Noise Research

Presented to: E&E REDAC Subcommittee

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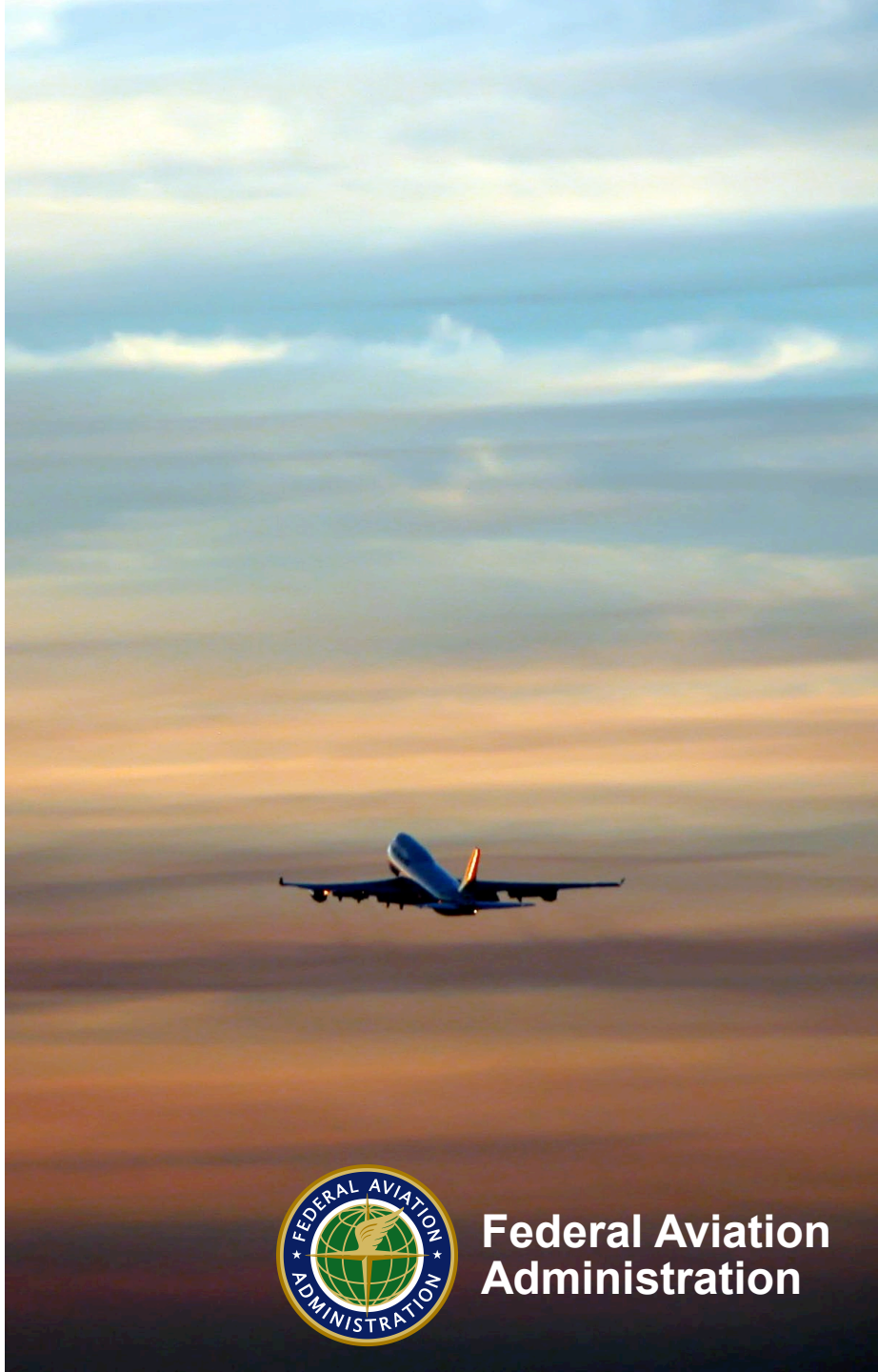
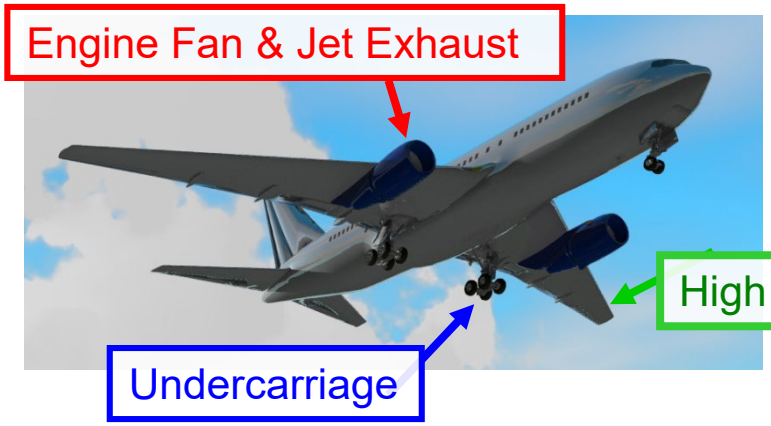


