2019 UC Davis
Aviation Noise & Emissions Symposium

Evolution of Aviation Noise

Presented by:

Steve Alverson, ESA

March 3, 2019

Copyright 2019 Environmental Science Associates

ESA

ESA is where solutions and service meet.

Evolution of Aviation Noise

- What is noise?
- Community annoyance with noise is not a modern issue
- Early aircraft noise issues
- Evolution of federal regulations addressing aircraft noise
- Technological improvements to reduce aircraft noise
- Recent trends in aircraft noise concerns

Copyright 2019 Environmental Science Associates

What is noise?

- Noise is unwanted sound
  - What is music to my ears, may be noise to you
- While noise is subjective on an individual basis, social surveys indicate a relationship between noise level and community annoyance
- Federal regulations set acceptable levels of aircraft noise for environmental assessment, land use planning, and noise mitigation purposes

Copyright 2019 Environmental Science Associates

Community Annoyance

- In 6000 BCE, the Sybarites banned blacksmiths and cabinets makers from working in residential areas due to the noise
  - First recorded zoning ordinance
- Julius Caesar banned chariots from the streets of Rome after dark to reduce nighttime noise
  - Oldest recorded noise ordinance

Copyright 2019 Environmental Science Associates

Community Annoyance

- In some medieval European cities, horse-drawn carriages were banned at night and straw was laid on the streets during the day to reduce noise levels
- Concerns regarding community noise levels and sleep disturbance have continued to modern times
- Noise was the most cited reason for moving in the 2000 United States census

Copyright 2019 Environmental Science Associates

Early Aircraft Noise Issues

- Barnstormers used the sound of their aircraft engines to attract a public eager to experience the wonders of flight
- Early commercial flights, first US mail and then passenger carriers, were few and far between
- The public perspective shifted in the early 1960s as commercial air carriers transitioned from propeller-driven aircraft to jets

Copyright 2019 Environmental Science Associates

ESA Airports

Evolution of Aviation Noise

1935

Photo Credit: Flightglobal.com

1918

Photo Credit: Skyways Journal Magazine

Copyright 2019 Environmental Science Associates

Early Aircraft Noise Issues

- Boeing 707s and Douglas DC-8s became the workhorses of commercial aviation
- Airport neighbors noticed and objected to this change in aircraft noise exposure and demanded action
- Aircraft noise was becoming recognized as a legitimate problem on both a local and national level

Copyright 2019 Environmental Science Associates

Evolution of Aviation Noise

1958

Photo Credit: Airliners.net

1957

Photo Credit: Air-Review.com

Copyright 2019 Environmental Science Associates

Federal Aircraft Noise Regulations – 1950s

- Federal Aviation Act of 1958
  - Congress gave the Federal Aviation Administration (FAA) the authority to regulate the use of the navigable airspace
  - Congress recognized that the public has a basic right to air transit, which was declared "a right of national sovereignty"

Copyright 2019 Environmental Science Associates

Federal Aircraft Noise Regulations – 1960s

- Amendment of the Federal Aviation Act of 1968
  - Recognized aircraft noise as a problem and authorized FAA to establish standards of measuring noise as well as regulations to control and abate aircraft noise
  - Required the regulations be "consistent with the highest degree of safety" and be "economically reasonable, technologically practicable, and appropriate for the particular type of aircraft."
  - Aimed at controlling noise at the source (i.e., aircraft) not airport proprietors

Copyright 2019 Environmental Science Associates

ESA Airports

Evolution of Aviation Noise

1963

Photo Credit: RuthAS

1967

Photo Credit: Boeing

Copyright 2019 Environmental Science Associates

Federal Aircraft Noise Regulations – 1960s

- FAA Promulgates Federal Aviation Regulation (FAR) Part 36 in 1969
  - Established uniform measurement system for aircraft noise certification
  - Established maximum allowable aircraft noise limits for *newly manufactured aircraft*
  - Permitted heavier aircraft to have higher noise levels

Copyright 2019 Environmental Science Associates

Federal Aircraft Noise Regulations – 1970s

- Noise Control Act of 1972
  - Prohibits FAA from issuing type certificates for aircraft not meeting the Part 36 noise limits
  - Added the Environmental Protection Agency (EPA) to the regulatory process, but did not require FAA to adopt EPA's regulations

Copyright 2019 Environmental Science Associates

Federal Aircraft Noise Regulations – 1970s

- FAA Amends FAR Part 36 in 1976
  - Required *currently operating aircraft* to comply with Part 36 noise limits
  - Allowed for phased compliance with the requirements by January 1, 1985, which was extended to January 1, 1988
  - The 1988 amendment also added the requirement for foreign carriers to comply with the regulations
- Established the noise-related "Stages"

Copyright 2019 Environmental Science Associates

Federal Aircraft Noise Regulations – 1970s

- FAA's Aviation Noise Abatement Policy of 1976
  - Identified the various roles and responsibilities for aircraft noise abatement
    - FAA, airport proprietors, airlines, state and local governments, and prospective residents
- This policy remains in effect today

Copyright 2019 Environmental Science Associates

Evolution of Aviation Noise

1979

Photo Credit: Boeing

Copyright 2019 Environmental Science Associates

Federal Aircraft Noise Regulations – 1970s

- Aviation Safety and Noise Abatement Act of 1979
  - Required FAA to establish a method of quantifying and assessing the impact of aircraft noise at airports
  - Provided for federal funding of voluntary airport noise and land use studies
- Resulted in FAR Part 150 Airport Noise and Land Use Compatibility Planning in 1984
  - Approved Noise Compatibility Programs measures are eligible for federal funding (e.g., sound insulation, land acquisition, ground run-up enclosures, noise monitoring systems)

Copyright 2019 Environmental Science Associates

Evolution of Aviation Noise

1981

Photo Credit: Boeing

Photo Credit: Boeing

Copyright 2018 Environmental Science Associates

Federal Aircraft Noise Regulations – 1990s

- Airport Noise and Capacity Act of 1990
  - Established the phase-out of Stage 2 aircraft greater than 75,000 pounds by January 1, 2000
  - Grandfathered existing airport-specific noise limits
- Resulted in 14 CFR Part 161- Notice and Approval of Airport Noise and Access Restrictions
  - Study of last resort
  - Many have tried, but only one restriction was approved since 1991

Copyright 2019 Environmental Science Associates

Technological Improvements

- Aircraft have become significantly quieter since the 707s and DC-8s of the early 1960s
- More stringent noise requirements through FAR Part 36 and the International Civil Aviation Organization's (ICAO) Committee on Aviation Environmental Protection (CAEP) have helped to drive aircraft noise research
- The airlines' desire to reduce fuel consumption and air emissions have provided further incentives to reduce aircraft noise

