Foundations of Aviation Noise

Fundamentals, metrics, standards, regulations, modeling, monitoring, and principles of noise control

Justin Cook

Long Beach Airport

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NOISE 101

Course Overview and Learning Objectives

Course Agenda Roadmap

1. **Fundamentals**
   Sound vs. Noise, Decibel Mathematics, Weighting
2. **Metrics**
   Lmax, SEL, Leq, DNL, Applying Metrics in Practice
3. **Regulations**
   History, Framework, FAA Part 36, FAA Part 150, ANCA
4. **Modeling and Monitoring**
   AEDT Inputs and Outputs, NOMS, Analytics and Reporting
5. **Principles of Noise Control**
   Source, Path, Receiver

Target Audience

- Airport Staff
- Consultants and Engineers
- Community
- Policymakers
- Aviation Professionals

Sound vs. Noise

Sound

Physical Definition: Energy that is transmitted by longitudinal pressure waves in a material medium (such as air) and is the objective cause of hearing.

Objective: Measurable Pressure Fluctuations

Noise

Subjective Definition: Unwanted sound. Includes a psychological response that varies by individual, context, and time of day.

Subjective Reaction Factors

- Interference with Speech/Sleep
- Perceived Necessity of Source
- Time of Day

Annoyance Scale

Decibel Mathematics & Rules of Thumb

Logarithmic Math Examples

70 dB + 70 dB = 73 dB

Doubling the sound energy adds only 3 dB; the total is not 140 dB.

70 dB + 50 dB = 70 dB

The louder sound completely masks the quieter one (logarithmic dominance).

70 dB × 10 = 80 dB

Ten identical aircraft increase the total noise level by 10 dB.

70 dB × 100 = 90 dB

One hundred identical aircraft increase the total noise level by 20 dB.

Excel Equation Sample: =10*LOG((10^(70/10))+(10^(70/10))) = 73 dB

Acoustical Rules of Thumb

Doubling Distance — -6 dB

Every doubling of distance from a point source (like an aircraft) results in a 6 dB reduction in sound level (spherical spreading).

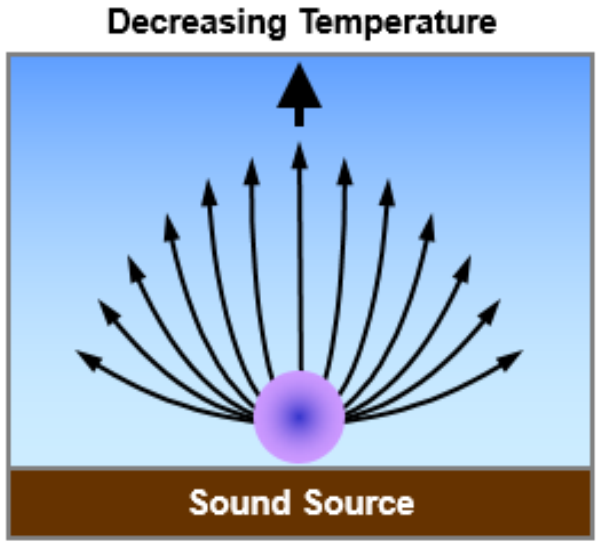
Doubling Operations — +3 dB

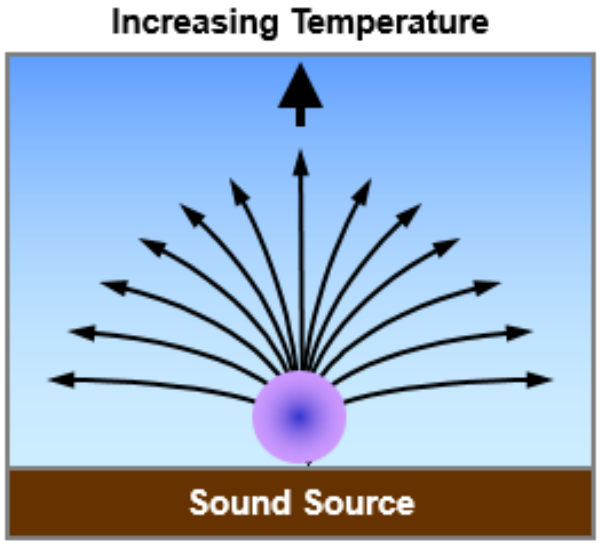
Doubling the number of flights (e.g., from 100 to 200 daily) adds 3 dB to the cumulative noise metric (DNL/CNEL).

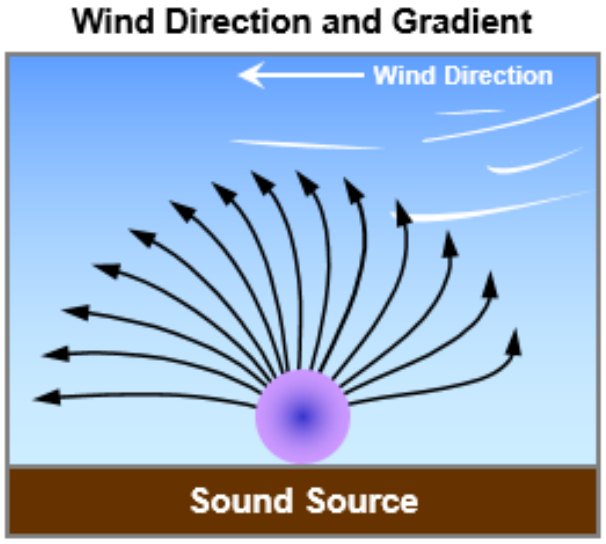
House Attenuation — -15 to -25 dB

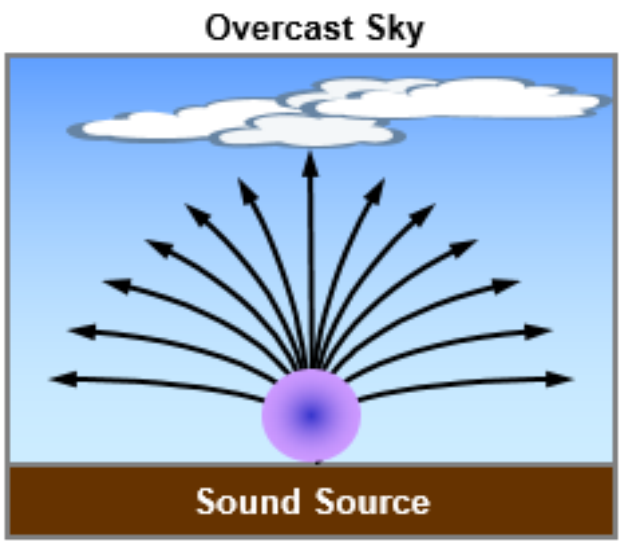
Typical housing reduces outdoor noise by ~15 dB with windows open and ~25 dB with windows closed.

Atmospheric Propagation Effects









Inversion / Downwind (Bad)

Temperature increases with height (inversion) or wind blows from source to receiver. Sound waves **refract downward**, trapping noise near the ground. Can increase noise levels by **>20 dB**.

Lapse / Upwind (Good)

Normal conditions where temperature decreases with height, or wind blows from receiver to source. Sound waves **refract upward**, away from the ground. Can decrease noise levels by **>20 dB**.