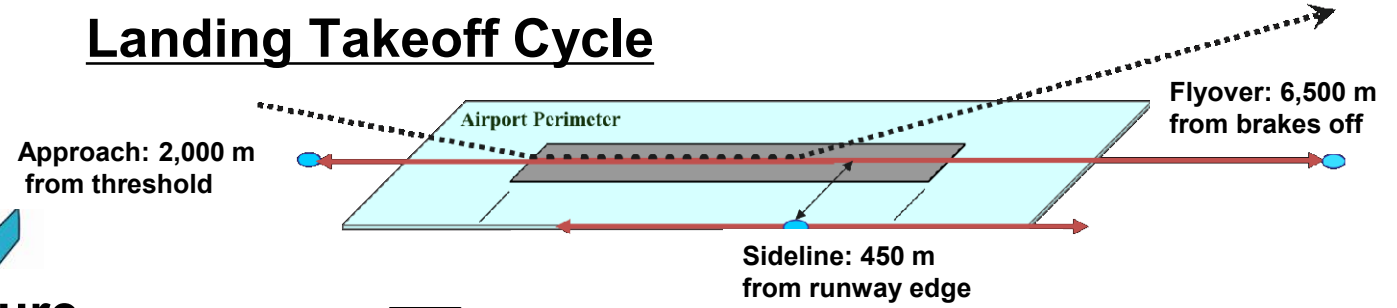
Community Noise from Aircraft

Aircraft Noise

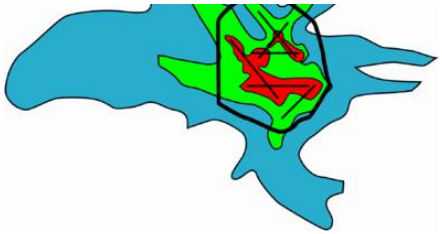


All noise sources contribute to acoustic signature – both at takeoff and during landing