Copyright 2019 Environmental Science Associates

ESA Airports

Evolution of Aviation Noise

Photo Credit: Museum of Flight

Copyright 2018 Environmental Science Associates

GE-9X Turbofan Engine for the 777X

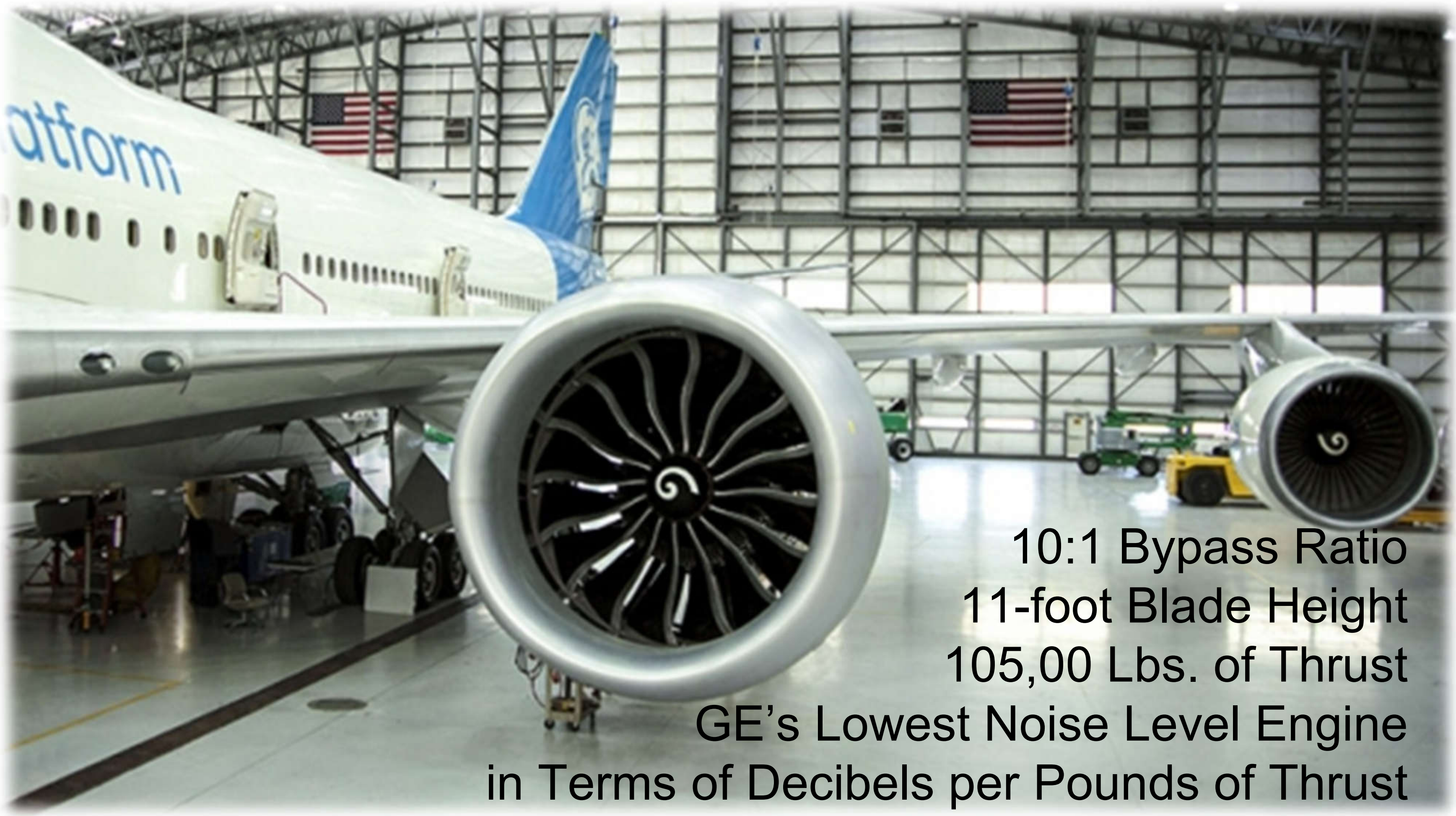


Photo Credit: General Electric

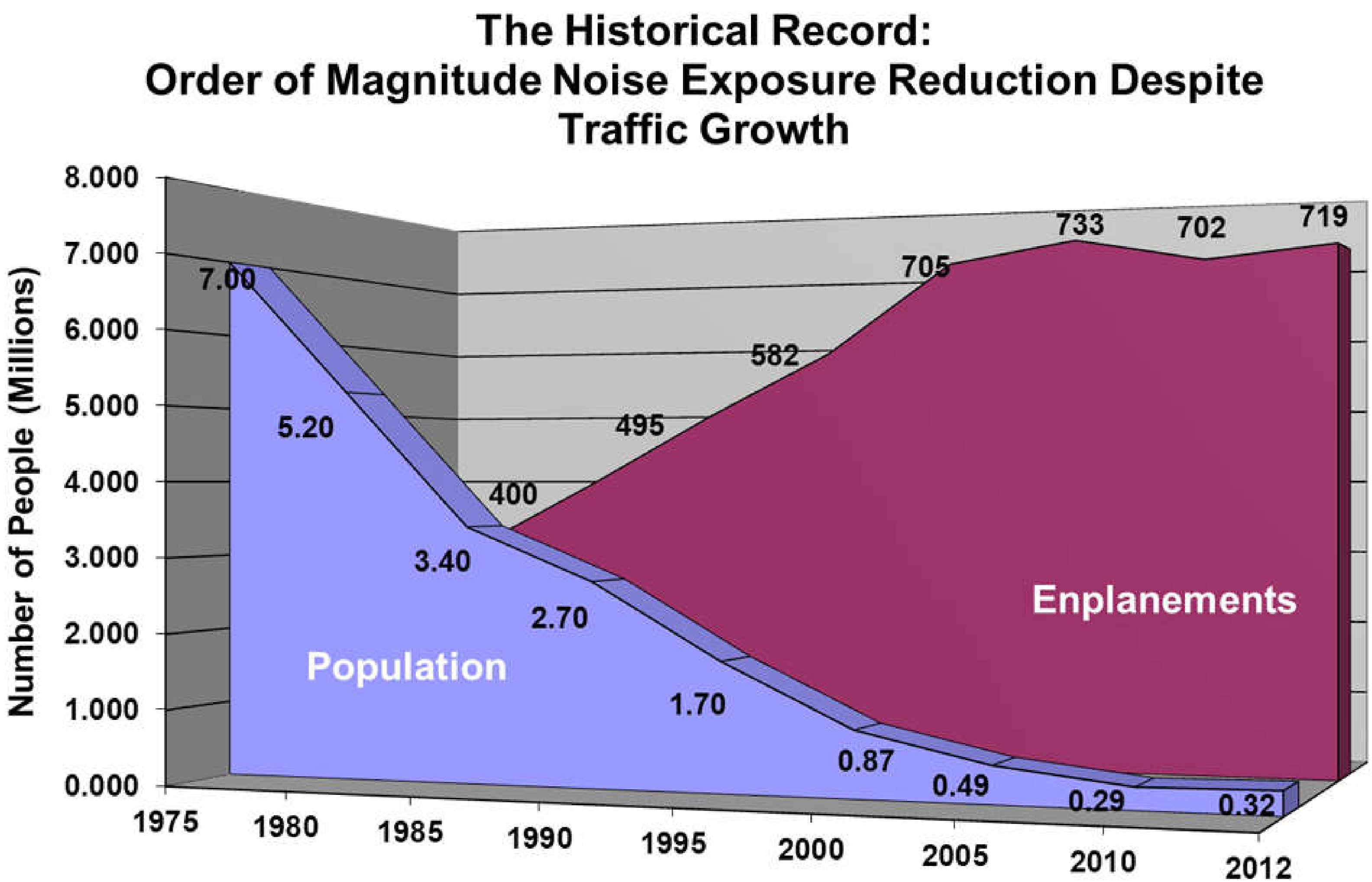
Copyright 2019 Environmental Science Associates

Technological Improvements

- At many airports, the average aircraft size is increasing as airlines “upgauge” their fleets
  - More passengers are carried with fewer operations
- As a result, aircraft operations have increased modestly as passenger volume has gone up dramatically
- These technological improvements and airline practices have resulted in millions of people being removed from noise impact areas near airports

Copyright 2019 Environmental Science Associates

Evolution of Aviation Noise



Source: FAA

Copyright 2019 Environmental Science Associates

Technological Improvements

- On the aircraft
  - Low-bypass engines replaced by high bypass engines
  - Improved wing designs and winglets; improved climb performance
  - Vortex generators reduce tonal noise from wing vents

Copyright 2019 Environmental Science Associates

Evolution of Aviation Noise

Photo Credit: Lufthansa

Photo Credit: Aviation Partners

Copyright 2019 Environmental Science Associates

Evolution of Aviation Noise

Photo Credit: Airbus

Copyright 2019 Environmental Science Associates

2017

Photo Credit: Boeing

Copyright 2019 Environmental Science Associates

Airline Fleet Changes

- For improved fuel efficiency, airlines are replacing four-engine long-haul aircraft (e.g., A-380s and B-747s) with twin-engine widebody aircraft (e.g., B-787s and B-777s)
- These aircraft look very similar to their much smaller twin-engine narrowbody counterparts such as the A-320 and B-737
- As a result, these widebody twin-engine aircraft often appear to be lower at the same altitude

Copyright 2019 Environmental Science Associates

Comparison of a Boeing 787-900 to a Boeing 737-900 at an altitude of 2,500' Above Ground Level

Source: Environmental Science Associates

Copyright 2019 Environmental Science Associates

Last week, Airbus announced the cessation of the production of the A-380 aircraft because. . .

Photo Credit: Airbus

Copyright 2019 Environmental Science Associates

Evolution of Aviation Noise

. . .it cannot compete with the fuel efficient, twin-engine widebody aircraft such as the 777 and 787.

Photo Credit: Boeing

Copyright 2019 Environmental Science Associates

ESA Airports

Evolution of Aviation Noise

While some future aircraft may become even quieter, others may require changes in current noise standards

Image Credit: Zunum

Image Credit: Airbus

Image Credit: Aerion

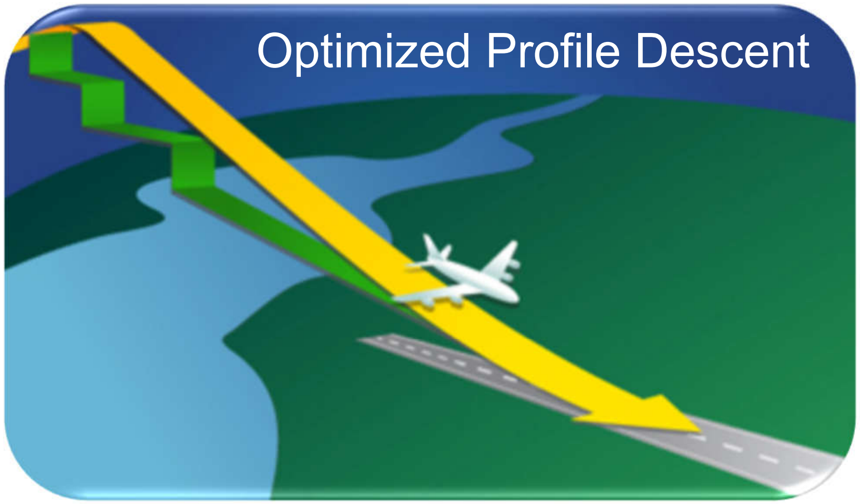
Copyright 2019 Environmental Science Associates