A-Weighting vs. C-Weighting

A-Weighting (dBA)

Standard for Community Noise

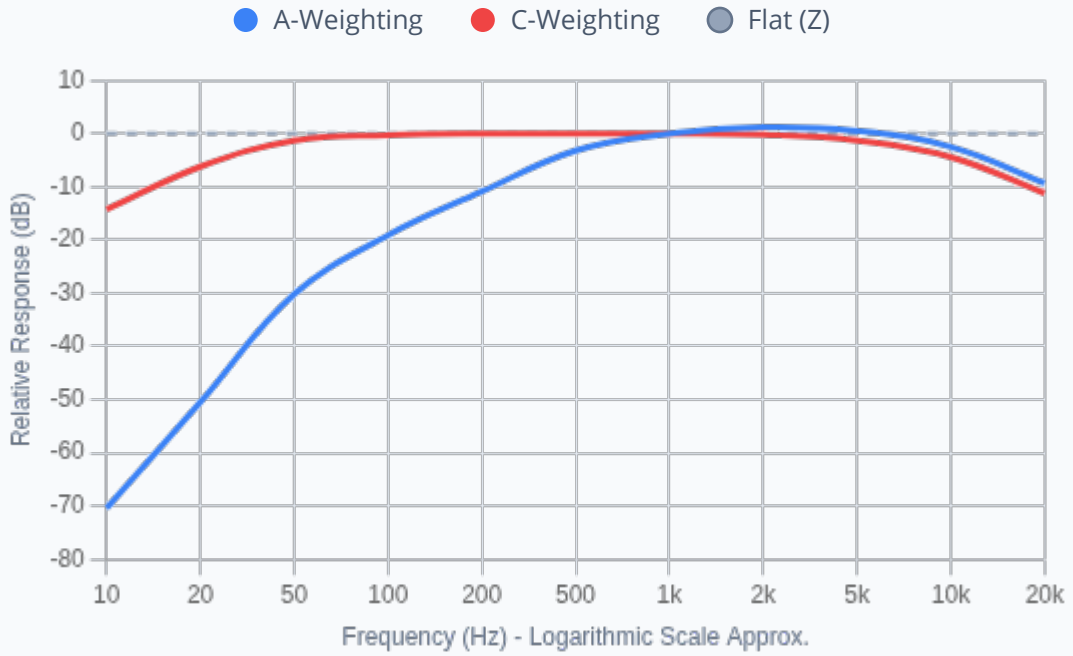
- ✓ Approximates human ear sensitivity at moderate levels
- ✓ Filters out low frequencies significantly (-20 dB at 100Hz)
- ℹ Used for almost FAA environmental analysis (DNL, CNEL)

C-Weighting (dBC)

Low Frequency Consideration

- ✓ Flatter response across frequency spectrum
- ✓ Retains more low-frequency energy (rumble, vibration)
- ℹ Used for special studies (e.g., ground base noise, structural vibration, helicopters, blast noise)

Frequency Response Curves



Key Insight: The large gap at low frequencies (left side) explains why dBA may underestimate "rumble" perception from heavy aircraft.

Noise Metrics Overview

Single Event Metrics

Describe individual aircraft flyovers

Lmax (Maximum Sound Level): Peak level

SEL (Sound Exposure Level): Total energy normalized to one second

SENEL (Single Event Noise Exposure Level): California specific SEL variation

Cumulative Metrics

Long-term average exposure (24-hour)

DNL (Day-Night Average Sound Level): FAA national standard with night penalty

CNEL (Community Noise Equivalent Level): California specific standard with evening & night penalties

Supplemental Metrics

Provide context beyond averages

Leq (Equivalent Continuous Sound Level): Average energy over defined period

TA (Time Above): Duration above threshold (e.g., TA65)

NA (Number Above): Count of events above threshold (e.g., N70)

Lmax: Maximum Sound Level

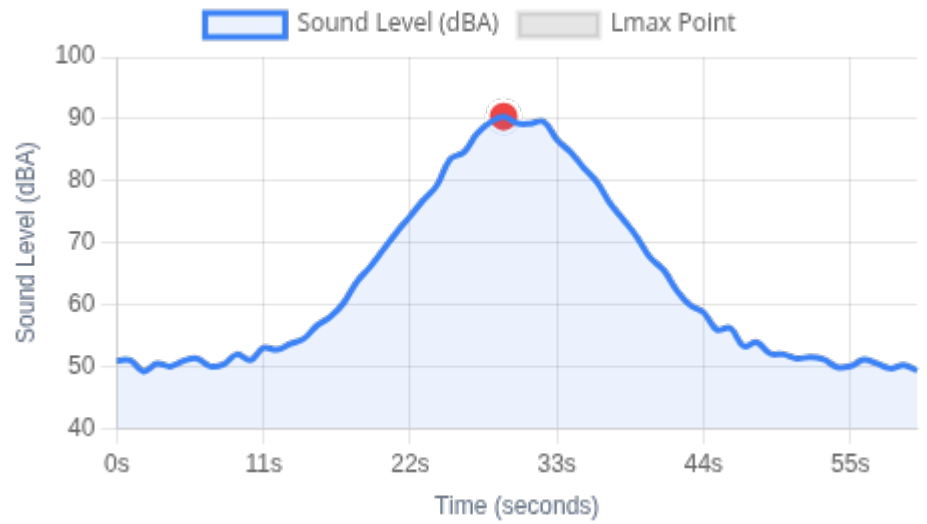
Concept & Definition

Lmax (Maximum Sound Level): The highest instantaneous A-weighted sound level measured during a single noise event.

Key Characteristics

- **Peak Value Only:** Captures the single loudest moment of an aircraft flyover.
- **Simple & Intuitive:** Easy for the public to understand ("How loud did it get?").
- **Speech Interference:** Highly correlated with interruption of conversation or TV listening.
- **Limitation:** Does not account for the duration of the event (how long the noise lasted).

Event Trace Visualization



Common Use Cases

- Community Outreach
- Complaint Investigation
- School Soundproofing
- Single Event Limits

SEL: Sound Exposure Level

Definition

SEL (Sound Exposure Level): Metric that compresses the total acoustic energy of a noise event into a single second.

SENEL (Single Event Noise Exposure Level): Effectively SEL, but often calculated with a specific threshold (e.g., only noise within 10dB of max).

Unit: **dBA** (A-weighted decibels).

Relevance

Duration Matters: Accounts for how long an event lasts, not just how loud it gets.

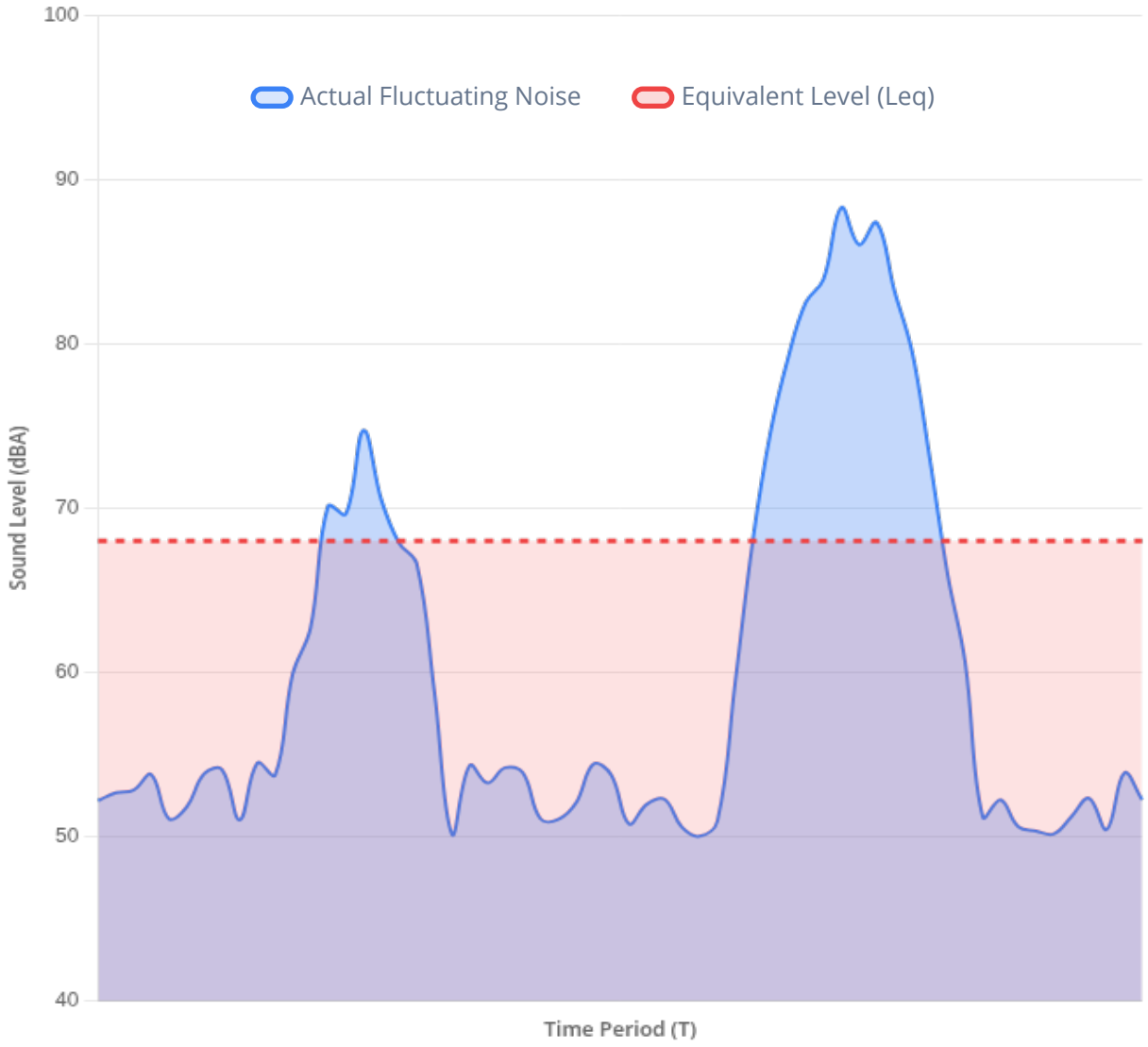
Awakenings: Stronger correlation with sleep disturbance than Lmax.