Landing Takeoff Cycle

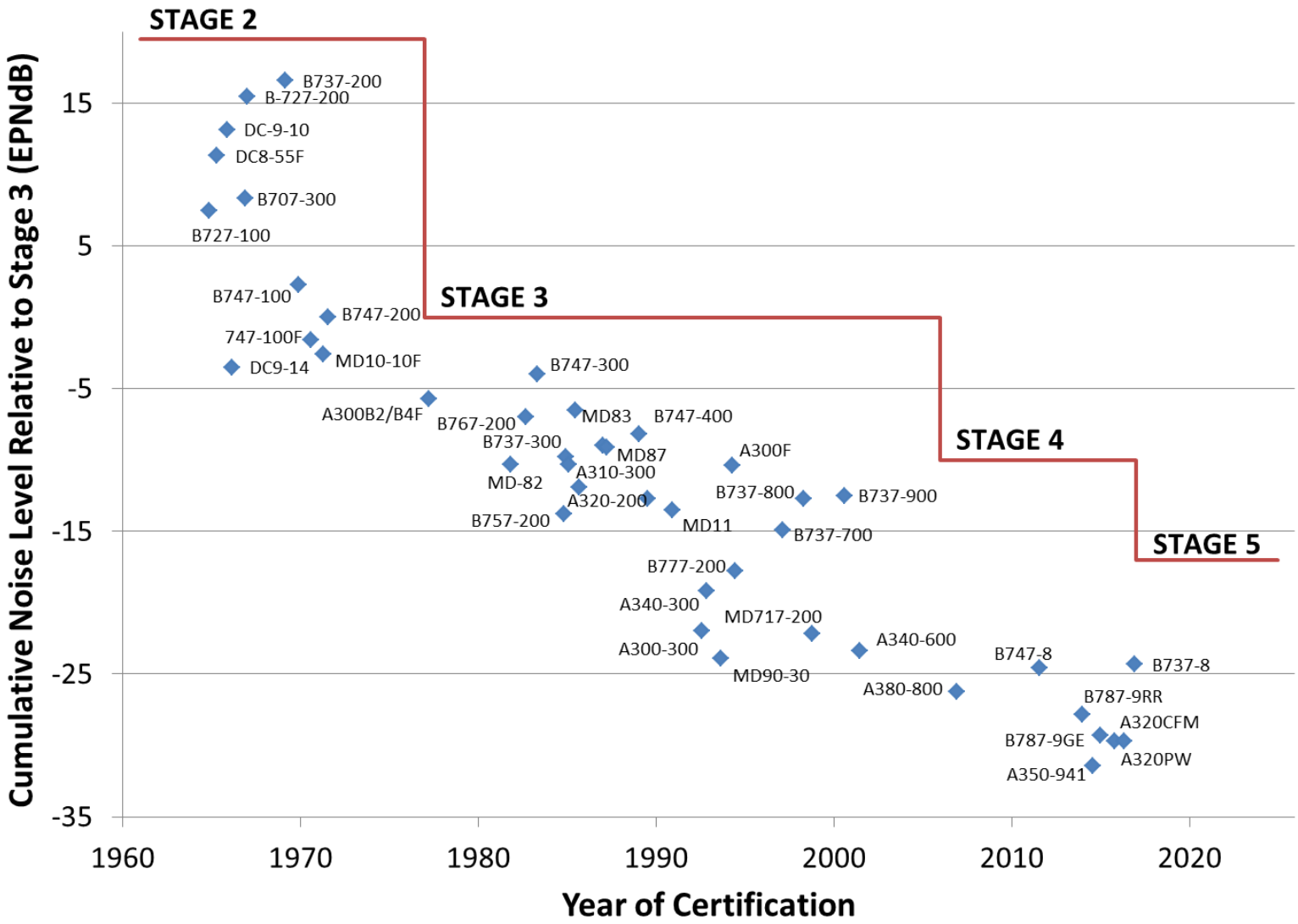


Community Exposure



Community exposure set by aircraft types and operational tempo over day and night

Commercial Aircraft Noise Evolution



Noise Reduction through Technology

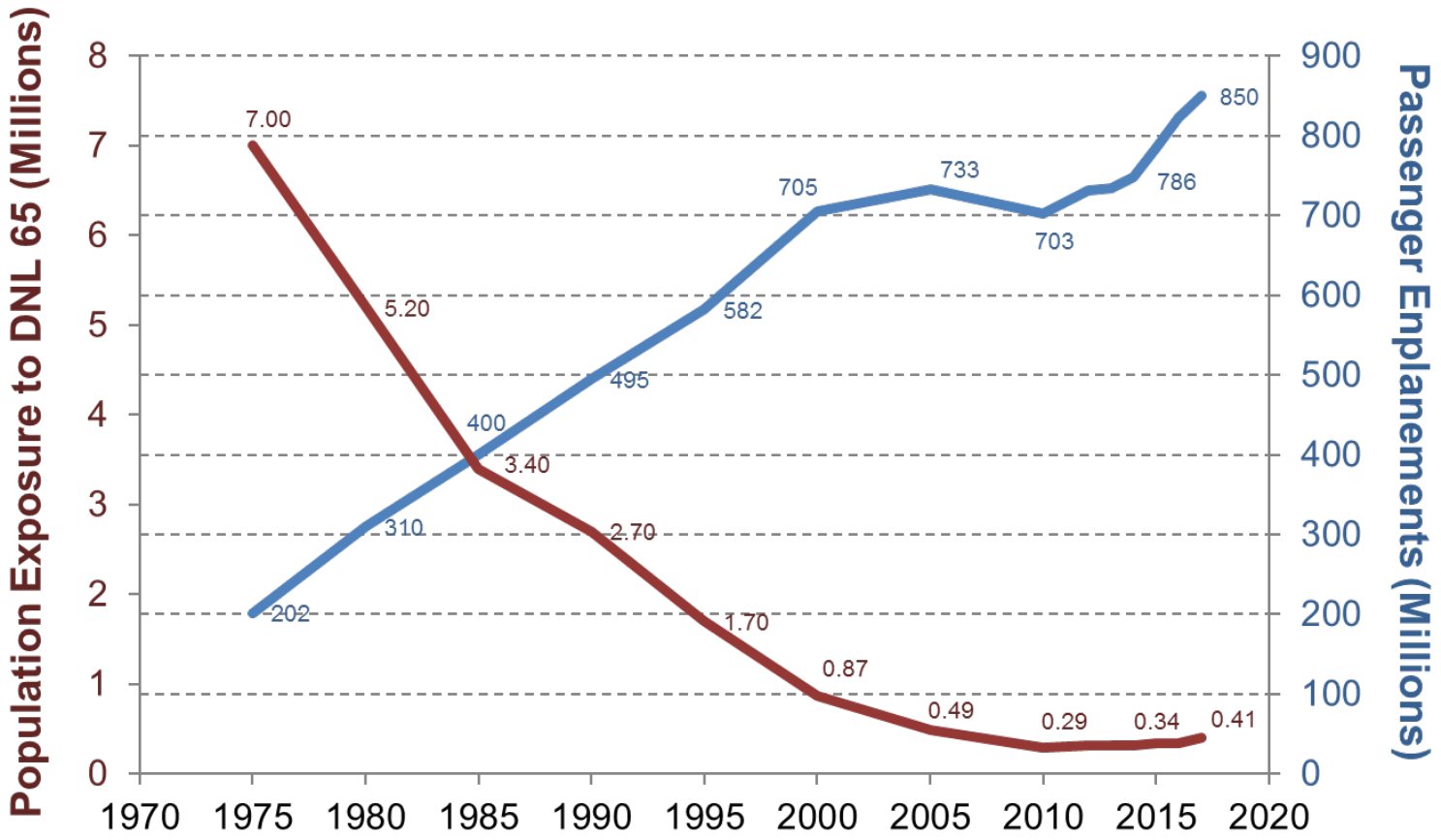
- Noise improvements have come with fuel efficiency gains
- Increased engine bypass ratio