Technological Improvements

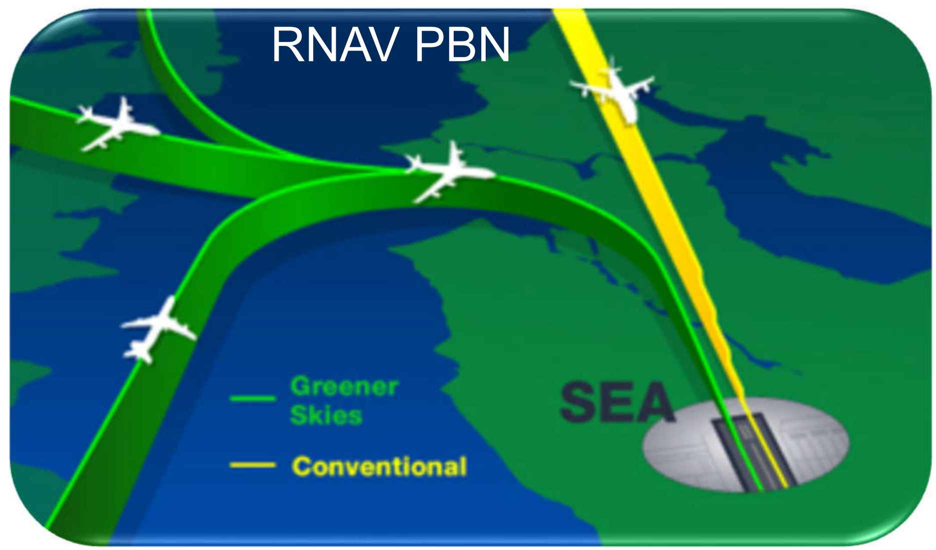
- In flight
  - Continuous Descent Approaches (CDAs) or Optimized Profile Descents (OPDs)
    - Uses flight-idle throttle settings and keeps the aircraft “clean” until several miles from touchdown
  - Performance Based Navigation (PBN), Required Navigation Performance (RNP), and Area Navigation (RNAV) departures and approaches
    - Incorporates OPDs into standard arrival procedures and, when possible, concentrates aircraft over compatible land uses

Copyright 2019 Environmental Science Associates

Evolution of Aviation Noise



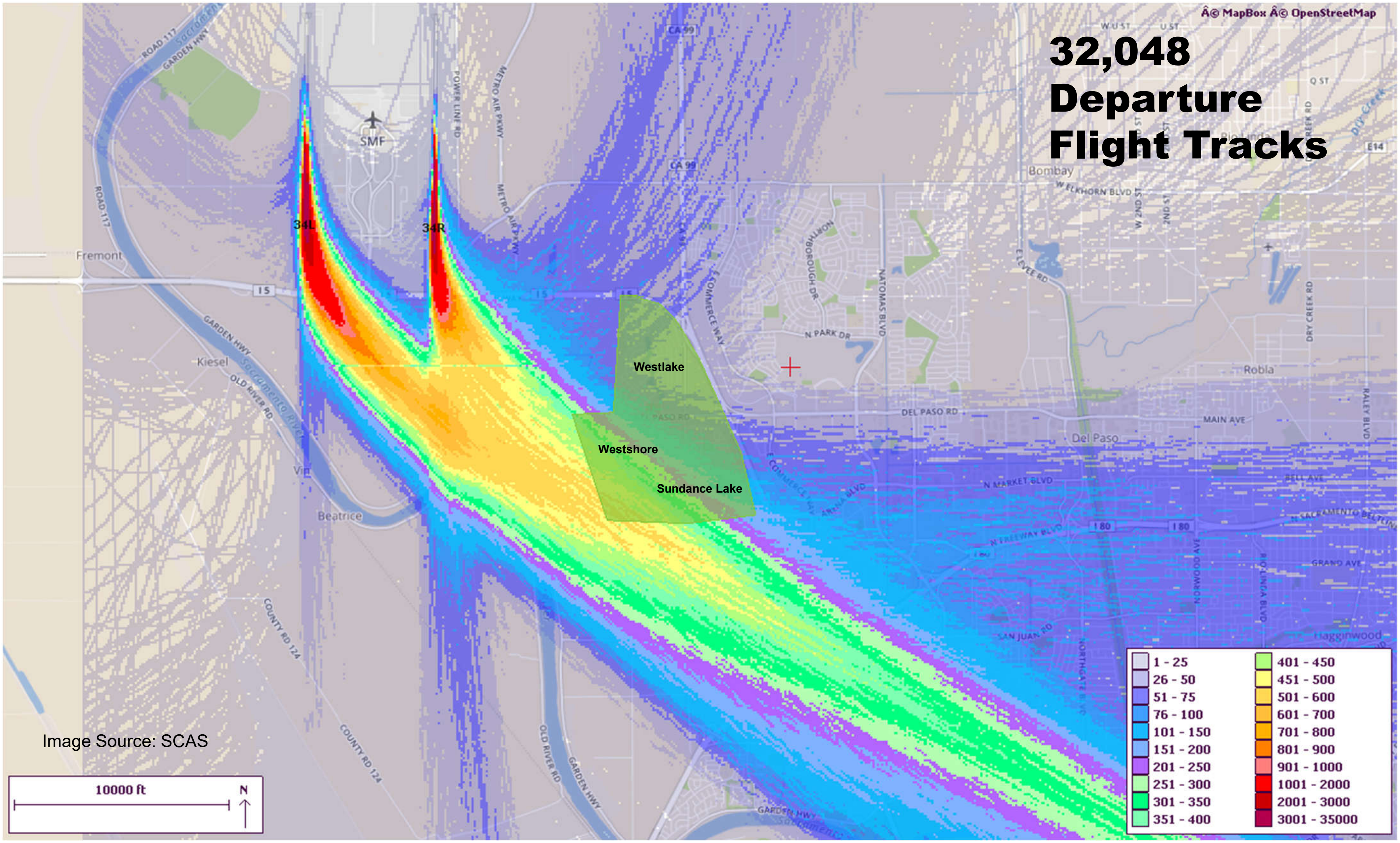
Source: FAA



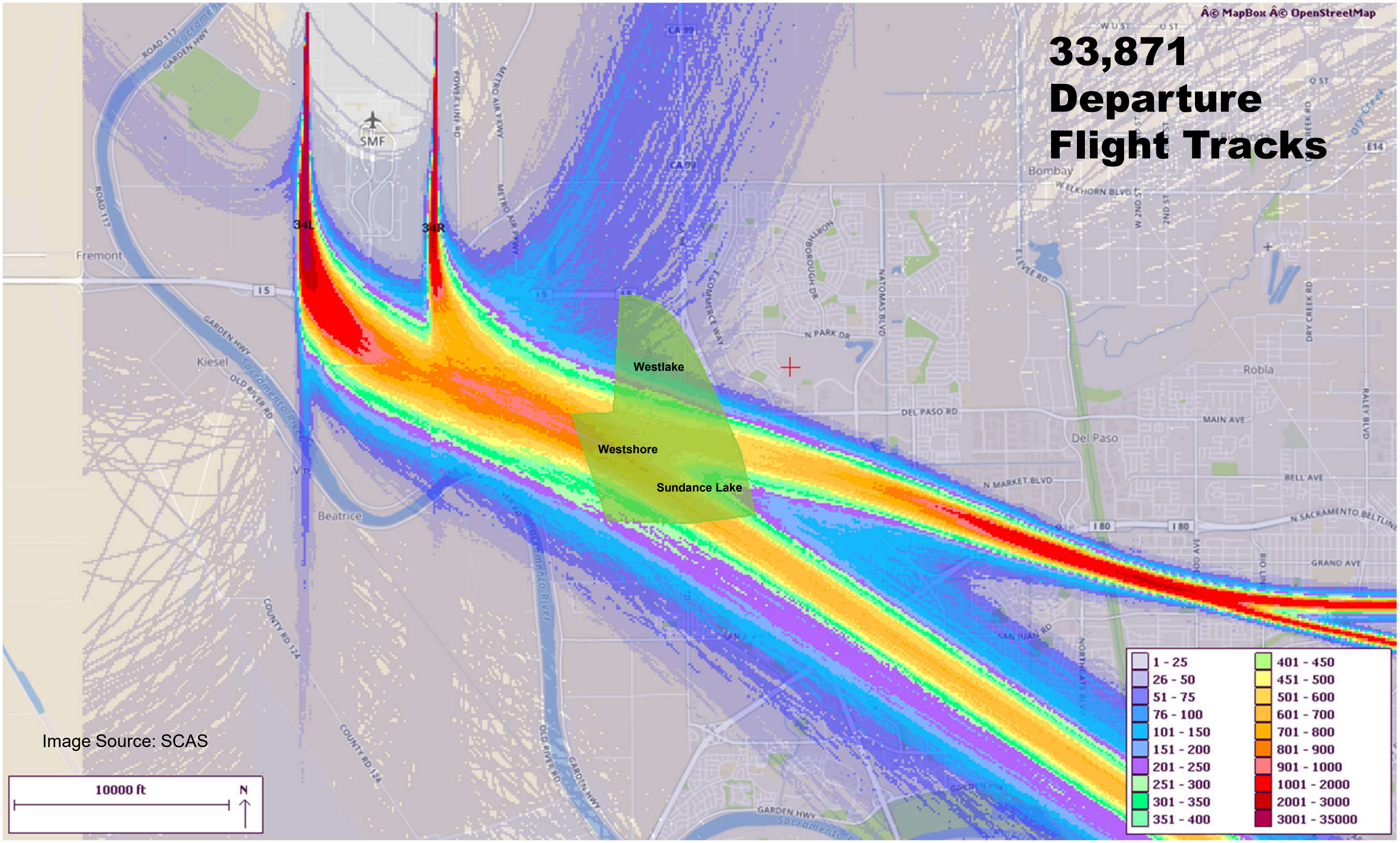
Source: FAA

Copyright 2019 Environmental Science Associates

2014 SMF South Flow Departures



2017 SMF South Flow Departures



Recent Trends in Aircraft Noise Concerns

- Concerns
  - Aircraft altitudes
  - Frequency of overflights
  - Increased nighttime flights
  - Concentrated flight tracks over noise sensitive land uses
  - New noise sensitive areas exposed to aircraft overflights and noise
  - Impact of aircraft noise on human health

