

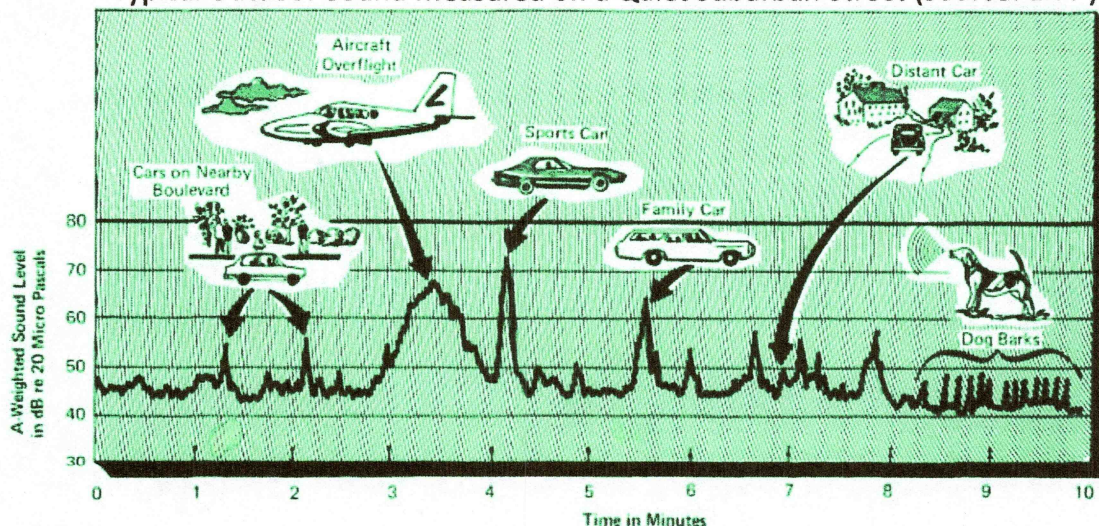


The Basics of Noise Metrics

Environmental sound is measured in dBA (Decibels, A-weighted), an international metric that is commonly used to assess environmental noise exposure

- Decibels (dB) measure the sound energy.
- The A-weighted scale adjusts the frequency content of the sound to approximate how noise is perceived on the human ear.
- As a rule of thumb, a **10 dB increase** is perceived as about **twice as loud**.

Typical Outdoor Sound Measured on a Quiet Suburban Street (Source: EPA¹)

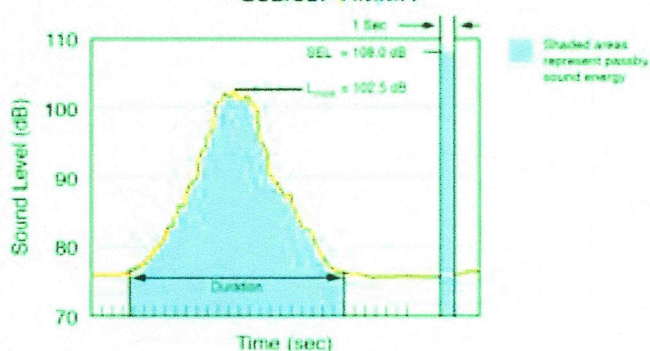


Single event noise metrics

- **Lmax**: Maximum noise level of one noise event.
- **SEL** (Sound Exposure Level): total A-weighted energy of a noise event over its entire duration but compressed to one second. SEL will typically be higher than Lmax.

Graphical Depiction of Sound Exposure Level

Source: HMMH



Average noise metrics

- **Leq** (Equivalent Noise Level): average sound level over a given time period.
- **LAeq** (also written as dBA Leq): same as Leq but A-weighted to approximate how the human ear would perceive the noise.
- **DNL** (Day-Night Average Sound Level) – also called **Ldn**
 - 24-hour time weighted energy average noise level
 - 10 dB penalty between 10pm to 7am to account for the higher sensitivity to noise at night due to lower background noise
- **CNEL** (Community Noise Equivalent Level): same as DNL but adds a 5 dB penalty between 7pm and 10pm. The FAA accepts the use of CNEL by California to assess noise effects.¹

¹ https://www.faa.gov/airports/environmental/environmental_desk_ref/media/desk-ref-chap17.pdf