- Simplified high lift systems

Images from airliners.net

Federal Aviation Administration

Historical Trends in Noise Exposure and Enplanements



A factor of 20 decrease in community noise exposure has been achieved despite a four-fold increase in passenger enplanements, but it has also been accompanied by increased community concerns

Equivalent Operations for DNL = 65

DNL Metric

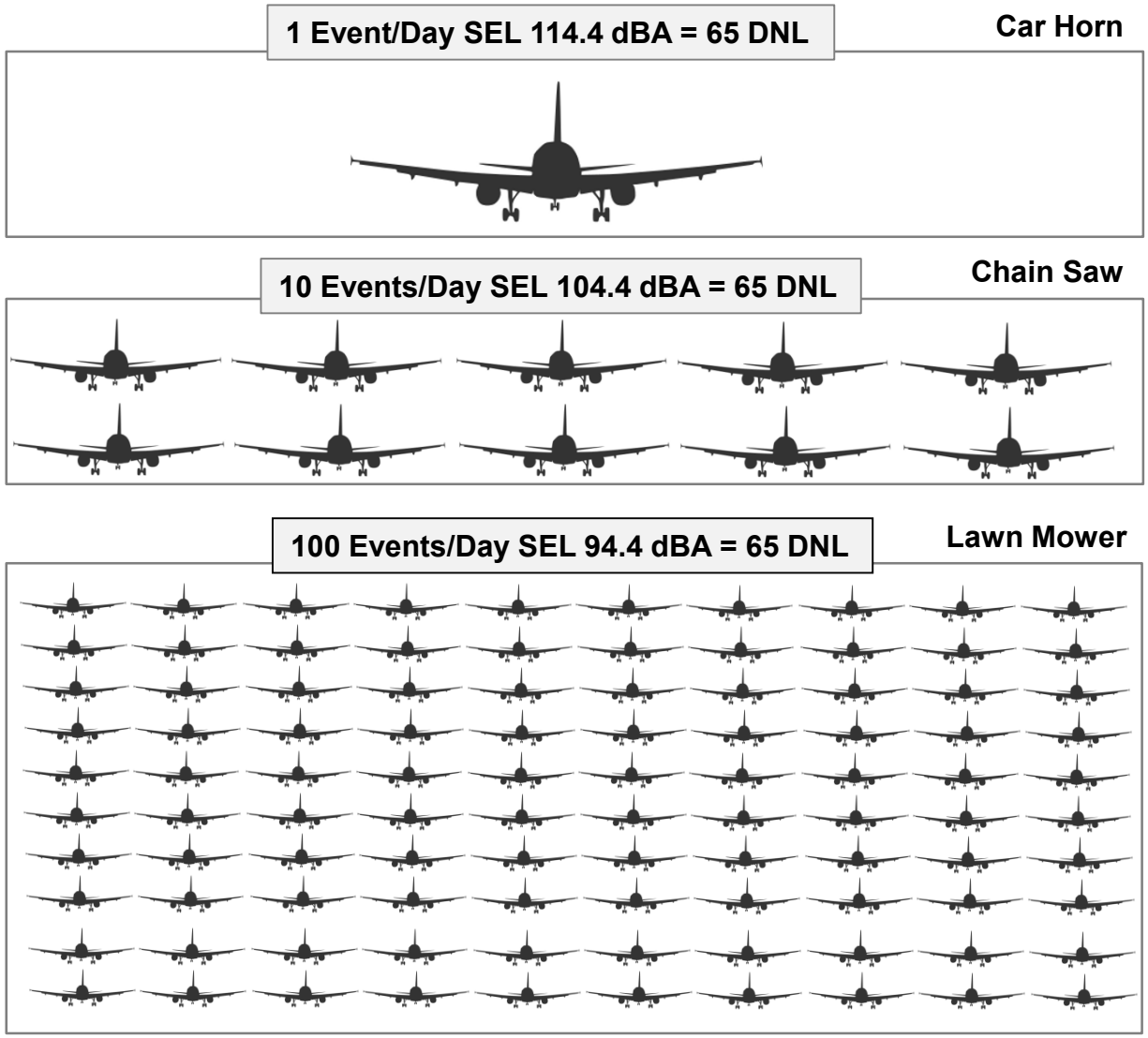
- DNL metric provides cumulative noise exposure to many individual noise events
- Can reach given DNL with single loud noise event or many quieter noise events

Aircraft Noise over Time

- Aircraft noise from 1970s is different than aircraft noise today
- Aircraft from 1970s produced the same acoustic energy as 10 to 30 aircraft operations today

Equivalent DNL

- A few, but relatively loud, events in 1970s would result in DNL 65 dB
- Many, relatively quiet events today would also result in DNL 65 dB
- However, noise experience would be very different



Precision Navigation

- Precision navigation is being implemented to increase the safety and efficiency of the NAS.
- It also leads to a reduction in the overall number of people exposed to noise from aircraft operations.
- However, the implementation of precision aircraft navigation over the last few years has contributed to the increased airport community concerns regarding noise.