Copyright 2019 Environmental Science Associates

Recent Trends in Aircraft Noise Concerns

- Reaction
  - Increased community activism
  - Requests for the establishment of lower national aircraft noise standards (i.e., 55 DNL)
  - Formation of a congressional caucus on aircraft noise
  - Independent aircraft noise complaint websites and automated noise complaint filing apps
  - Threats of litigation

Copyright 2019 Environmental Science Associates

Evolution of Aviation Noise

- What is noise?
- Community annoyance with noise is not a modern issue
- Early aircraft noise issues
- Evolution of federal regulations addressing aircraft noise
- Technological improvements to reduce aircraft noise
- Recent trends in aircraft noise concerns

Copyright 2019 Environmental Science Associates

Questions?

Copyright 2019 Environmental Science Associates

2019 UC Davis
Aviation Noise & Emissions Symposium

Quantifying Aviation Noise

Presented by:

Steve Alverson, ESA

March 3, 2019

Copyright 2019 Environmental Science Associates

ESA

ESA is where
solutions and
service meet.

Quantifying Aviation Noise Exposure

- Aircraft noise can be measured and modeled
- Measurements and modeling can describe historical noise levels, but only modeling can predict *future* noise levels
- Measured and modeled noise levels can be compared
- Federal regulations require the use of noise models, not measurements, to quantify aircraft noise exposure
- California regulations require the use of noise measurements to validate the aircraft noise impact boundary

Copyright 2019 Environmental Science Associates

Quantifying Aviation Noise Exposure

- Aircraft noise exposure can be quantified using:
  - Measurements
  - Modeling

Copyright 2019 Environmental Science Associates

Quantifying Aviation Noise Exposure

- Measuring sound levels will accurately tell us:
  - The sound levels at a specific location for the time period the measurements were made
  - The historical record of the sound levels at a specific location
  - Historical trends; but measurements do not predict future noise levels

Copyright 2019 Environmental Science Associates

Quantifying Aviation Noise Exposure

- Modeling sound exposure accurately tells us the sound levels:
  - Over broad geographic areas as well as at specific locations for a specific time period
  - Modeling can produce a historical record
  - Modeling can be predictive by showing expected trends in aircraft noise exposure
  - Modeling can be used to prepare “What If?” scenarios

Copyright 2019 Environmental Science Associates

Noise Measurement Standards

- Noise monitoring equipment and the field measurements must be made in accordance with all applicable standards
  - Federal
  - State
  - Local

Copyright 2019 Environmental Science Associates

Noise Measurement Standards

- 14 CFR FAR Part 150 establishes the noise measurement methods and metrics for conducting aircraft noise measurements

- Local municipalities often specify noise measurement standards in noise ordinances or general plans

Copyright 2019 Environmental Science Associates

Noise Measurement Equipment

- Permanent noise monitors cover a limited area, but provide long-term noise measurement data for analyzing trends
  - Operation is automated requiring very little staff labor

- Portable noise monitors can be moved from location to location for short periods of time and may be returned to the same location to analyze trends
  - Very labor intensive for noise office staff

Copyright 2019 Environmental Science Associates

Noise Measurement Equipment

- Measured noise events can be correlated with aircraft flight track and identification data in an airport's airport Noise and Operations Management System (NOMS)
  - Both portable and permanent noise measurement sites can be entered into an airport's NOMS
  - Noise levels can be tracked over time and can be analyzed by:
    - aircraft type, type of operation, time of day, and noise measurement site

Copyright 2019 Environmental Science Associates

Noise Measurement Equipment

Portable Noise Monitor

Permanent Noise Monitor

Copyright 2019 Environmental Science Associates

Aircraft Noise Modeling Concepts

- Mathematical models are used everyday to depict a variety of real-life situations such as:
  - Bridge loading, aerodynamic performance, fuel economy, and computer animation
- Model accuracy is a function of the modeling algorithms, the empirical databases, and user sophistication
- When used properly, aircraft noise models have proven to be highly accurate

Copyright 2019 Environmental Science Associates

Aircraft Noise Modeling Tools

- Commonly used aircraft noise modeling tools:
  - FAA's Aviation Environmental Design Tool (AEDT)
  - FAA's Integrated Noise Model (INM) (Superseded by AEDT)
  - FAA's Noise Integrated Routing System (NIRS) (Superseded by AEDT)
  - US Air Force's NOISEMAP
  - US Air Force's BOOMAP
- Modeling tools quantify aircraft noise exposure in the vicinity of airports as well as at more distant locations

Copyright 2019 Environmental Science Associates

Aircraft Noise Modeling Tools

- The AEDT is the FAA approved model for use in preparing:
  - Noise elements of airport master plans
  - Noise exposure maps for 14 CFR Part 150 and 14 CFR Part 161 studies
  - Noise elements of federal environmental assessments and environmental impact statements
  - Noise contours for state environmental impact reports

Copyright 2019 Environmental Science Associates

Aircraft Noise Modeling Tools

- NIRS was formerly approved for use in assessing changes in aircraft noise exposure resulting from changes in air traffic procedures over large geographic areas. NIRS has been superseded by AEDT
- NOISEMAP is approved for noise studies involving predominately military aircraft operations
- BOOMAP is for use in modeling sonic booms in military special use areas

Copyright 2019 Environmental Science Associates

Integrated Noise Model (INM)

- FAA’s standard tool since 1978 for determining the predicted noise impacts around airports
- INM handled fixed wing and rotary wing aircraft and is the FAA’s state-of-the-art aircraft noise model
- Model produced noise exposure contours that are used for determining land use compatibility

Copyright 2019 Environmental Science Associates

Integrated Noise Model (INM)

- INM had been in use for over 35 years and was continually updated to improve its accuracy
- INM contained an extensive aircraft performance and noise level database derived from actual noise measurements of aircraft in flight
- INM results have been validated on several occasions with overall modeled and measured levels falling within a couple of decibels of each other

Copyright 2019 Environmental Science Associates

Aviation Environmental Design Tool (AEDT)

- INM was replaced by the AEDT at the end of May 2015
- AEDT combines the capabilities of the Emissions Dispersion Modeling System (EDMS) and INM in a single model
- AEDT allows for assessing the trade offs between air emissions and noise impacts
- AEDT is the FAA-approved tool for aircraft noise modeling

Copyright 2019 Environmental Science Associates

AEDT

- AEDT can also predict noise at a specific location that may be sensitive to noise impacts (school, hospital, noise measurement sites, etc.)

- 16 predefined noise metrics are supported, including:
  - DNL
  - CNEL
  - Lmax
  - Leq
  - SEL
  - SENEL

Copyright 2019 Environmental Science Associates

AEDT Process: Input

- AEDT uses the following inputs:
  - Annual average temperature
  - Airport elevation
  - Airport layout
    - runways, landing areas, run-up locations
  - Surrounding terrain

Copyright 2019 Environmental Science Associates

AEDT Process: Input

- AEDT uses the following inputs:
  - Number of annual-average day operations
    - by aircraft type and time of day
  - Runway use
    - by aircraft type and time of day
  - Approach, departure, and training flight paths
  - Flight path usage
    - by aircraft type and time of day

Copyright 2019 Environmental Science Associates

AEDT Process: Computation

- Each aircraft type “flies”:
  - off the runways as they are used
  - departure profiles based on aircraft weight, annual average temperature, and airport altitude
  - the flight tracks as they are used during the year
  - approach profiles as they are flown

Copyright 2019 Environmental Science Associates

AEDT Process: Computation

- AEDT computes the exposure of each operation:
  - as it would be measured in the airport environs accounting for the annual-average use

- The noise exposure of each aircraft operation is:
  - energy-summed over a user-specified grid to determine the annual average noise exposure

- Values of equal noise exposure are connected using "contour lines"

Copyright 2019 Environmental Science Associates

AEDT Process: Output

- Depictions of aircraft noise exposure
  - DNL or CNEL contours
  - SEL or Lmax contours
  - DNL values over a grid

- Noise levels at specific points such as a:
  - home
  - noise monitor
  - school
  - church