Building Block: Used to calculate cumulative metrics like DNL and CNEL.

Comparison: Same Lmax, Different SEL

Insight: Both events hit a peak of **90 dBA (Lmax)**. However, Event B lasts longer, resulting in a higher **SEL (+5.2 dBA)**. This represents significantly more total noise energy.

Leq: Equivalent Continuous Sound Level



Definition

Leq (Equivalent Continuous Sound Level) is the steady sound level that contains the same total acoustic energy as the actual varying sound over a specific time period.

Why use it?

It compresses complex, fluctuating noise environments into a single, comparable number.

Energy Average vs. Arithmetic

Leq is an **energy** average, not a simple math average of decibels. Loud events dominate the calculation.

A single 100 dB event has as much energy as
100,000 events at 50 dB.

DNL: Day-Night Average Sound Level

Definition & Structure

24-hour energy average sound level (Leq)

Applies a **10 dB penalty** to noise events between 10:00 PM and 7:00 AM

Penalty accounts for increased sensitivity to noise during sleep hours and lower ambient background noise

Equivalent to treating one night flight as **10 daytime flights**

Significance & Usage

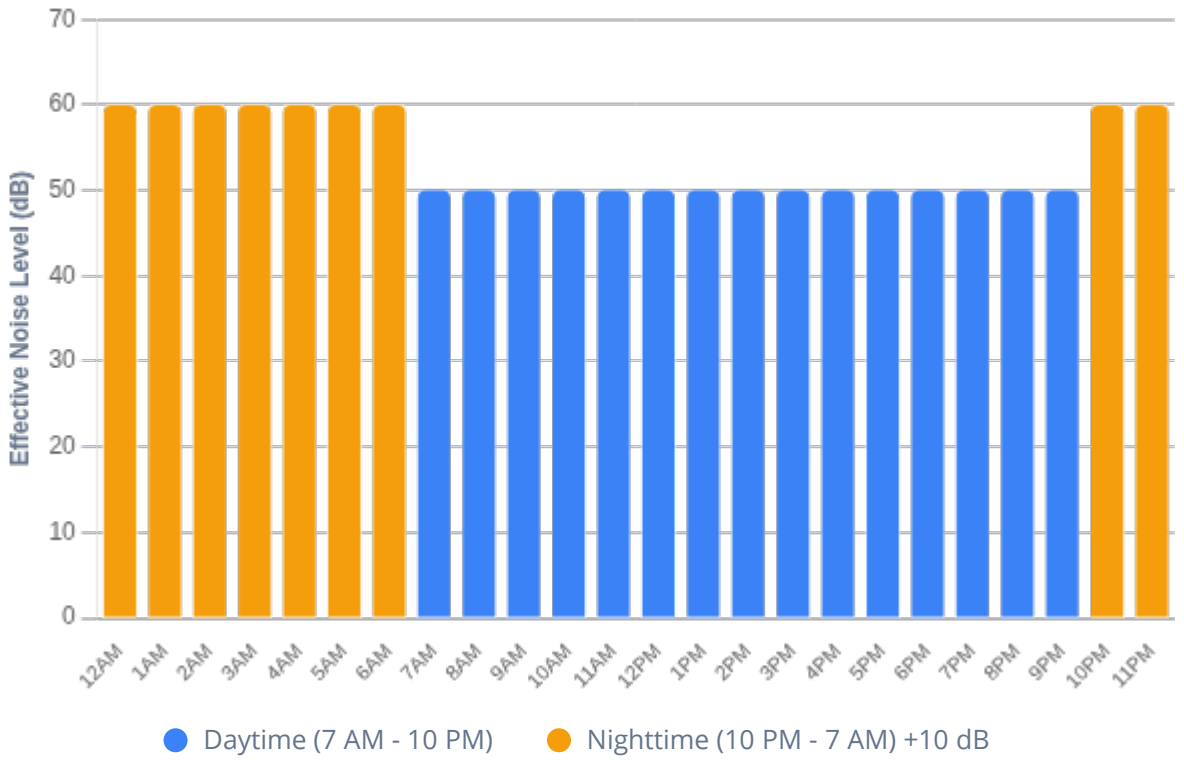
Standard FAA national metric for community noise exposure

Basis for NEPA environmental assessments

DNL 65 is the federal significance threshold for residential compatibility

Used for Airport Noise Compatibility Planning (Part 150)

DNL Weighting Mechanism



The chart illustrates how a constant noise level would be weighted differently depending on the time of day. Nighttime noise is artificially boosted by 10 dB in the calculation.

DNL vs. CNEL Comparison

DNL (Day-Night Average Sound Level)

Federal Noise Standard

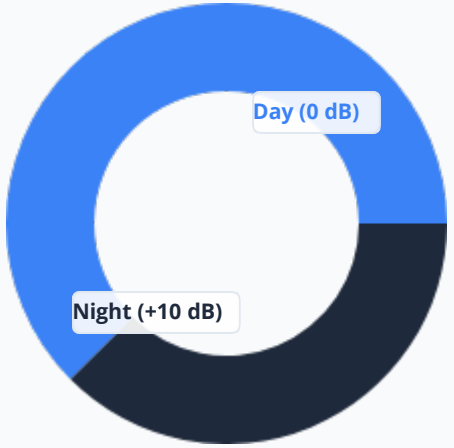
- ✓ Standard metric for all U.S. airports (except California)
- **2 Time Periods:** Day (7am-10pm) & Night (10pm-7am)
- ✓ Nighttime events counted as 10x equivalent day events (+10 dB)

CNEL (Community Noise Equivalent Level)

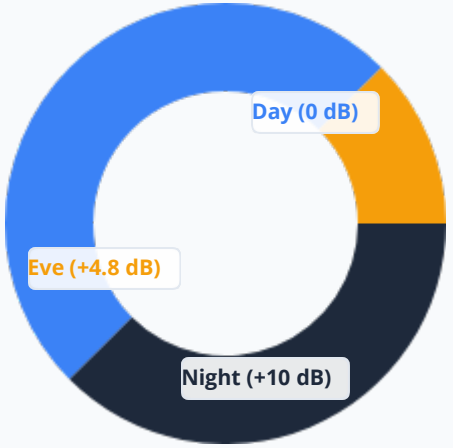
California Noise Standard

- ✓ Required by California Code of Regulations for airports
- **3 Time Periods:** Day, Evening (7pm-10pm), Night
- ✓ Evening penalty (+4.8 dB)

Weighting Periods Visualized



DNL / Ldn



CNEL

Practical Difference: CNEL is typically 0.5 to 1.5 dB higher than DNL for the same operation mix due to the evening penalty.

Metric Comparisons and Conversions

Comparison of key aviation noise metrics, their primary applications, and typical conversion relationships for decision-making.

Metric	Definition / Unit	Primary Application	Pros & Cons
Lmax	Maximum Sound Level dBA (Instantaneous)	Speech Interference Single Event Complaint	Easy to understand Ignores duration
SEL	Sound Exposure Level dBA (Energy normalized to one second)	Sleep Disturbance Building DNL	Accounts for duration Abstract concept
DNL	Day-Night Average Level dBA (24-hr avg + 10dB night penalty)	FAA/NEPA Standard Land Use Planning	Correlates with annoyance Masks individual events
CNEL	Community Noise Eq. Level dBA (24-hr avg + 5dB eve + 10dB night)	California Standard Evening Sensitivity	Addresses evening noise Complex calculation

Single Event to Cumulative

DNL ≈ SEL + 10 log(N) - 49.4 dB

N = Number of daily events (Night weighted)

Equivalency Example (65 dB DNL)

1 Event @ 114.4 dB SEL

= 100 Events @ 94.4 dB SEL

DNL vs CNEL

CNEL ≈ DNL + 0.5 to 1.5 dB

Due to additional evening penalty weighting

Applying Metrics in Practice

Community Outreach

Lmax & TA: Relatable metrics for specific complaints

Communicates "loudness" and "duration" clearly

Use for individual event analysis

Environmental Review

DNL / CNEL: Regulatory standard for land use

Required for NEPA, Part 150, AIP funding

Defines "significant impact" areas

Health & Sleep Studies

SEL & Nighttime Leq: Correlate with awakenings

Used in advanced health impact assessments

Key for nighttime insulation prioritization

Complaint Response — Lmax / TA

85 dBA

Explain single events using Maximum Level. "The aircraft was as loud as a food blender for 15 seconds."