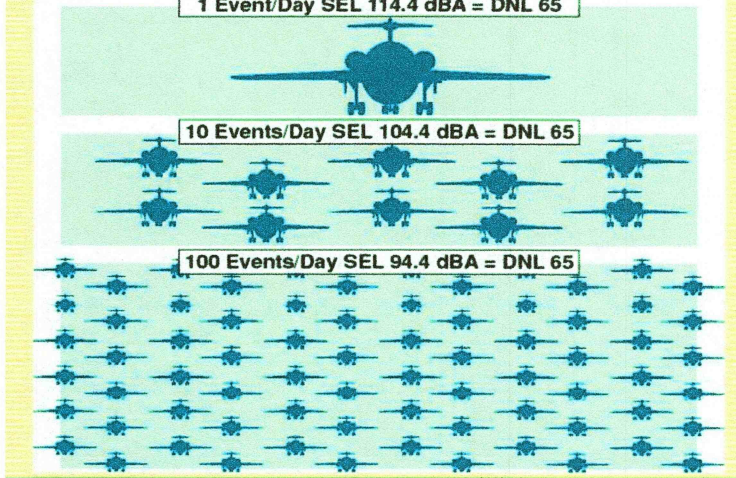
Different DNL 65 Environments

Identical DNL Levels

1 Event/Day SEL 114.4 dBA = DNL 65

10 Events/Day SEL 104.4 dBA = DNL 65

100 Events/Day SEL 94.4 dBA = DNL 65



Source: SFO Round Table²

SEL does not capture the repetitiveness of the sound exposure caused by many aircrafts flying over the same area. As shown on the left diagram, SEL decreases even though the number of aircrafts goes up.

WHO recommends that noise exposure does not exceed 50 to 55 dB outdoors and 30 to 35 dB indoors³. Both values are below the FAA noise threshold of 65 dB.

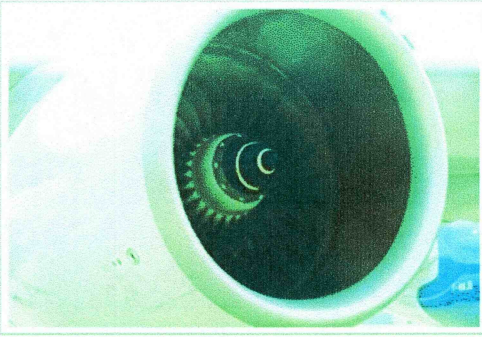
World Health Organization - Guideline values for community noise in specific environments (LAeq for "daytime" is 16 hours and LAeq "night-time" is 8 h)

Specific environment	Critical health effect(s)	LAeq [dB]	Time base [hours]	LAm _{ax, fast} [dB]
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors Inside bedrooms	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School class rooms and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	during class	-
Pre-school bedrooms, indoors	Sleep disturbance	30	sleeping-time	45
School, outdoor playground	Annoyance (external source)	55	during play	-

² SFO Community Round Table, Noise 101, Jul 2013

³ WHO Guidelines for Community Noise, April 1999 <http://www.who.int/docstore/peh/noise/Commnoise4.htm>

Aircraft Noise



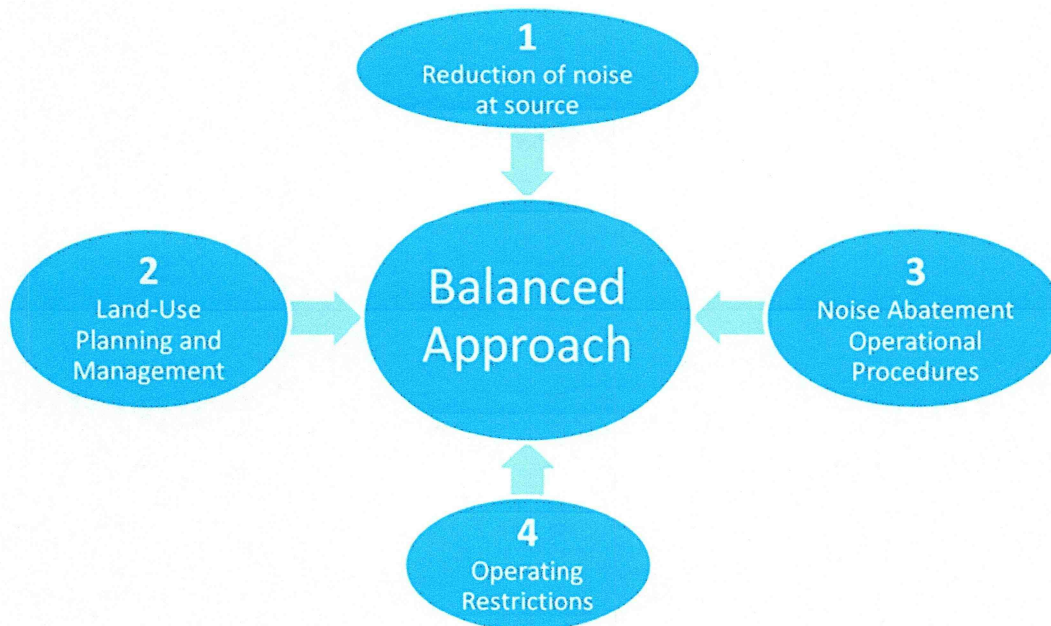
Balanced Approach to Aircraft Noise Management

Aircraft noise is the most significant cause of adverse community reaction related to the operation and expansion of airports. This is expected to remain the case in most regions of the world for the foreseeable future. Limiting or reducing the number of people affected by significant aircraft noise is therefore one of ICAO's main priorities and one of the Organization's key environmental goals.