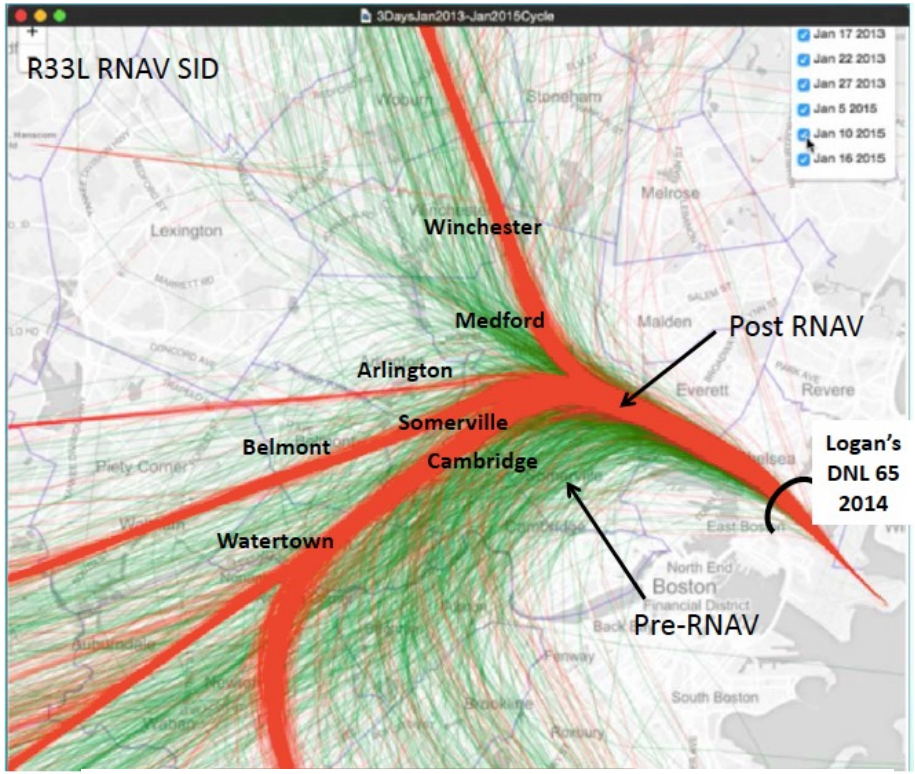


Image Source: Massport

Today's Situation

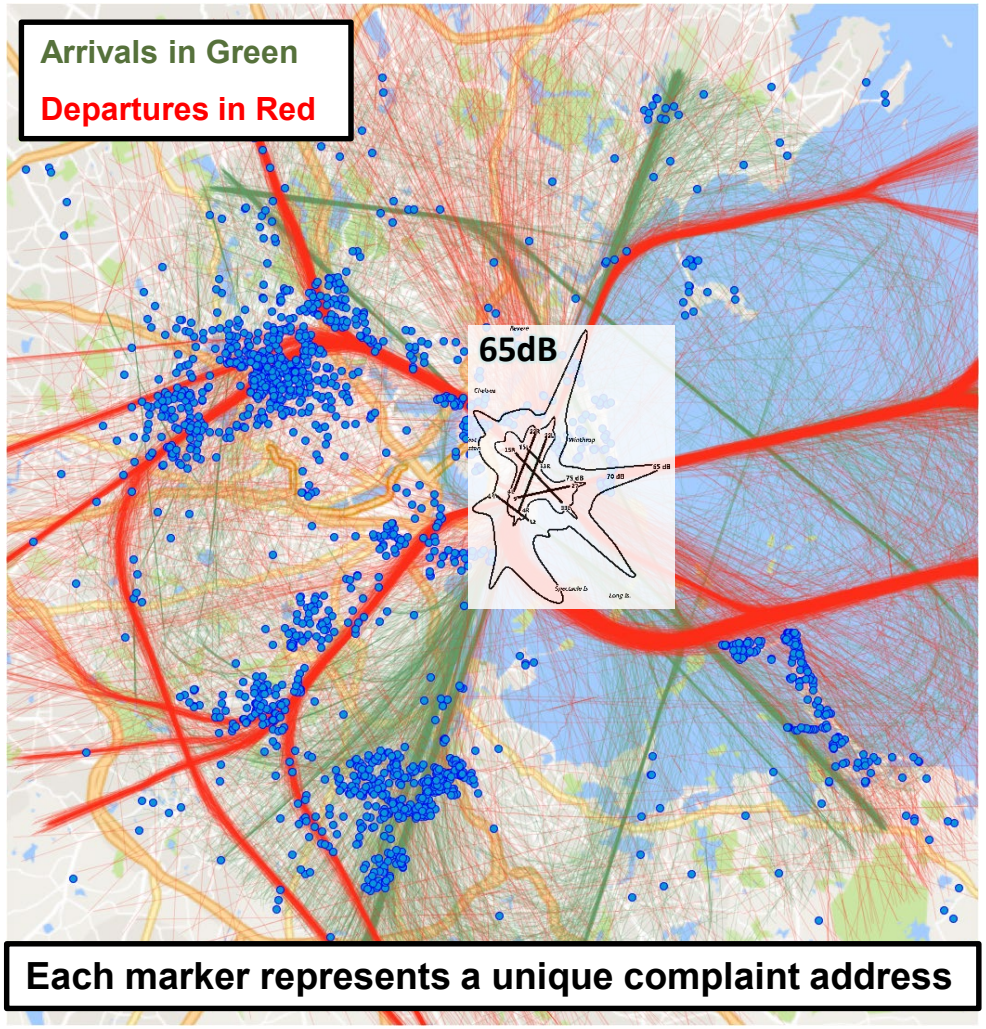
Old Perspective:

"*If you don't like airport noise, then don't live near an airport."*

- Anonymous blogger in response to Washington Post editorial on aircraft noise

New Perspective:

People from well outside the DNL 65 contour are expressing concerns today.



Graphic compiled by J. Hansman et al. (MIT) using complaint data from Massport complaint system and noise contours from the Boston-Logan International Airport 2015 Environmental Data Report (http://www.massport.com/media/2274/2015_edr_compiled_final_version.pdf)

Current Noise Challenge

- Interest by the Public and Congress in re-evaluating NEPA Significance Levels
- Interest to accelerate reintroduction of civil supersonic flight
- Expansion of UAS use
- Helicopter noise concerns
- Public interest in noise associated with new projects
- Public interest in reducing existing noise
- Interest in mitigation and abatement

Addressing the Aircraft Noise Challenge

- **Understanding Impact of Noise**
  - Noise impacts: annoyance, sleep, health and children's learning
  - Aircraft Noise Modeling
  - Sonic boom / puff acceptability
  - Public reaction to UAS noise
  - Helicopter noise impacts
- **Outreach**
  - Increase public understanding
  - Community outreach
- **Mitigation**
  - Land use planning
  - Vehicle operations

Research Areas on Noise Impacts

Community Annoyance (HMMH / Westat)

- **Objective**: Develop an updated and nationally representative dose-response curve of civil aircraft noise exposure and community annoyance. Query individuals experiencing a wide range of noise exposure near airports with variations in aircraft operations using an identical methodology.
- **Status and Timeline:** Mail survey results and a draft report are in process of being reviewed by FAA in coordination with Department of Transportation and other federal agencies. Once final, report will be made available to the public. Analysis of phone survey results is ongoing – likely will take a year to complete.

Children's Learning (ACRP 02-26 and 02-47)

- **Objective:** Understand potential effects of aviation noise exposure on learning in children through test scores, classroom observations, and teacher questionnaires.
- **Results:** ACRP 02-26 study showed a small but statistically significant correlation exists between noise exposure and student test scores. ACRP 02-47 teacher survey suggests that even moderate levels of aircraft noise exposure may impact children's learning experiences; however, there were no observed aircraft noise related distractions on any day of the study period.
- **Status and Timeline:** ACRP Studies are complete. Exploring next steps.

More Information:

- ACRP 02-26: Assessing Aircraft Noise Conditions Affecting Student Learning
  http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2797
- ACRP 02-47: Assessing Aircraft Noise Conditions Affecting Student Achievement--Case Studies
  http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3693

Research Areas on Noise Impacts

Sleep Disturbance (ASCENT Project 17)

- **Objective:** Develop and use an inexpensive, scientifically sound methodology to obtain objective measures of sleep disturbance from aircraft noise. Use methodology to develop relationship between aircraft noise exposure and sleep disturbance that is representative of airport communities across the U.S.
- **Status and Timeline:** Conducted field studies to test different equipment viability in PHL. Validated in another U.S. airport. Recently began planning national sleep study that will require 4 to 5 years of effort.

Health Impacts (PARTNER Project 44 and ASCENT Project 3)

- **Objective**: Determine what, if any, correlation exists between cardiovascular disease and aviation noise. Using noise modeling with epidemiological studies.
- **Status and Timeline:** Have expanded upon initial work PARTNER that used Medicare database to look at other health cohort databases. Leveraging work being funded by National Institutes of Health. Initial results with new cohorts coming out this year. Expect work to continue for a few more years.

More Information:
- PARTNER Project 44: http://partner.mit.edu/projects/aviation-related-noise-effects-elderly
- ASCNET Project 003: https://ascent.aero/project/noise-impact-health-research/
- ASCENT Project 017: https://ascent.aero/project/noise-exposure-response-sleep-disturbance/

Supersonics Interest within the U.S.