Copyright 2019 Environmental Science Associates

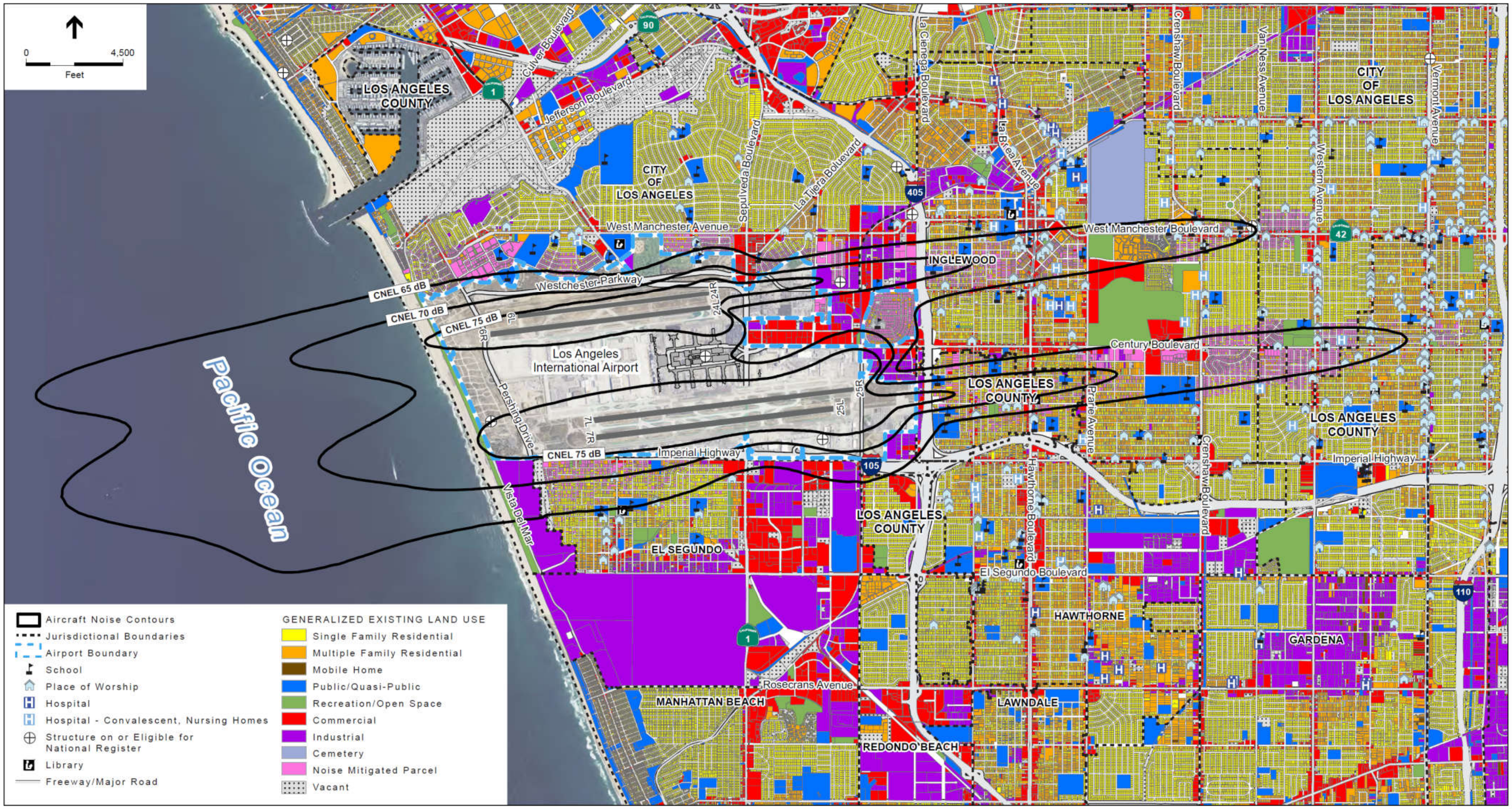
Aircraft Noise Model Application

- Aircraft noise modeling tools have many analytical uses:
  - Depicting annual aircraft noise exposure
  - Depicting single-event noise exposure
  - Predicting future aircraft noise exposure
  - Assessing changes in noise impacts resulting from runway configuration changes or new runways
  - Assessing changes in fleet mix and/or number of operations
  - Evaluating operational procedures

Copyright 2019 Environmental Science Associates

ESA Airports

Noise Model Output: CNEL Contours



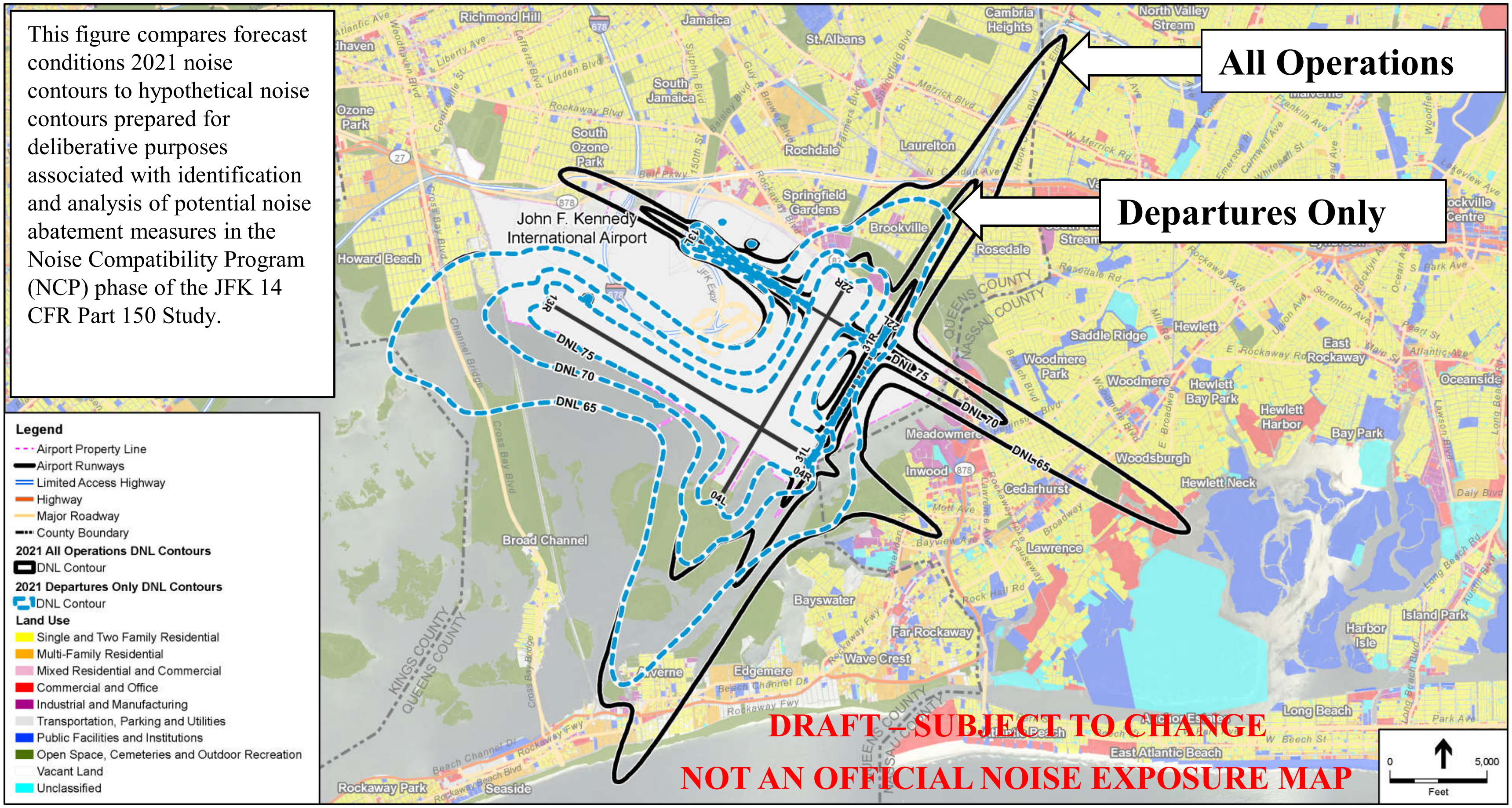
SOURCES: LAWA, 2014; ESA Airports, 2014; ESRI ArcGIS Online, 2011; ESRI World Imagery - Aerial; PCR Services Corporation, 2012
NOTES: CNEL = Community Noise Equivalent Level; dB = Decibel.

Los Angeles International Airport 14 CFR Part 150 Study . 130072.03
Exhibit 5-1
2015 Noise Exposure Map – Los Angeles International Airport

Copyright 2019 Environmental Science Associates

Noise Contributions: 2021 Departures Only (Excluding Arrivals)

This figure compares forecast conditions 2021 noise contours to hypothetical noise contours prepared for deliberative purposes associated with identification and analysis of potential noise abatement measures in the Noise Compatibility Program (NCP) phase of the JFK 14 CFR Part 150 Study.