Land Use Planning — DNL / CNEL

65 dB

Determine incompatible zones. "Residential development is discouraged inside the 65 DNL contour."

Sleep Impact — SEL / Night Leq

90 dB

Assess awakening potential. "Indoor SEL > 90 dB has a 5% probability of awakening."

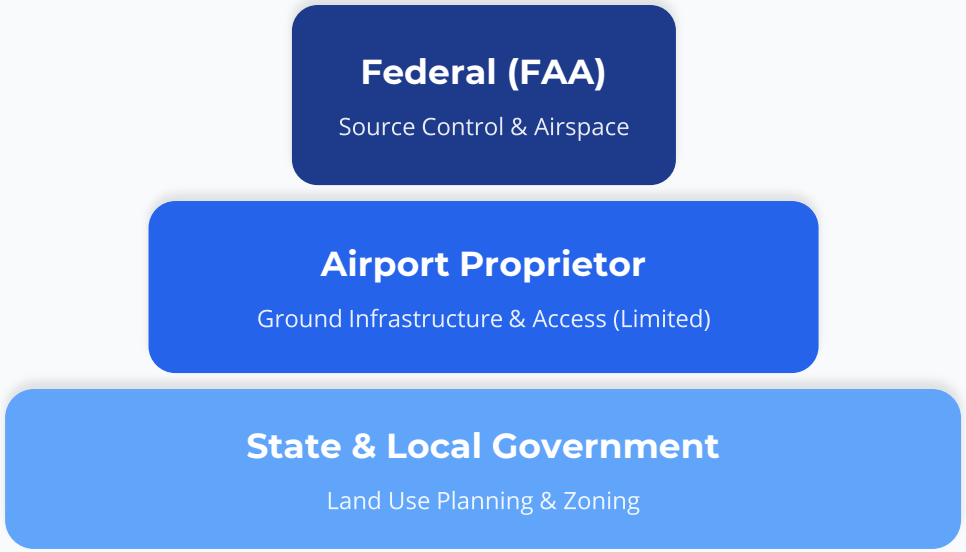
Trend Monitoring — N-Metrics (N65)

N65

Track frequency. "Number of events above 65 dB increased by 10% compared to last year."

Who Controls Aircraft Noise?

Authority Hierarchy



Authority flows downward; preemption flows upward.

Roles & Limitations

Federal Aviation Administration (FAA)

Exclusive sovereignty over airspace management, air traffic control, and aircraft noise certification (Part 36). Sole authority to change flight tracks.

Airport Proprietor

Can propose noise compatibility measures (Part 150) and reasonable, non-discriminatory access restrictions (subject to ANCA 1990 review).

Local/State Authority

Controls compatible land use zoning around airports. Cannot regulate flight operations, curfews, or noise limits on aircraft in flight.

Federal Preemption

Under the Supremacy Clause and 1973 *City of Burbank v. Lockheed Air Terminal* decision, local police powers cannot restrict aircraft operations to control noise.

Roles and Responsibilities

Matrix: Clarifying the specific roles of key stakeholders in the complex ecosystem of aviation noise management.

ACTIVITY / FUNCTION	FAA	AIRPORTS	AIRLINES / ATC	COMMUNITIES
Aircraft Certification Setting Source Noise Standards (Part 36)	A R	I	C	I
Airspace & Procedures Designing flight paths & corridors	A R	C	C	C
Part 150 Planning Developing compatibility programs	C	A R	C	C
Land Use Zoning Controlling development near airports	I	C	I	A R

R — Responsible
Those who do the work to achieve the task.

A — Accountable
The "owner" who approves the final work.

C — Consulted
Subject matter experts who provide input.

I — Informed
Those kept up-to-date on progress.

Regulatory History: 1960’s-1970’s

1968

FAA Authority Granted

Congress amends Federal Aviation Act giving FAA authority to prescribe standards for aircraft noise control.

1969

Part 36 & NEPA

Establishment of noise standards for new aircraft designs; National Environmental Policy Act enacted.

1972

Noise Control Act

Mandates EPA coordination with FAA; establishes national policy to promote environment free from noise.

1976-77

Abatement Policy & Stage 2

1976 Aviation Noise Abatement Policy issued; 1977 Stage 2 noise limits introduced for aircraft.

Regulatory History: 1980’s-1990’s

1979-80

ASNA Act Passed

Aviation Safety & Noise Abatement Act enables Part 150 planning and AIP funding for compatibility measures.

1990

ANCA & Phase-out

Airport Noise and Capacity Act (ANCA) limits local restrictions; sets national phase-out of Stage 2 aircraft.

1992

FICON Report

Federal Interagency Committee on Noise establishes guidance on metrics and impacts outside 65 DNL.

Era of Preemption

Federal Preemption

Key court rulings reinforce federal authority over airspace, limiting local noise ordinances.

Regulatory History: 2000's-Present

2005

Stage 4 Rule

Adoption of Stage 4 noise standards, aligning with ICAO Chapter 4. Requires quieter new aircraft designs.

2010s

NextGen Implementation

Rollout of PBN procedures (RNAV/RNP). Increased precision concentrates noise, sparking community concerns.

2017

Stage 5 Standards

Final Rule establishing Stage 5 (ICAO Chapter 14). Applies to new type designs from 2017/2020 onward.

Present

Emerging Issues

Focus on UAM/AAM noise, Reauthorization Acts, and updated community engagement practices.

Current Regulatory Framework

Source Control (Part 36)

Regulates noise at the source (the aircraft itself).

Establishes "Stage" limits (Stage 3, 4, 5).

Requires acoustical change approvals to prevent regression ("backsliding") in noise performance.

Exposure & Compatibility (Part 150)

Voluntary airport noise compatibility planning.

Produces Noise Exposure Maps (NEM) & Noise Compatibility Programs (NCP).

Unlocks AIP funding for mitigation (insulation, land use).

Environmental Review (NEPA)

Mandatory review for federal actions (new procedures, infrastructure).

Guided by FAA Order 1050.1G & 5050.4B.

Determines "Significant Impact" based on thresholds.

The Three Pillars of Noise Regulation

The Aircraft

14 CFR Part 36
Certification & Airworthiness

The Airport

14 CFR Part 150
Land Use & Compatibility

The Process

NEPA / 1050.1G
Environmental Impact Analysis

FAA Part 36

Applicability

Part 36 prescribes noise standards for the issuance of type certificates, changes to those certificates, and standard airworthiness certificates.

Transport Category & Jet Airplanes
Subsonic jet airplanes & large transport category

Propeller-Driven Small Airplanes
Commuter category & small propeller aircraft

Helicopters
Primary, normal, transport, & restricted categories

Tiltrotors
Specialized powered-lift category requirements

Measurement Standards

Primary Metric: EPNdB (Effective Perceived Noise Level)

Certification requires noise measurement at three specific reference points to ensure standardized comparison across aircraft types.

Measurements are taken at three specific reference points to capture the full noise profile during takeoff, sideline acceleration, and landing approach.

Aircraft Stage Classifications and ICAO Mapping

Comparison of U.S. FAA Part 36 Stage classifications with ICAO Annex 16 Chapters, showing the evolution of increasingly stringent noise standards.