The main overarching ICAO policy on aircraft noise, which contains details on all the elements that can be employed to achieve noise reductions, is the Balanced Approach to Aircraft Noise Management. This can be found in the ICAO Doc 9829, Guidance on the Balanced Approach to

Aircraft Noise Management.

The Balanced Approach consists of identifying the noise problem at a specific airport and analyzing various measures available to reduce noise through the exploration of various measures which can be classified into four principal elements, described in Figure 1. The goal is to address noise problems on an individual airport basis and to identify the noise-related measures that achieve maximum environmental benefit most cost-effectively using objective and measurable criteria.



The four principal elements of the Balanced Approach to Aircraft Noise Management

1. Reduction of Noise at Source
2. Land-use Planning and Management
3. Noise Abatement Operational Procedures
4. Operating Restrictions

ICAO Current initiatives on Aircraft Noise

Over the past three years (2013-2016), work has been conducted by ICAO to ensure the currency of the technical basis underpinning the ICAO Standards, guidance and policies associated with reducing aircraft noise. This work has included, among several topics, investigations into emerging subsonic aeroplane noise reduction technologies, studies into the status of aeroplane and helicopter noise reduction technology and the continuing development of SARP's for future supersonic aeroplanes. ICAO has also worked on the environmental aspects of airport land-use planning, and airport community engagement good practices.

APPENDIX D

Washington State Statutes, King County, and City of Seattle Noise Ordinances

Washington State

1. The State of Washington's exemptions of noise from aircraft and aircraft operations, Exemptions state that:
 - Sounds created by aircraft engine testing and maintenance not related to flight operations between the hours of 7:00 a.m. and 10:00 p.m.: Provided, that aircraft testing and maintenance shall be conducted at remote sites whenever possible. (Chapter 173-60-040 WAC)
 - Sounds originating from aircraft in flight and sounds that originate at airports which are directly related to flight operations. Chapter 173-60-050 (3)(b) WAC):

King County

2. King County Ordinance 14114, Section 11, adopted September 12, 2001: "Sounds exempt at all times.
 - Sounds originating from aircraft in flight and sounds that originate at airports and are directly related to flight operations;"

City of Seattle

3. City of Seattle Noise Ordinance, Chapter 25.08.530 "Sounds exempt at all times.
 - The following sounds are exempt from the provisions of this chapter at all times:
 - Sounds originating from aircraft in flight, and sounds which originate at airports and are directly related to flight operations;"

APPENDIX G

Quotations from FAA Policies regarding Environmental Assessments and Noise Exposure Maps

I. Document #1 - FAR Title 14, Part 150

As a requirement of the Part 150 program, two Noise Exposure Maps must be produced. The first map indicates the existing conditions and the second map is based upon a 5-year projection of the airports operations.

There is no requirement by the FAA to periodically review or evaluate noise exposure conditions to substantiate changes to an airports Part 150 program.

FAA policy for many years has been to interpret an increase in noise of 1.5 DNL within areas exposed to noise at or above 65 DNL, as **significant** impacts. (FAA Order 1050.1, Change 1, Attachment 2, page 1; and FAR Part 150, Section 150.21(2)(d)(1), which reads:

- (1) If, after submission of a noise exposure map under paragraph (a) of this section, any change in the operation of the airport would create any '**substantial, new non-compatible use**' in any area depicted on the map beyond that which is forecast for a period of at least five years after the date of submission, the airport operator shall in accordance with this section, promptly prepare and submit a revised noise exposure map. A change in the operation of an airport creates a substantial new non-compatible use if that change results in an increase in the yearly day-night average sound level of 1.5 dB or greater in either a land area which was formerly compatible but is thereby made non-compatible under Appendix A (Table 1), or in a land area which was previously determined to be non-compatible under that Table and whose non-compatibility is now significantly increased.

Note: There are three additional conditions that would "trigger" new NEMs, such as (1) a reduction of noise of 1.5 dB DNL, (2) if any assumptions leading to a Part 150 recommendation that is denied requires revisiting, (3) or reassessment of high ambient noise levels that were previously excluded in the Part 150. Any of these four conditions requires consultation and public comment.