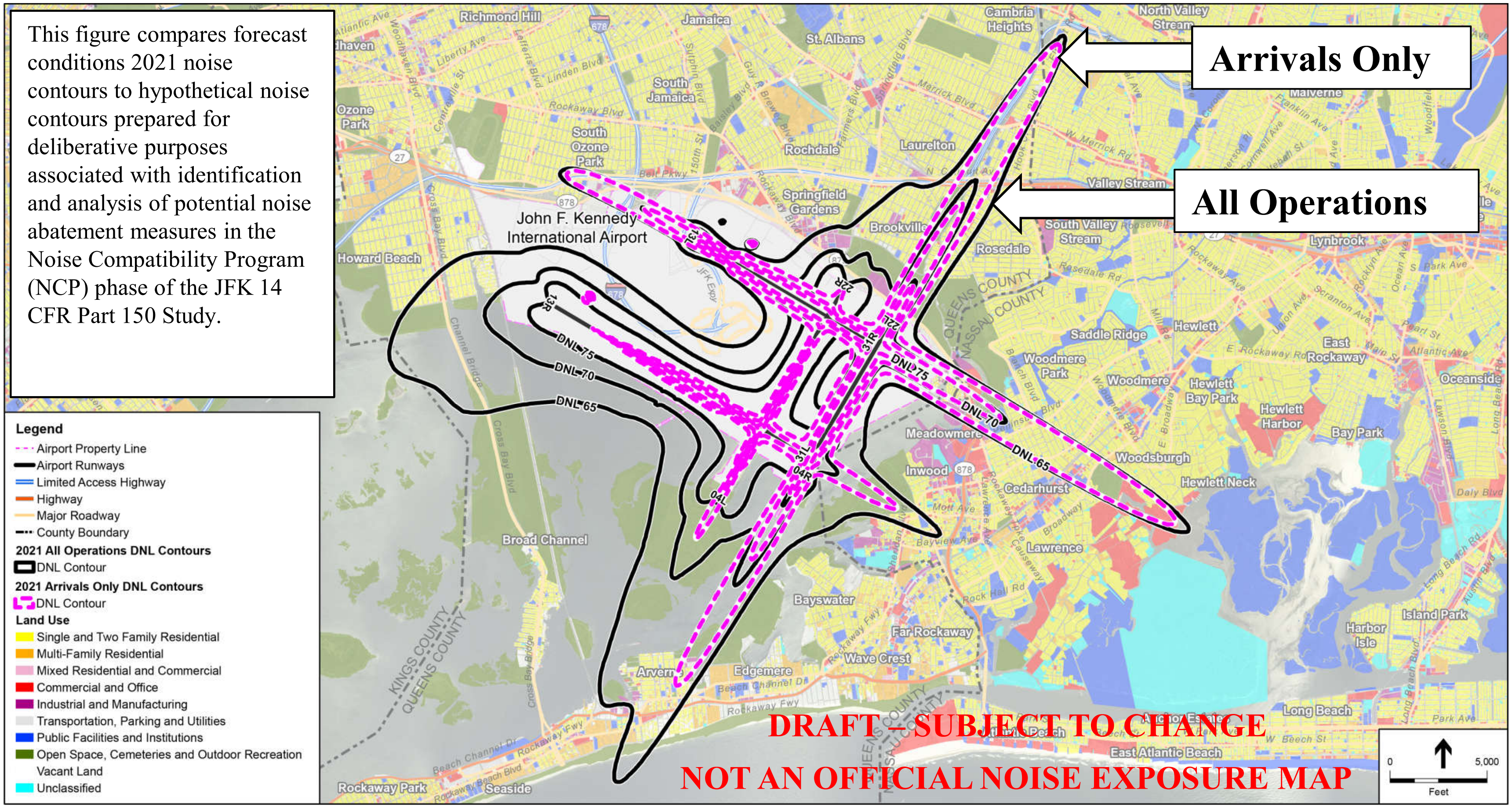


SOURCE: New York City Department of City Planning, MapPLUTO 15V1-Tax lot/land use geographic information database, March 2015-June 2015 (adapted by ESA); Nassau County Department of Public Works Planning Division; Property classification and geographic information database, September 2015; ESRI Mapping Services; Environmental Science Associates, 2016; Planning Technology, Inc. 2016.

Copyright 2019 Environmental Science Associates

Noise Contributions: 2021 Arrivals Only (Excluding Departures)

This figure compares forecast conditions 2021 noise contours to hypothetical noise contours prepared for deliberative purposes associated with identification and analysis of potential noise abatement measures in the Noise Compatibility Program (NCP) phase of the JFK 14 CFR Part 150 Study.



SOURCE: New York City Department of City Planning, MapPLUTO 15V1-Tax lot/land use geographic information database, March 2015-June 2015 (adapted by ESA); Nassau County Department of Public Works Planning Division; Property classification and geographic information database, September 2015; ESRI Mapping Services; Environmental Science Associates, 2016; Planning Technology, Inc. 2016.

Copyright 2019 Environmental Science Associates

Comparison of Common Aircraft Types at JFK

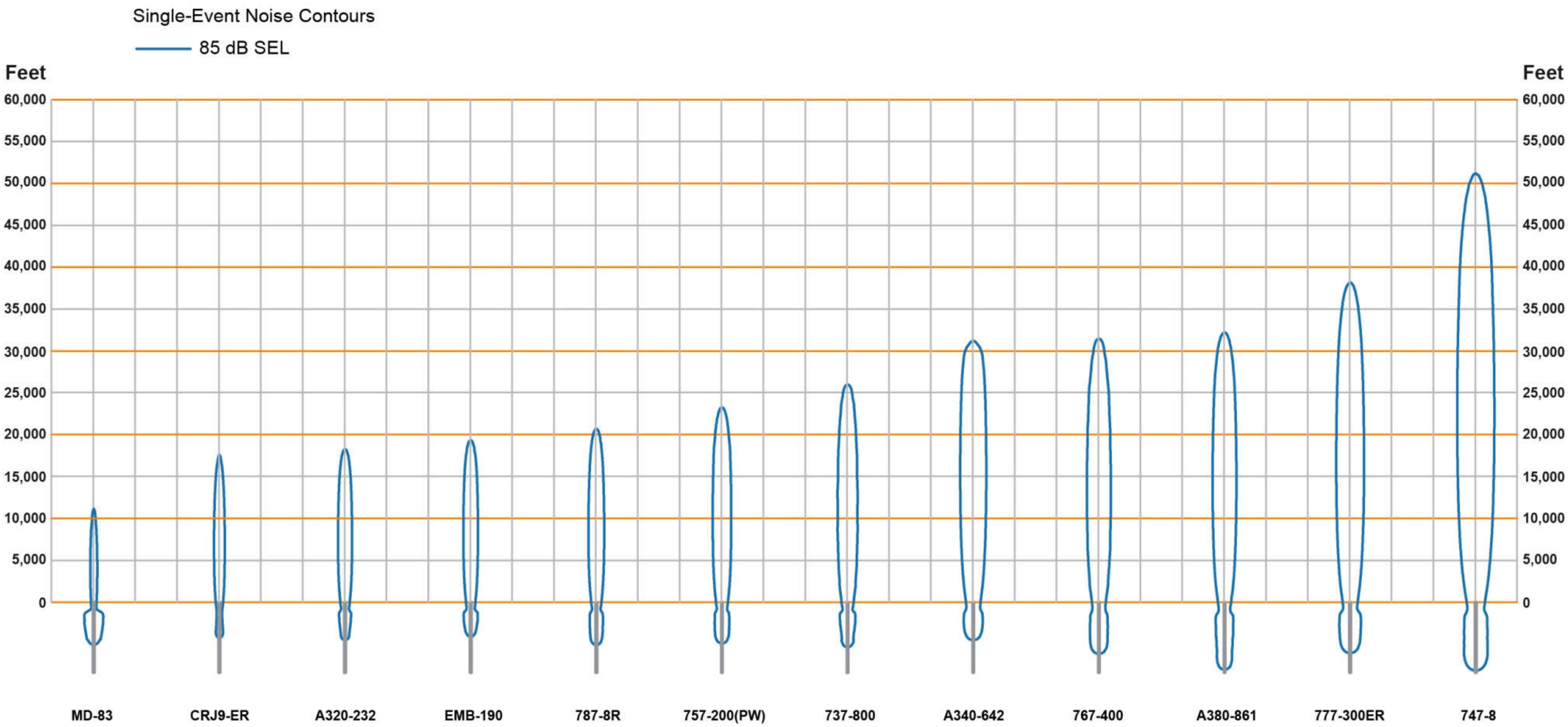
Copyright 2019 Environmental Science Associates

A Diverse Airline Aircraft Fleet at JFK

	A-380	EMB-190
Seats (two-classes)	644	94
Length	239’	119’
Wingspan	262’	94’
MTOW	1,268,000 lbs	105,000 lbs
MLW	869,000 lbs	95,000 lbs
Range	8,200 nmi	1,850 nmi
Source: Airbus and Embraer		