US Stage	ICAO Chapter	Stringency / Description	Applicability Date (New Types)	Current Status
Stage 1	**Chapter 2**	Loudest aircraft (e.g., B707, DC-8) First generation jets	Pre-1969	**Phased Out (1985)**
Stage 2	**Chapter 2**	Moderate noise reduction (e.g., B727, DC-9) Limits based on weight/engines	1969 - 1977	**Phased Out (2015)*** *Except < 75k lbs
Stage 3	**Chapter 3**	Significant reduction (e.g., B737-300, MD-80) -10 to -20 EPNdB vs Stage 2	Nov 1977	**Operational**
Stage 4	**Chapter 4**	Cumulative -10 EPNdB reduction vs Stage 3 Must meet Stage 3 at all points	Jan 2006	**Standard (Current Fleet)**
Stage 5	**Chapter 14**	Cumulative -7 EPNdB reduction vs Stage 4 Latest technology standard	Dec 2017 (MTOW >121,254 Pounds) Dec 2020 (MTOW <121,254 Pounds)	**New Certification Standard**

ANCA and FAA Part 161

The Airport Noise and Capacity Act (ANCA) of 1990 limits airport proprietors' ability to impose access restrictions, establishing a rigorous federal review process known as 14 CFR Part 161.

Key Requirement	FAA & Practical Implications	Analytical Burden
National Policy	**Strict Federal Oversight:** Part 161 governs the analysis, notice, and approval process for any noise or access restriction.	Requires extensive notice process to aircraft operators and public.
Cost-Benefit Analysis	**Substantial Evidence:** Must demonstrate benefits (monetized quality of life) exceed costs (fuel, delays, fleet changes) to operators.	Extremely onerous; difficult to monetize noise benefits in dollars.
Statutory Conditions	**Six Mandatory Conditions:** Must be non-discriminatory, not an undue burden on commerce, and not conflict with FAA authority.	Must meet all 6 conditions; failure on one results in disapproval.
Stage Pathways	**Stage 2 vs Stage 3:** Stage 2 restrictions (historic) had lower hurdles; Stage 3 restrictions require FAA approval.	Stage 2 is now moot (phased out).

The Reality

Part 161 is a "study of last resort." FAA encourages voluntary agreements. Only **2 successes** since 1991.

Naples Airport (APF)

The only successful Stage 2 ban approved via Part 161 process. Demonstrated unique local benefits.

Van Nuys Airport (VNY)

Implemented a Stage 2 phaseout, but it was "grandfathered" under pre-ANCA rules, not a pure Part 161 win.

FAA Part 150: Overview

Program Purpose

Definition: 14 CFR Part 150, "Airport Noise Compatibility Planning," is a voluntary federal program that establishes standard methodologies for airport operators to create noise exposure maps and compatibility programs.

Primary Goal
Reduce noncompatible land uses around airports

Funding Eligibility
Unlocks AIP funding for noise mitigation projects

Balanced Approach
Considers aviation needs alongside community impacts

The Voluntary Process

1. **Noise Exposure Maps (NEM)**

   Develop contours for current year and 5-year forecast. Identify noncompatible land uses (e.g., residential within 65 DNL).

2. **Noise Compatibility Program (NCP)**

   Propose measures to reduce noise impacts (operational procedures, land use controls, mitigation). Must be feasible and cost-effective.

3. **Public Consultation**

   Extensive stakeholder engagement required with local residents, agencies, and air carriers.

4. **FAA Review & Approval**

   FAA has 180 days to approve or disapprove NCP measures. NEMs are "accepted" rather than approved.

Note: *Part 150 does not grant airports authority to regulate flight paths or restrict access arbitrarily. Federal preemption applies.*

FAA Part 150: Noise Exposure Maps (NEMs)

Legend

Noise Contours (DNL)

- 75+ dB DNL
- 70-75 dB DNL
- 65-70 dB DNL

Land Use Categories

- Residential
- Commercial
- Industrial

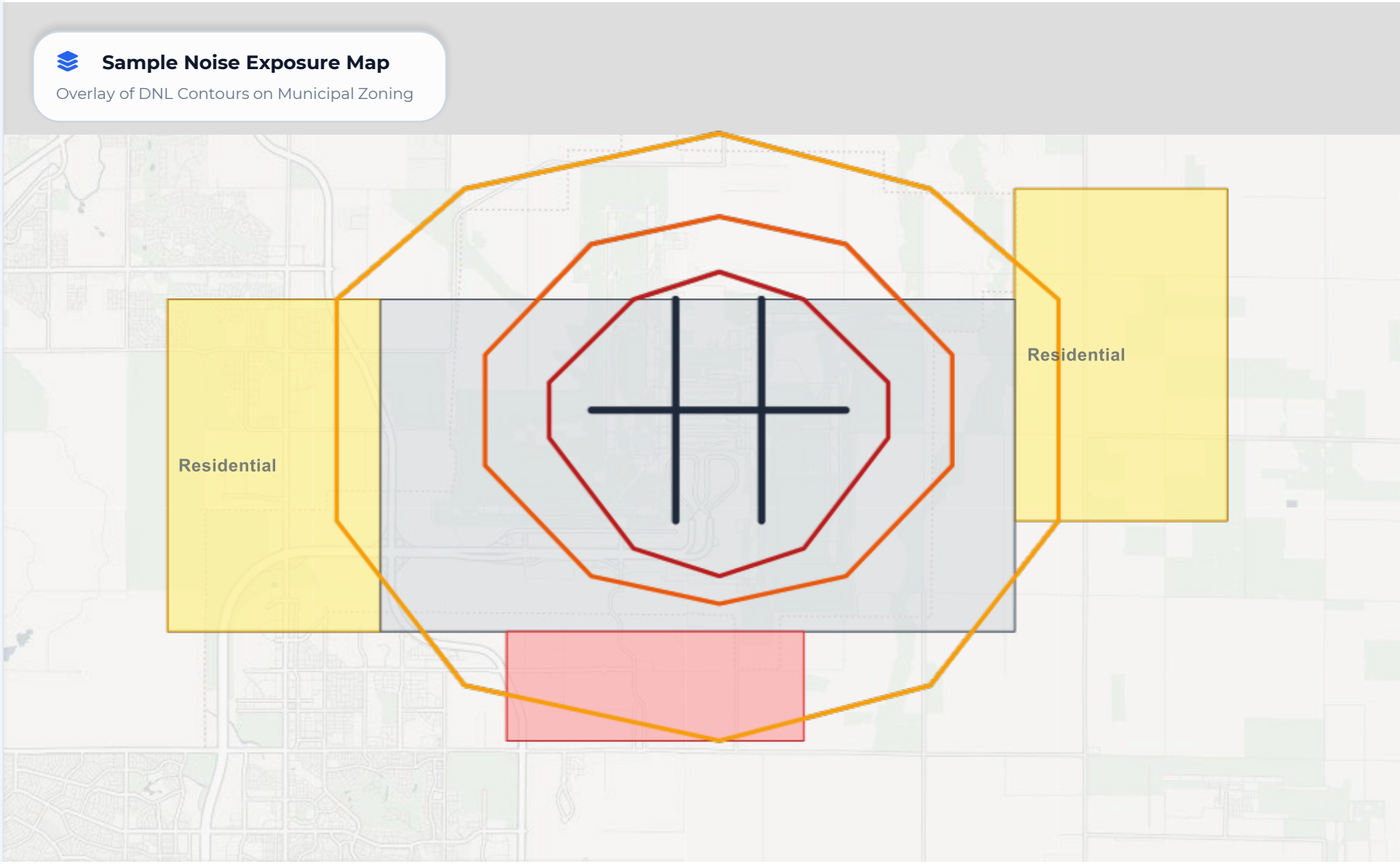
Part 150 Requirement

NEMs must follow 14 CFR Part 150, Appendix A standards. They define the "noise impact boundary" to identify non-compatible land uses for mitigation eligibility.

Maps must be prepared for two timeframes: **Existing Conditions (Year of Submission)** and **Future Forecast (Year+5)** to account for operational growth.

Sample Noise Exposure Map

Overlay of DNL Contours on Municipal Zoning



FAA Part 150: Noise Compatibility Programs (NCPs)

Typical measures included in FAA Part 150 Noise Compatibility Programs to reduce exposure and mitigate impacts on communities.

Category	Typical Measures	Primary Goal
	• Noise Abatement Departure Procedures (NADPs) • Preferential Runway Use • Flight Track Optimization	Shift noise away from people
	• Sound Insulation (Residential/Schools) • Property Acquisition/Relocation • Avigation Easements	Reduce indoor noise levels
	• Zoning Changes / Overlays • Building Code Updates • Real Estate Disclosure	Stop new incompatible use
	• Noise Monitoring System • Noise Office • Periodic Review/Updates	Ensure compliance & trust

NEPA in Aviation Environmental Review

Guided by FAA Orders 1050.1G & 5050.4B

1. CATEX

Categorical Exclusion

Applicability:

- Actions typically without significant environmental impact
- Listed in FAA Order 1050.1G
- No extraordinary circumstances

Outcome:

- Documented CATEX
- Simplest review path

Is action categorically excluded?