- 35-70 pax
- Low-Boom Airliner
- 4,000 nm @ Mach 1.6-1.8

- 8-12 pax
- 4,750 nm
- Mach 1.4, 120k MRW
- -> 2023 EIS

- 12-18 pax
- Low-Boom SBJ
- 6,200 nm
- Mach 1.6, 115k MRW
- -> 2023 EIS

- Low-Boom Demo
- Mach 1.4, 25k MRW
- Lockheed design
- Funded through PDR
- FF 1Q2021

- 80 pax Low-Boom Airliner
- 5,000 nm @ Mach 1.7
- -> 2025 EIS

- 55 pax Airliner
- 4,000 nm @ Mach 2.2
- -> 2026 EIS

- 8-12 pax Low-Boom QSJ
- -> 4,000 nm
- Mach 1.8, 100k MRW
- -> 2030 EIS

Supersonics Research

- Reconsider ban on operations over Mach 1 in the US
  - Heavy reliance on NASA Research for identification of community response to sonic boom for public acceptance
- En route sonic boom standard
  - ASCENT Project 41 supporting develop of certification procedures & technology limits for supersonic airplanes
- Mach Cut-off operability desired by some manufacturers
  - ASCENT Project 42 examining feasibility of Mach Cut-off concept
- US subsonic landing and take-off noise standards
  - Part 36 noise standards are not applicable to supersonic aircraft other than the Concorde.*
- Modeling efforts (ASCENT Project 10)
  - Details provided in Emissions briefing

*https://www.faa.gov/about/office_org/headquarters_offices/agc/practice_areas/regulations/interpretations/data/interps/2018/Executive%20Director-AEE-1%20-%20(2018)%20Legal%20Interpretation.pdf

UAS Noise Research

- **Certification**
  - Exempted in certain situations (Section 333 and Part 107)
  - Measurement of UAS of multiple propulsions and weights is happening, but we **need more noise data**
  - Laying ground work to develop certification framework for all UAS – examining potential for it to be risk-based
  - Examining alternative measurement methods for certification including measurement setups, flight regime, metric, etc. - current standards do not work with all UAS types
  - Conducting subject psychoacoustic tests regarding the annoyance generated by small UAS noise
- **National Environmental Policy Act (NEPA)**
  - Examining modeling needs
  - Determining how to gather necessary information to satisfy noise analysis for NEPA

Helicopter Noise Research

- **Understanding Impacts**
  - Building off ACRP and internal study to conduct a larger study to understand the relationship between helicopter noise and annoyance
- **Noise Abatement Procedures**
  - Develop noise abatement procedures for a variety (classes) of helicopters which will have a positive impact on the community
  - PSU has developed a physics based model that currently has the capability to predict steady state and turning rotorcraft operations (ASCENT 38)
  - Future work will involve additional modeling and validation
  - Additional details provided in Operations Briefing tomorrow
- **IFly Neighborly / Fly Quiet**
  - Outreach and communication programs for operators

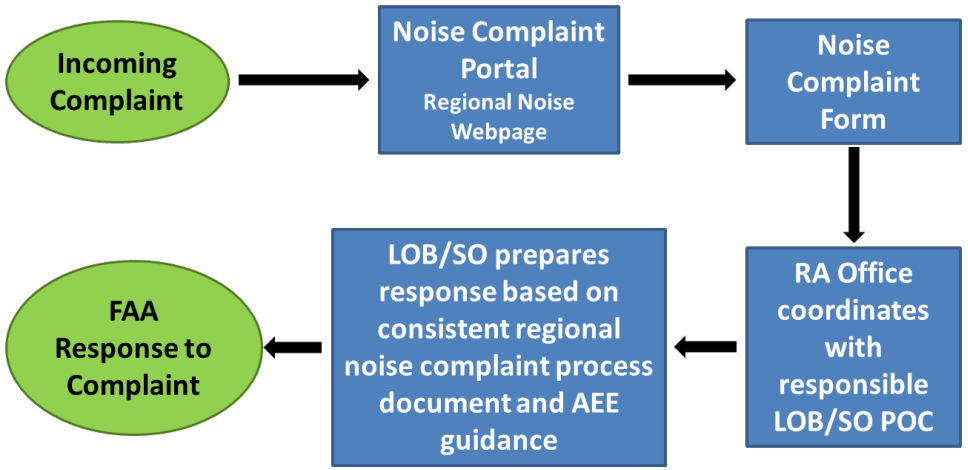
Noise Webpage

- Want new and innovative ways to engage public
- Goal is consistent messaging regarding aircraft noise across agency
- Initial focus will be on basic information regarding noise and FAA noise policy
- Phase I content is complete
  - Fundamentals of noise and sound
  - Community response to noise
  - FAA history of noise
- Phase II will focus on noise survey results

- Have been funding NoiseQuest website (with PSU) for many years, but are not sure about its utility.

Noise Complaint Initiative (NCI)

- More efficiently and effectively address noise complaints in a manner that is both responsive to the public and applies best use of FAA resources



Information from incoming complaints will be stored in a National Noise Complaint Database, managed by AEE and updated automatically from the FAA Noise Complaint Form with information inputted manually from the appropriate LOB/SO as needed.