II. Document #2 - FAA Order 1050.1D – Policies and Procedures for Considering Environmental Impacts (and procedures for preparing EISs, FONSI, or EAs) (findings of no significant impact—FONSI)

Chapter 3, Environmental Actions, Section 32 – EXTRAORDINARY CIRCUMSTANCES

(e) An action that is likely to:

- (1) Cause substantial division or disruption of an established community, or disrupt orderly, planned development, or is likely to be not reasonably consistent with plans or goals that have been adopted by the community in which the project is located; or
- (2) **Cause a significant increase in surface traffic congestion.**

(f) An action that is likely to:

- (1) **Have a significant impact on noise levels of noise sensitive areas.**
- (2) Have a significant impact on air quality or violate the local, state, or Federal standards for air quality.
- (3) Have a significant impact on water quality or contaminate a public water supply system.
- (4) Be inconsistent with any Federal, State, or local law or administrative determination relating to the environment.”

Chapter 3, Environmental Actions, Section 37 – **ACTIONS REQUIRING ENVIRONMENTAL IMPACT STATEMENTS**

a. After an EA has been prepared, an EIS shall be prepared if an FAA action:

- (1) Has an effect that is not minimal on properties protected under Section 4(f) of the DOT Act, or Section 106 of the Historic Preservation Act.
- (4) Causes substantial division or disruption of an established community....(repeats (e)(1) above).
- (5) Causes a significant increase in surface traffic congestion.
- (6) Has a significant impact on noise levels of noise sensitive areas.

b. An EIS is required not only when the impact of the proposed project itself is significant, but also when the ***cumulative*** impact of the proposed project and other past, present and reasonably foreseeable future actions is significant. A series of actions considered on an individual bases may have a limited environmental impact, yet, when considered together, may have a significant, cumulative impact.”

III. Document #3 - FAA Order 1050.1E

Chapter 4. **Environmental Assessments and Findings of No Significant Impact** (findings of no significant impact—FONSI)

Section 4011. Issuance of an operating certificate, issuance of an air carrier operating certificate, or approval of operations specifications or amendments that may significantly

change the character of the operational environment of an airport, including, but not limited to:

401. ACTIONS NORMALLY REQUIRING AN ENVIRONMENTAL ASSESSMENT

401m. New instrument approach procedures, departure procedures, enroute procedures, and modifications to currently approved instrument procedures which routinely route aircraft over noise sensitive areas at less than 3,000 feet above ground level (AGL).

401n. New or revised air traffic control procedures which routinely route air traffic over noise sensitive areas at less than 3,000 feet AGL.

IV. Document #4 - Airport Environmental Handbook FAA Order 5050.4A

Chapter 3 – ENVIRONMENTAL ACTION CHOICES

Section 22 – ACTIONS NORMALLY REQUIRING AN ENVIRONMENTAL ASSESSMENT.

a. Federal financial participation in, or airport layout plan approval of, the following categories of actions shall be subject to the analysis of an environmental assessment and subsequent decision as to whether to prepare an environmental impact statement or a finding of no significant impact.

(3) Major runway extension.

(4) Runway strengthening which would result in ***a 1.5 Ldn or greater increase in noise over any noise sensitive area located within the 65 Ldn contour.***

Section 24 – EXTRAORDINARY CIRCUMSTANCES.

e. An Action that is likely to:

(1) Cause substantial division or disruption of an established community, or disrupt orderly, planned development, or is likely to not be reasonably consistent with plans or goals that have been adopted by the community in which the project is located; or

(2) Cause a significant increase in surface traffic congestion.

f. An action that is likely to:

(1) Have a significant impact on noise levels of noise sensitive areas;

- (2) Have a significant impact on air quality or violate the local, state, or Federal standards for air quality;
 - (3) Have a significant impact on water quality or contaminate a public water supply system; or
 - (4) Be inconsistent with any Federal, state, or local law or administrative determination relating to the environment.
- g. Other action that is likely to directly or indirectly affect human beings by creating a significant impact on the environment.

Chapter 5 – AIRPORTS PROGRAM ENVIRONMENTAL DEFINITIONS

a. Federal Action. The Federal action as far as the Airports Program is concerned may be any of the following:

- (1) Approval of an airport location.
- (2) ***Approval of an airport layout plan or revisions to an airport layout plan.***
- (3) Approval of funding for airport development (including separate funding of plans and specifications for development).
- (4) Requests for the conveyance of government land under Section 516 of the Airport and Airway Improvement Act of 1982 for development or improvement of a public airport.
- (5) Approval of release of airport land.

h. Major Runway Extension. This is a runway extension which results in impacts as specified in paragraph 22a(8) or which results in ***a 1.5 Ldn or greater increase in noise over any noise sensitive area located within the 65 Ldn contour.*** Instructions in paragraph 47e(1)(a) through (d) shall be used to determine the noise impact. Removal of a relocated threshold is considered a runway extension if it was indicated on an airport layout plan (ALP) as a permanently relocated threshold; removal of a displaced threshold is not considered a runway extension.

Note: All words bolded and italicized were additions made by the typist.