Copyright 2019 Environmental Science Associates

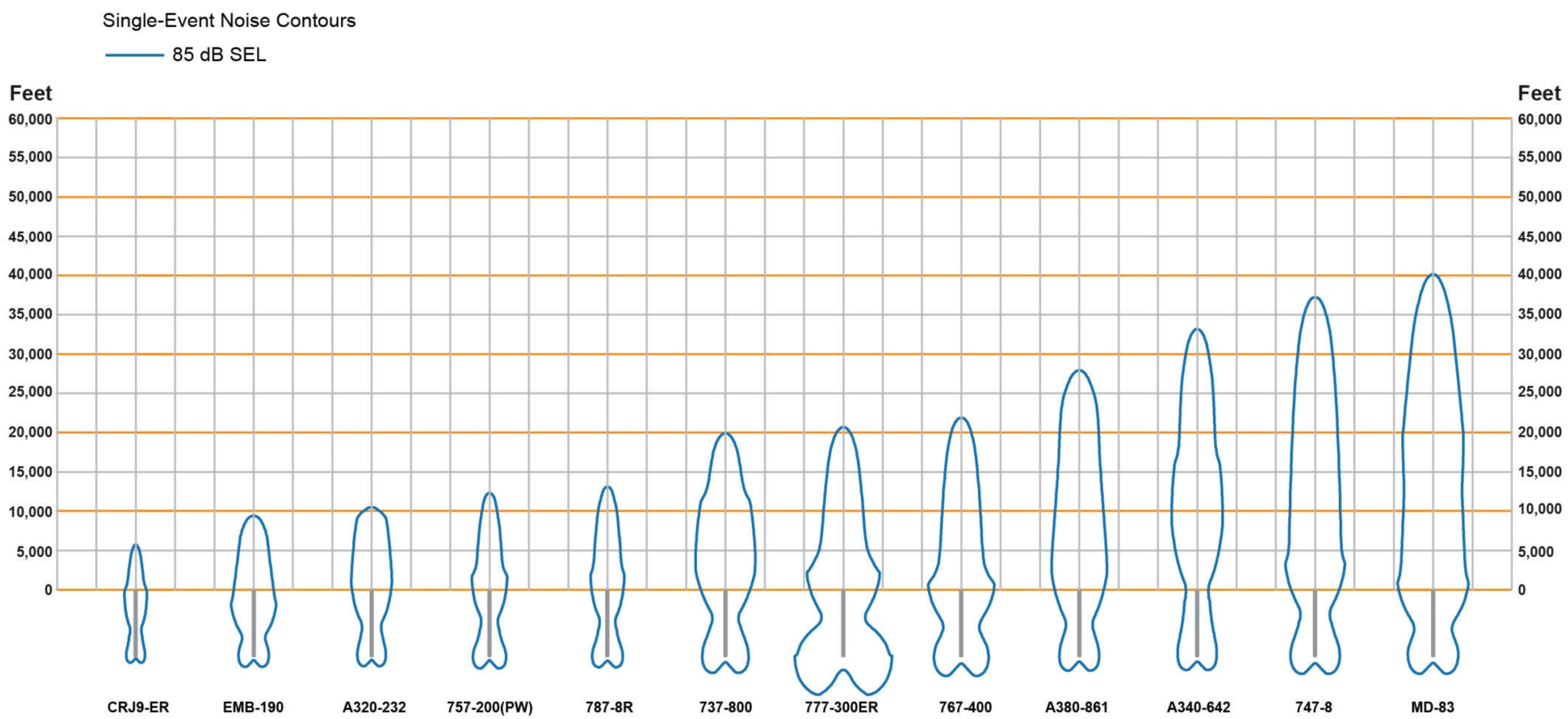
JFK Arrival Sound Exposure Level (SEL) Contour Comparison



Source: INM 7.0d

Copyright 2019 Environmental Science Associates

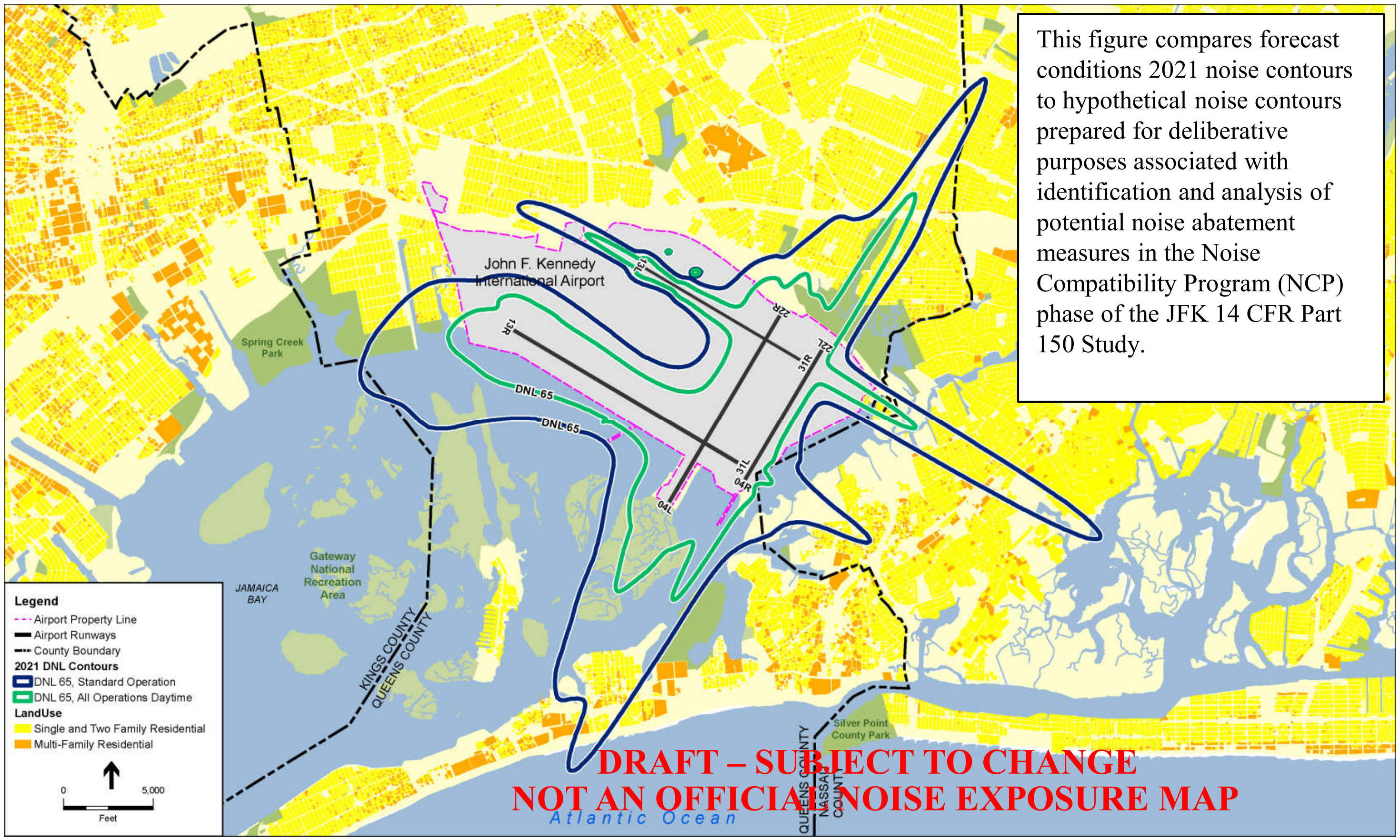
JFK Departure Sound Exposure Level (SEL) Contour Comparison



Source: INM 7.0d

Copyright 2019 Environmental Science Associates

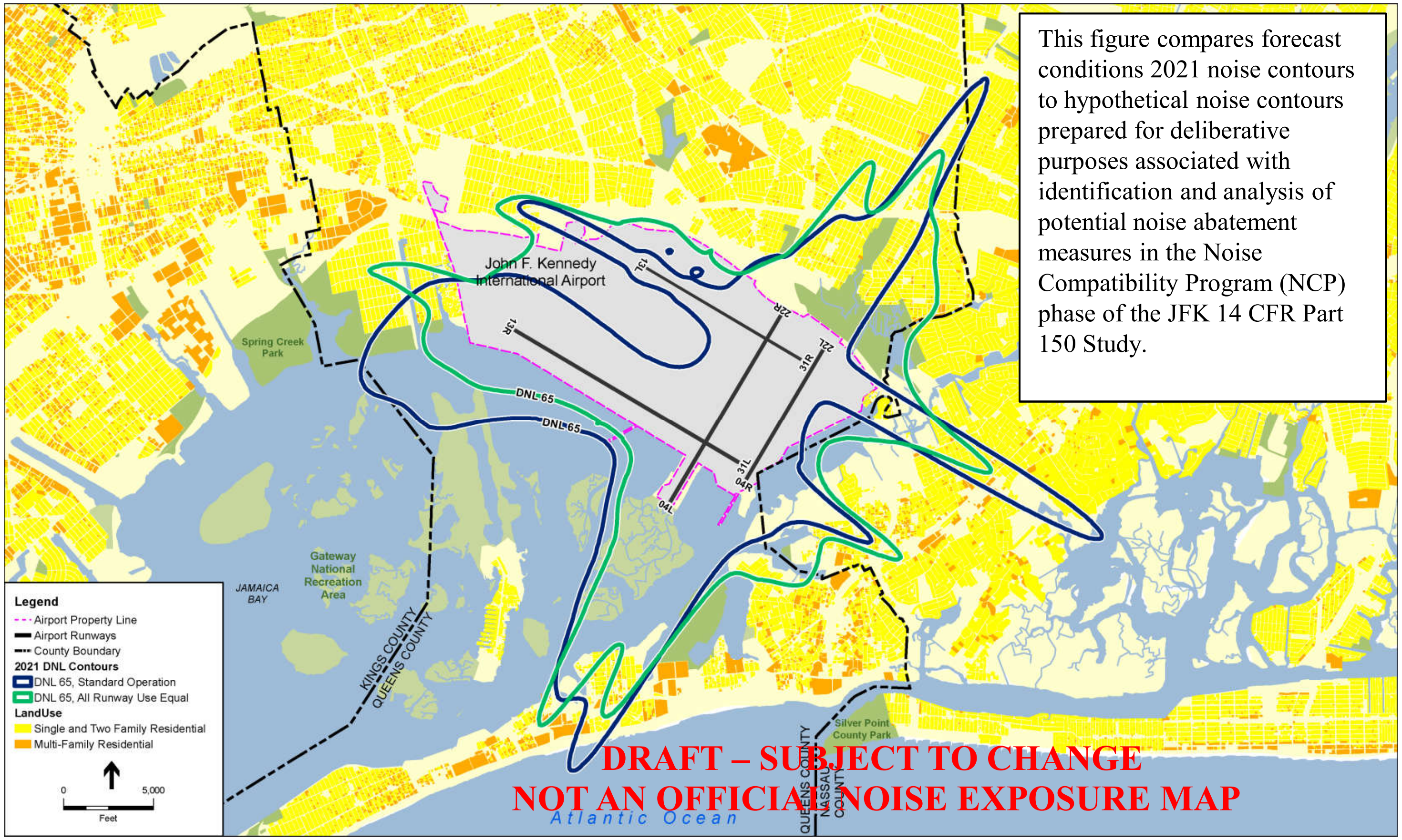
What if all JFK nighttime flights occurred in the daytime?