2. EA

Environmental Assessment

Applicability:

- Impacts uncertain or not CATEX eligible
- Concise analysis of impacts
- Evaluate alternatives

Outcome:

- **FONSI:** Finding of No Significant Impact
- Or proceed to EIS if impacts significant

Are impacts significant?

3. EIS

Environmental Impact Statement

Applicability:

- Significant environmental impacts expected
- Highly controversial actions
- Major federal actions

Outcome:

- **ROD:** Record of Decision
- Detailed public scoping & comment required

Rigorous analysis required

Public Involvement increases with complexity level

Noise significance threshold: +1.5 dB DNL in 65+ DNL areas

Noise Significance Thresholds

Proposed Action Analysis

Evaluate noise changes compared to No Action baseline

Is Area Noise Sensitive?

Residential, schools, places of worship, etc.

Exposure Criteria Check

Is the DNL ≥ 65 dB with the proposed action?

Significant Impact

If increase is ≥ 1.5 dB within DNL 65+ contour

Not Significant

If increase < 1.5 dB OR outside DNL 65 contour

The 1.5 dB Standard

Federal policy defines a significant noise impact as a 1.5 dB DNL increase in noise-sensitive areas exposed to DNL 65 dB or higher.

Reportable Changes

While not "significant," changes of +3.0 dB (DNL 60-65) and +5.0 dB (DNL 45-60) are typically reportable in environmental documents.

CRITICAL THRESHOLD

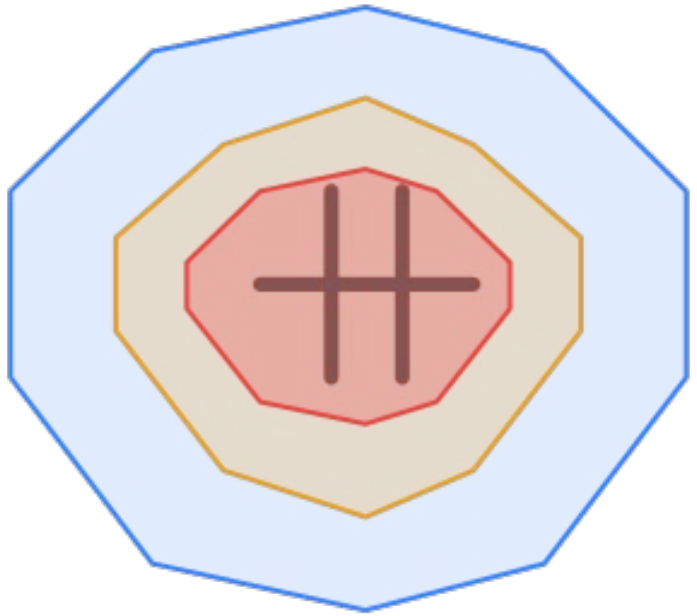
A finding of significant impact typically triggers the requirement for a full Environmental Impact Statement (EIS) unless mitigation measures can reduce the impact below the threshold.

What Are Noise Contours?

Legend

- 65+ dB DNL/CNEL
- 60-65 dB DNL/CNEL
- 55-60 dB DNL/CNEL

Simulated Airport Noise Exposure Map (NEM)



Understanding Contours

Noise contours are lines connecting points of equal sound exposure, similar to topographical lines on a map showing elevation. They visualize the spatial extent of noise impact over a year.

Policy Threshold

The **65 dB DNL/CNEL** contour is the primary federal threshold for determining significant noise impact and land use compatibility for residential areas.

How Noise Contours Are Created: AEDT Workflow

1. Inputs

- Fleet Mix & Operations
- Flight Tracks & Procedures
- Terrain & Weather Data
- Day/Evening Night Schedules

2. Processing

- Trajectory Calculation
- Noise-Power-Distance (NPD)
- Atmospheric Propagation
- Grid Point Integration

3. Outputs & Analysis

- Contour Lines
- Grid Analysis Results
- Population Exposure Counts
- NEPA Disclosure Metrics

The Aviation Environmental Design Tool (AEDT) integrates aircraft performance in space and time to compute noise, fuel burn, and emissions simultaneously.

AEDT Inputs and Outputs

Model Inputs

Fleet Mix: Aircraft types, engines, and modifications

Operations: Schedule (day/evening/night), runway use, flight tracks

Profiles: Departure/arrival procedures

Environment: Terrain elevation, weather/atmospheric data

Performance: Weight, thrust settings, flaps/gear

Model Outputs

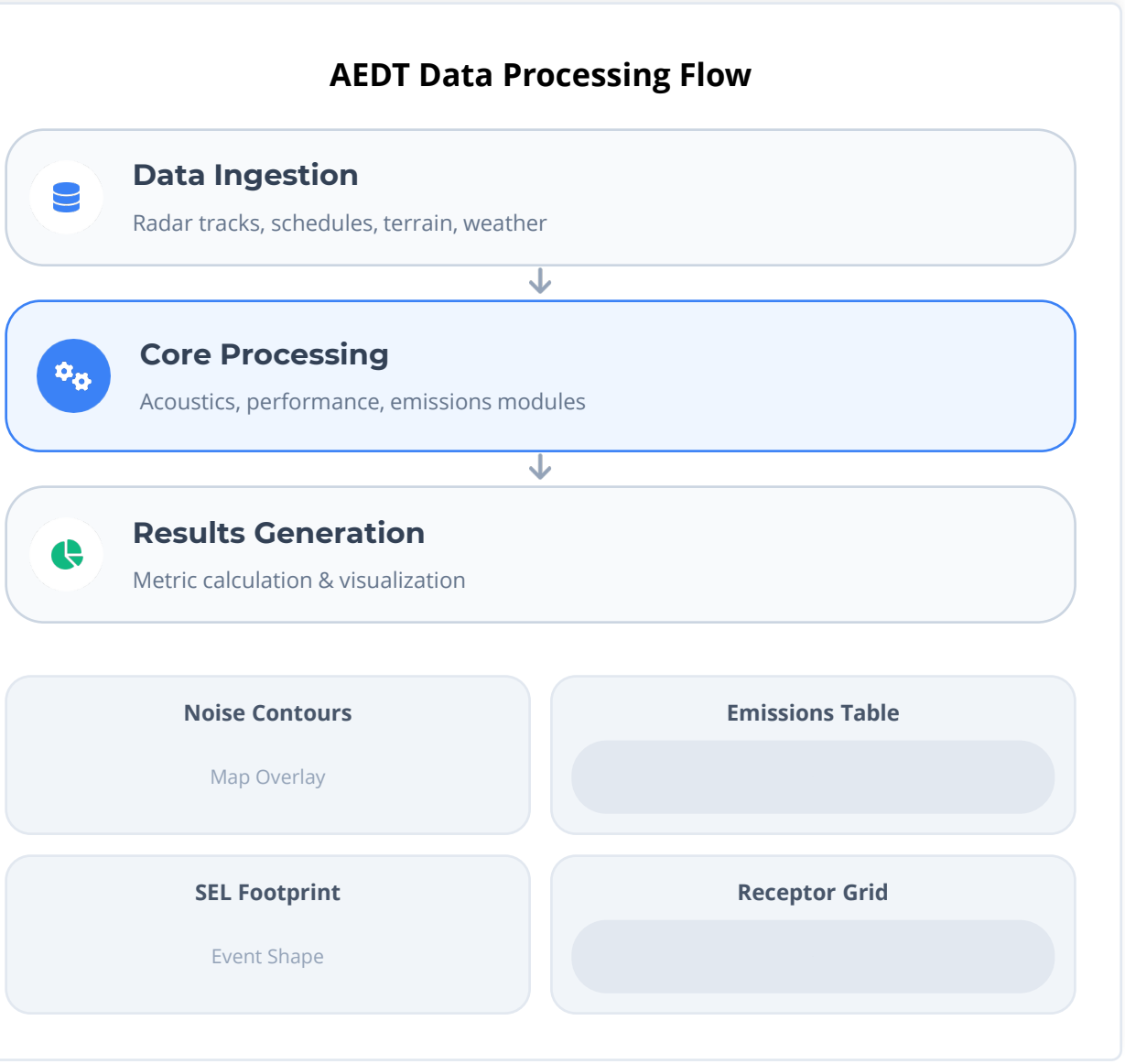
Noise Contours: DNL, CNEL

Grid Points: Detailed receptor-specific levels

Footprints: Single-event SEL/Lmax contours

Emissions: Fuel burn, CO2, NOx, PM inventory

Reports: Standard tables for NEPA/150 compliance



Why Monitor Noise?

