 2011 (municipal boundaries, streets); Ricondo & Associates, Inc., 2013 (noise contour).
PREPARED BY: Ricondo & Associates, Inc., August 2013.

NORTH 0 2,000 ft.

**EXHIBIT 7**

Boeing 767-300 Taxi
Single Event Footprint