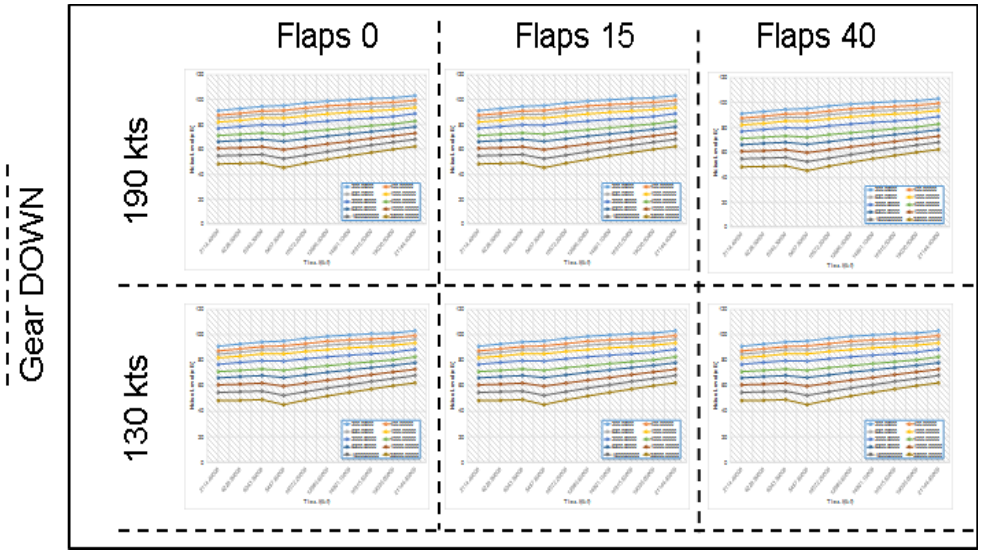
- Testing in Eastern Service Area is on-going
- AEE roll-out of NCI internal process to other service areas:
  - Western Service Area 27-28 February 2018
  - Central Service Area planned for April 2018
- NCI & Noise Portal eLMS course (May 2018)
- Noise Portal Roll-out internal and public (June 2018)

Noise Level Reduction (NLR) Research

- NLR estimation and variation
  - Research effort started in 2012
  - NLR variation → tolerance of indoor DNL eligibility requirement
  - Diverse funding venues: AEE, ATR, ACRP, and ASCENT
- Research identified gaps and findings started to be incorporated into FAA's guidance updates
- Ongoing research is necessary to further understand the difference between the aircraft flyover noise and loudspeaker noise testing (funded by ATR)
- Research program is expected to lead to update of a new industry standard via SAE A-21 (a technical committee focusing on aircraft noise and emissions)

Noise Modeling

- **Higher fidelity Noise Source Characterization**
  - Develop analytical techniques to capture airframe noise (ASCENT 23)
  - Develop Noise Power Distance plus Configuration (NPDC) format that enables more accurate noise prediction due to aircraft configuration and speed changes (ASCENT 43)



- **Propagation**
  - Acquired multiple sets of field measurement data and started validation of prediction models (ASCENT 40)
  - Evaluated and validated promising models that predict the effect of mixed ground types and that can be integrated into AEDT (ACRP 02-52).

Making a Difference over Last 5 Years

- AEE has a leadership role in the ICAO Committee on Aviation Environmental Protection, which agreed on a new noise standard for subsonic jet airplanes in 2013. The new noise standard ensures the latest available noise reduction technology is incorporated into new aircraft designs starting January 1, 2018.

- Research of the impacts of aircraft noise on learning has demonstrated that sound insulation is effective in mitigating impacts. Continued research of aircraft noise impacts on learning as well as annoyance, sleep disturbance, and health is crucial for understanding the impacts of aircraft noise and informing FAA policy.

- Research on aircraft source noise (ASCENT Project 23) has helped inform operational concepts that could help reduce noise around Boston Logan airport. Continued research of higher fidelity aircraft noise characterization (ASCENT Project 43) will improve aircraft noise modeling and assist in determining benefits of advanced operational procedures.

FY19 Budget Implications

- **Rotorcraft noise is a growing concern**
  - Issues continue with Long Island North Shore, the LA Basin, the Grand Canyon, and Hawaii
  - Lawsuit filed by Public Employees for Environmental Responsibility (PEER) over excessive National Park overflights
- **Helicopter portfolio has blossomed in the last few years and the need for research will continue.**
- **Helicopter research <u>will not be funded</u> under the current FY19 budget.**

Summary

- **Noise continues to be a concern.**
- **Many initiatives are underway to address noise from multiple aircraft types.**
- **Renewed interest in supersonic aircraft flight over land.**
- **Research has made a difference but there is more work to be done.**
- **Helicopter portfolio in jeopardy under current FY19 budget scenario.**