Strategic Objectives

Validate Models & Forecasts

Ground-truth AEDT computer modeling results with real-world measurements to ensure planning accuracy.

Program Performance Tracking

Quantify the effectiveness of noise abatement program measures.

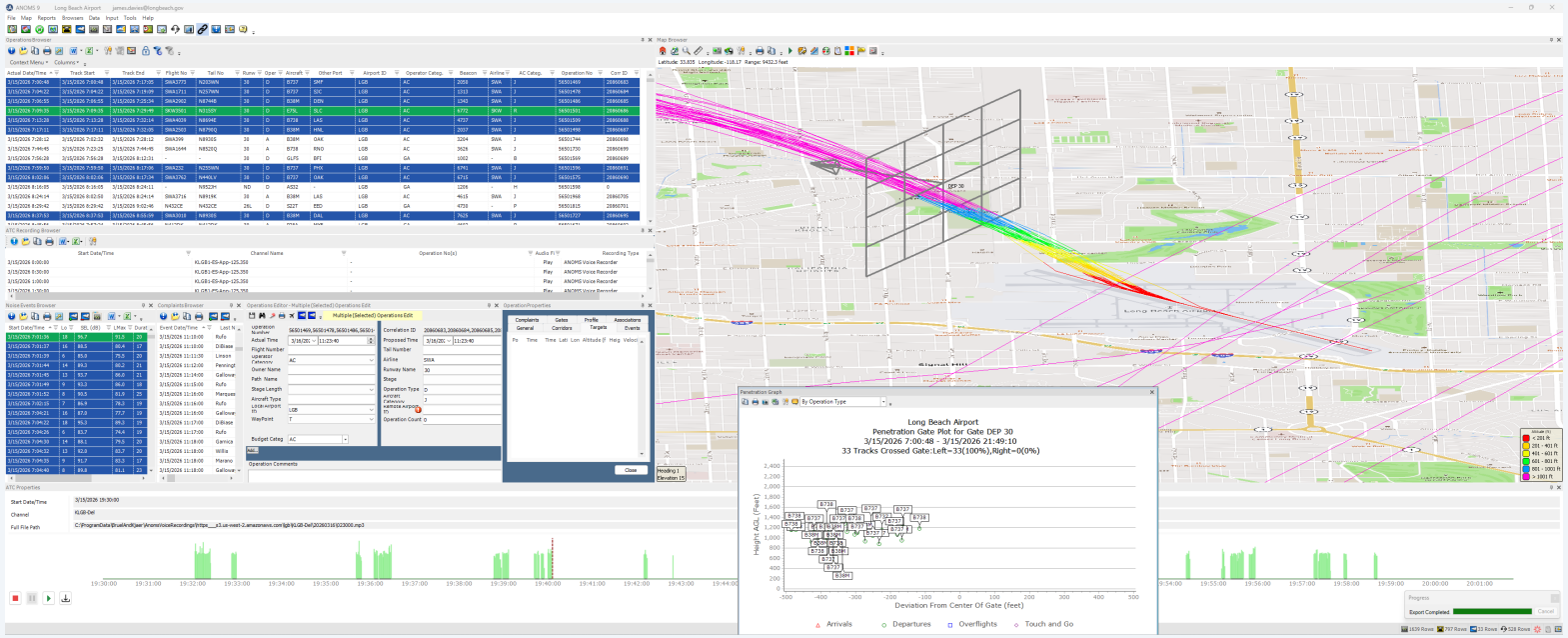
Community Transparency

Provide objective data to address public complaints and build trust through transparent reporting.

Identify "Hotspots"

Detect specific locations or times with unusual noise events not captured by annual average metrics.

Real-Time Monitoring System



Noise and Operations Monitoring System (NOMS)

System Types & Deployment

Permanent Noise Monitoring Terminals (NMTs): Fixed installations for long-term compliance tracking, trend analysis, and public transparency.

Portable Monitors: Short-term deployment for specific complaint investigation.

Siting Strategy: Locations governed by Part 150 study, specific community requests, or flight corridor alignment.

Permanent NMT

Pole-mounted, solar/mains power, weather-proof.

Portable NMT

Tripod-mounted, battery powered, rapid deployment.

Core Components & Tech

Class 1 Sound Level Meter (SLM): High-precision measurement microphone with windscreen to filter wind noise.

Connectivity: Cellular for real-time data upload to central server.

Event Correlation: Integration with radar tracks to distinguish aircraft noise from community noise (dogs, sirens).

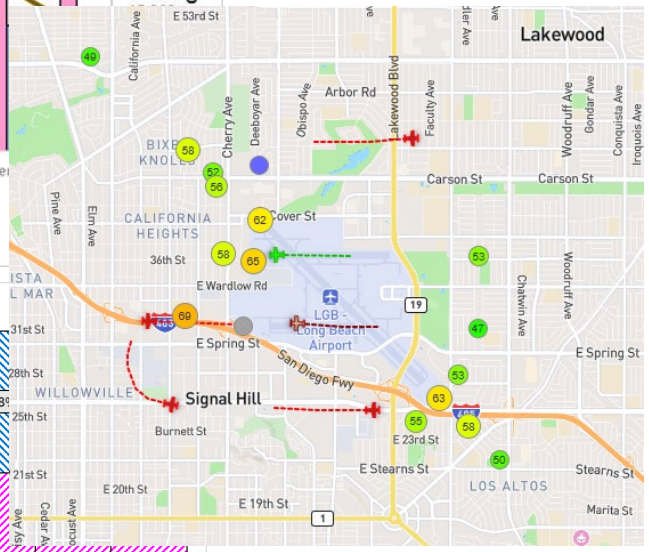
Microphone
Precision Class 1

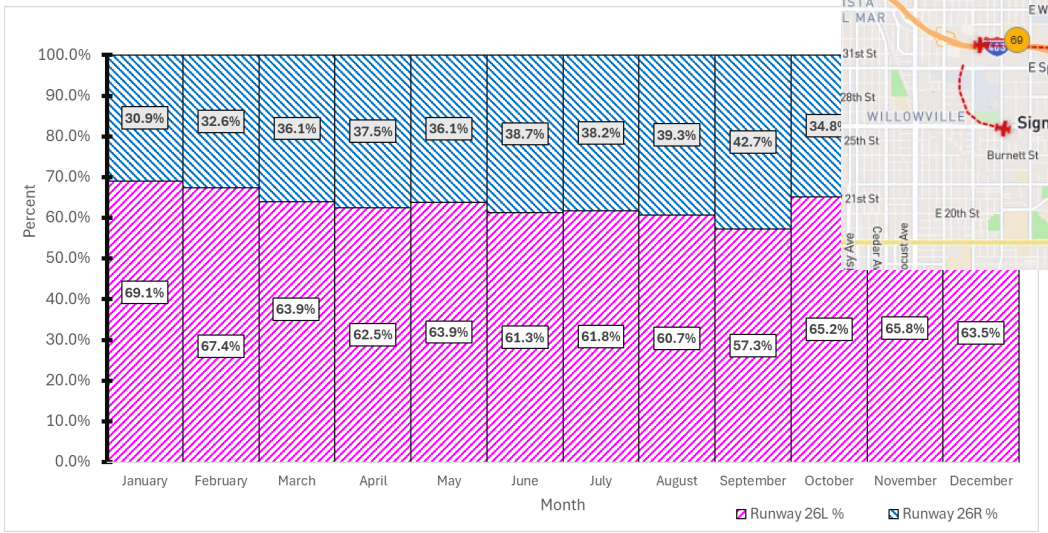
Weather Unit
Wind/Rain/Temp

Telemetry
Cellular

NOMS Backend
Radar Flight Track Matching

Analytics and Reporting





Critical Metrics

Effective monitoring systems aggregate millions of data points into actionable metrics.

Lmax & SEL: Characterize individual flyover events.

Time Above (TA): Total duration noise exceeds a specific threshold (e.g., 65 dB) in a day.

Correlated Events: % of noise events matched to radar flight tracks.

Reporting & Transparency

Regular reporting builds community trust. Public portals/dashboards allow residents to view near real-time flight tracks and historical noise data.

- Monthly/Annual Compliance Reports
- Interactive "Flight Replay" Tools

Modeling vs. Monitoring

Understanding the distinct roles, strengths, and limitations of computer modeling versus noise monitoring in aviation noise management.

Aspect	Modeling	Monitoring
Required For	**NEPA Compliance** (EAs/EISs) **Part 150** (NEMs/NCPs) Federal Environmental Review	**CA Title 21** (Boundary Validation) Noise Ordinance Compliance Diagnostic & Investigative Studies
Strengths	**Area-wide Coverage:** Calculates noise anywhere **Predictive:** Models future scenarios/alternatives **Consistent:** Standardized federal methodology **Specific:** Isolates aircraft noise from ambient	**Historical Reality:** Validates actual trends **Total Noise:** Captures all noise sources **Transparency:** Builds community trust **Tangible:** Relates directly to human experience
Limitations	Cannot be "calibrated" to measurements per FAA policy Relies on database assumptions (profiles/thrust) Does not reflect daily operational anomalies	**Discrete Points:** Only measures at monitor location **Not Predictive:** Cannot forecast future noise **Contamination:** Can be difficult to separate community noise
Funding	**Federally Supported:** Essential for AIP funding eligibility Contours determine mitigation boundaries	**Limited Federal Support:** Usually only within 65 DNL Often funded by airport/local budget
Best Use Cases	Long-term planning, alternatives analysis, policy making, "What-if" scenarios	Community transparency, complaint correlation, hot-spot identification, QA/QC of model inputs

Principles of Aircraft Noise Control: Source

Engine & Airframe Quieting

High-Bypass Engines: Reduced jet velocity lowers exhaust noise (primary source).

Fan & Compressor: Acoustic liners and optimized blade geometry reduce whine.

Chevrons: Sawtooth patterns on nacelles mix exhaust flow to reduce turbulence.

Airframe Noise: Fairings on landing gear and smooth flap deployment reduce drag noise.

Modernization & Retrofit

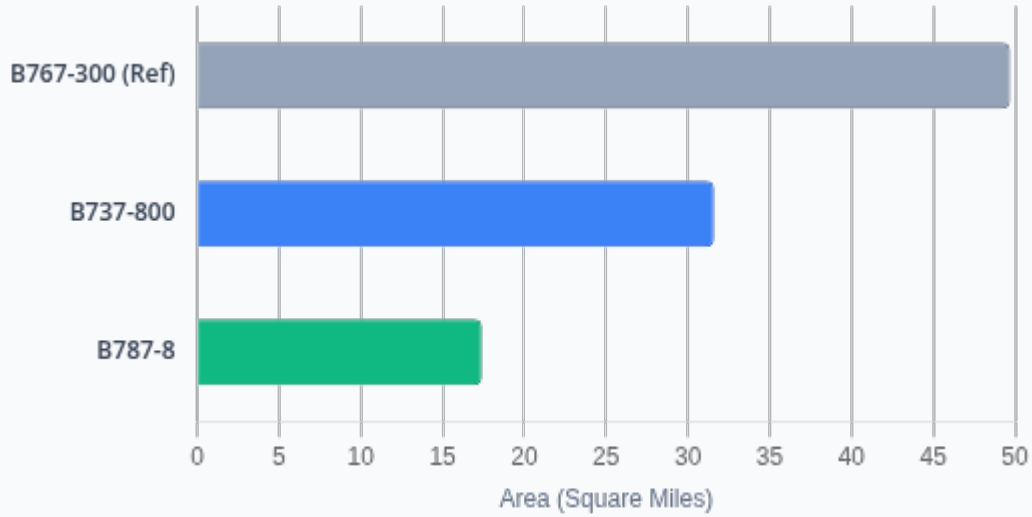
Fleet Renewal: Transitioning to Stage 4 and Stage 5 certified aircraft.

Vortex Generators: Small fins prevent "whistle" from fuel vents.

Maintenance: Regular engine tuning keeps noise levels at design specifications.

Noise Footprint Comparison

Area of 65 dB Lmax Contour (Square Miles)



AEDT Data Insight: The modern B787-8 reduces the 65 dB noise footprint by nearly 65% compared to the reference B767-300, demonstrating the effectiveness of high-bypass engine technology.

Principles of Noise Control: Path

NADP 1

Noise Abatement Departure Procedure 1

Goal: Reduce noise close to the airport

- Maintain takeoff thrust/flap setting to higher altitude (e.g., 3,000 ft)
- Delays acceleration and flap retraction
- Result: Steeper climb, higher altitude over close-in neighborhoods

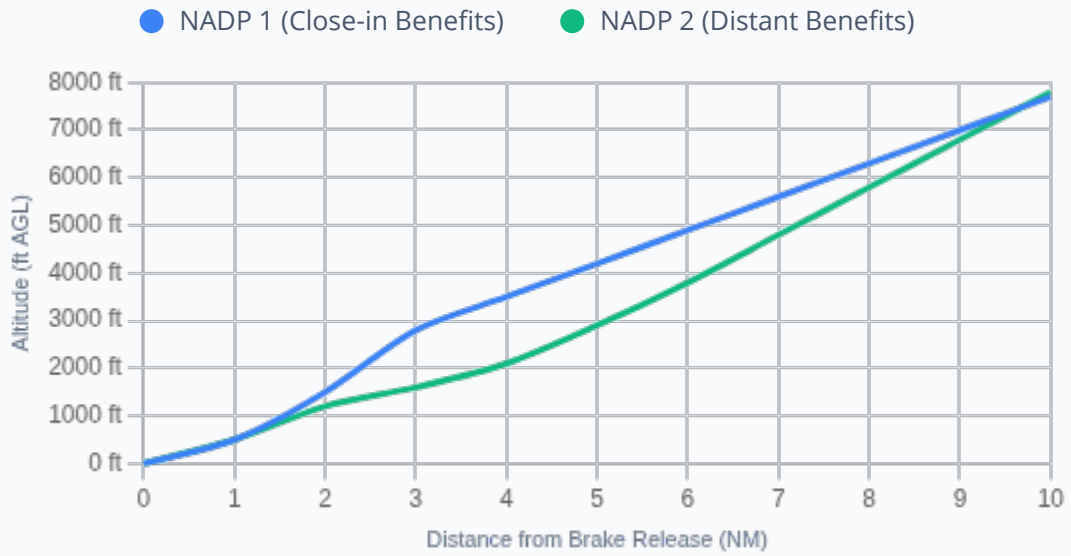
NADP 2

Noise Abatement Departure Procedure 2

Goal: Reduce noise further away

- Accelerate and retract flaps at lower altitude (e.g., 1,000 ft)
- Reduces thrust sooner (cutback) for acceleration
- Result: Lower climb profile but reduced source noise (clean configuration) for distant areas

Departure Profile Comparison



Key Trade-off: NADP 1 keeps aircraft higher over close communities but requires higher thrust settings longer. NADP 2 cleans up the aircraft sooner for better fuel efficiency and lower noise far downrange, but the aircraft is lower over close-in neighbors.

Other Operational Strategies:

- Continuous Descent Approaches (CDA) / OPDs
- Optimized Flight Tracks (over water/industrial areas)
- Preferential Runway Use Programs

Principles of Noise Control: Receiver

Sound insulation programs serve as a primary mitigation strategy for existing non-compatible land uses within the DNL 65 contour.

1. Eligibility & Selection

- Location within DNL 65 contour
- Residential or sensitive use
- Built before Oct 1, 1998
- Average interior noise > CNEL 45

2. Acoustic Testing

- Pre-construction testing
- Determine scope of work
- Identify leakage points
- Design custom treatments

3. Installation

- High-STC windows & doors
- HVAC upgrades / baffles
- Attic/wall insulation
- Caulking and sealing

4. Post-Audit

- Post-construction testing
- Verify 5 dB reduction
- Homeowner acceptance
- Easement recording

Avigation Easement Requirement: In exchange for sound insulation, property owners must typically sign an easement granting the airport the right of flight and releasing future noise claims.

Thank You!

Contact Information:

Phone: 562.453.6878
Email: Justin.Cook@longbeach.gov
Website: www.lgb.org/noise

long beach airport
4100 Donald Douglas Drive
Long Beach, CA 90808
www.lgb.org

CITY OF LONGBEACH
411 West Ocean Boulevard
Long Beach, CA 90802
www.longbeach.gov