SOURCE: New York City Department of City Planning, MapPLUTO 15V1-Tax lot/land use geographic information database, March 2015-June 2015 (adapted by ESA); Nassau County Department of Public Works Planning Division; Property classification and geographic information database, September 2015; ESRI Mapping Services; Environmental Science Associates, 2016.

Copyright 2019 Environmental Science Associates

What if each runway end is used equally?



This figure compares forecast conditions 2021 noise contours to hypothetical noise contours prepared for deliberative purposes associated with identification and analysis of potential noise abatement measures in the Noise Compatibility Program (NCP) phase of the JFK 14 CFR Part 150 Study.

SOURCE: New York City Department of City Planning, MapPLUTO 15V1-Tax lot/land use geographic information database, March 2015-June 2015 (adapted by ESA); Nassau County Department of Public Works Planning Division; Property classification and geographic information database, September 2015; ESRI Mapping Services; Environmental Science Associates, 2016.

Copyright 2019 Environmental Science Associates

Aircraft Noise Model Application

- FAA Orders 1050.1F and 5050.4B require the use of noise models for the quantification of aircraft noise impacts in environmental assessments (EAs) and environmental impact statements (EISs)

- Noise measurements may be made for 14 CFR Part 150 studies, EAs, and EISs to provide supplemental information, but they may not be used to “calibrate” the noise models

Copyright 2019 Environmental Science Associates

Comparing Measured and Modeled Levels

- Measured single event levels (Lmax and SEL) can be compared to the single event levels predicted by the model
  - Measurements should be observed or correlated with radar data and of sufficient quantity

- Measured cumulative noise levels (DNL or CNEL) can be compared to modeled cumulative levels
  - Ideally, compare one year of aircraft noise measurement data to the same year modeled

Copyright 2019 Environmental Science Associates

Comparing Measured and Modeled Levels

- Modeled annual-average day DNL contours will not always match short-term measured values due to variables such as:
  - Runway use
  - Fleet mix
  - Wind and weather conditions
  - Pilot/controller techniques
  - Ambient community noise levels

Copyright 2019 Environmental Science Associates

Quantifying Aviation Noise Exposure

- Aircraft noise can be measured and modeled
- Measurements and modeling can describe historical noise levels, but only modeling can predict *future* noise levels
- Measured and modeled noise levels can be compared
- Federal regulations require the use of noise models, not measurements, to quantify aircraft noise exposure

Copyright 2019 Environmental Science Associates

Questions?

Copyright 2019 Environmental Science Associates

2019 UC Davis
Aviation Noise & Emissions Symposium

Regulating Aviation Noise

Presented by:

Steve Alverson, ESA

March 3, 2019

Copyright 2019 Environmental Science Associates

ESA

ESA is where solutions and service meet.

Presentation Outline

- Introduction
- Airport Noise – Roles and Responsibilities
- Regulatory Framework
- Federal Aviation Noise Regulations
- Recent Aviation Noise-Related Legislation
- Summary

Copyright 2019 Environmental Science Associates

Introduction

- Aircraft/Airport noise regulations and policies are not static
- Careful balance between federal and local authority
- FAA sets many rules and controls funding
- Local governments have an important role to play through the regulation of land use

Copyright 2019 Environmental Science Associates

Roles and Responsibilities

- Roles and Responsibilities – Airport Noise Control*
  - Federal Aviation Administration
  - Airport Proprietor
  - Local Governments
  - Aircraft Operators
  - Others

*DOT/FAA Aviation Noise Abatement Policy, November 18, 1976

Copyright 2019 Environmental Science Associates

Roles and Responsibilities

Federal Aviation Administration

- Sets noise level requirements for aircraft
- Provides funding for, and approval of, noise compatibility planning (when appropriate and/or when funds are available)
- Manages the air traffic control and airspace system

Copyright 2019 Environmental Science Associates

Roles and Responsibilities

Federal Aviation Administration

- Exclusive authority to certify aircraft and pilots
- Exclusive authority to control aircraft in the air and on runways/taxiways*

*Control of aircraft in flight is shared with the pilot-in-command

Copyright 2019 Environmental Science Associates

Roles and Responsibilities

Airport Proprietors

- Plan and implement actions designed to reduce the adverse effects of noise on residents of the surrounding area including:
  - Improvements in airport design
  - Noise abatement ground procedures
  - Land acquisition
  - Restrictions on airport use (reasonable, nonarbitrary and not unjustly discriminatory restrictions)

Copyright 2019 Environmental Science Associates

Roles and Responsibilities

Local Governments

- Can
  - Promote compatible land use through zoning
  - Prohibit incompatible land uses
  - Require real estate disclosure
  - Include current noise data in municipal code
- Cannot
  - Directly restrict aircraft operations or regulate “routes, rates or service” of air carriers
  - Tax airport passengers

Copyright 2019 Environmental Science Associates

Roles and Responsibilities

Aircraft Operators

- Fly quieter aircraft

- Fly responsibly
  - Safety first and foremost
  - Use industry recommended noise abatement procedures
  - Use preferred noise abatement runways
  - Follow airport's published noise abatement procedures
  - Follow noise abatement flight tracks

Copyright 2019 Environmental Science Associates

Roles and Responsibilities

Others

- Pilot in command has sole responsibility for the safe operation of his or her aircraft
- Aviation system users pay for the entire aviation system including the adverse impacts of noise
- Users finance the cost of noise-reducing measures such as:
  - New quieter aircraft
  - Research and development into noise reducing technologies
  - Planning and land use compatibility studies
  - Land acquisition, sound insulation, ground run-up enclosures

Copyright 2019 Environmental Science Associates

Roles and Responsibilities

Others

- Prospective residents should become informed about aircraft noise impacts and should act accordingly

Copyright 2019 Environmental Science Associates

Regulatory Framework

- Federal law sets aircraft noise standards, prescribes operating rules, establishes the compatibility planning process, and limits airport proprietor's ability to restrict aircraft operations

- State laws establish compatibility planning guidelines and noise standards, but aircraft in flight are exempt

Copyright 2019 Environmental Science Associates

Regulatory Framework

- Local noise ordinances set local noise standards and provide for compatible land use planning, but aircraft in flight are exempt

FEDERAL LAW PREEMPTS STATE AND LOCAL REGULATIONS

Copyright 2019 Environmental Science Associates

Federal Aviation Noise Regulations

- 14 CFR Part 36 and 14 CFR Part 91
- U.S. Department of Transportation Aviation Noise Abatement Policy
- Aviation Safety and Noise Abatement Act of 1979
- 14 CFR Part 150
- Airport Noise and Capacity Act of 1990 and 14 CFR Part 161
- FAA Orders 5050.4B and 1050.1F
- FAA Order 5100.38D and FAR Part 158
- Advisory Circular 150/5020-1

Copyright 2019 Environmental Science Associates

14 CFR Part 36 – Noise Standards: Aircraft Type and Airworthiness Certification

- Adopted in 1969 in response to the Federal Aviation Act enacted by Congress in 1968
- Prescribes noise standards for issuance of new aircraft type certifications
- Amended in 1973 in response to the Noise Control Act of 1972
- Amended again in 1977 and 2003
- In November 2017, FAA issued Stage 5 regulations mirroring the ICAO Chapter 14 Standards with two effective dates for small (2020) and large aircraft (2017)
  - The dividing line between large and small is 121,254 pounds

Copyright 2019 Environmental Science Associates

14 CFR Part 36 – Noise Standards: Aircraft Type and Airworthiness Certification

- Aircraft may be certified as Stage 1, Stage 2, Stage 3, Stage 4 or Stage 5 based on their noise level, weight, number of engines, and in some cases – number of passengers
- Stage 1 and Stage 2 are no longer permitted to operate in the United States
- FAA has indicated it does not intend to propose a phase out of Stage 3 aircraft in the foreseeable future

Copyright 2019 Environmental Science Associates

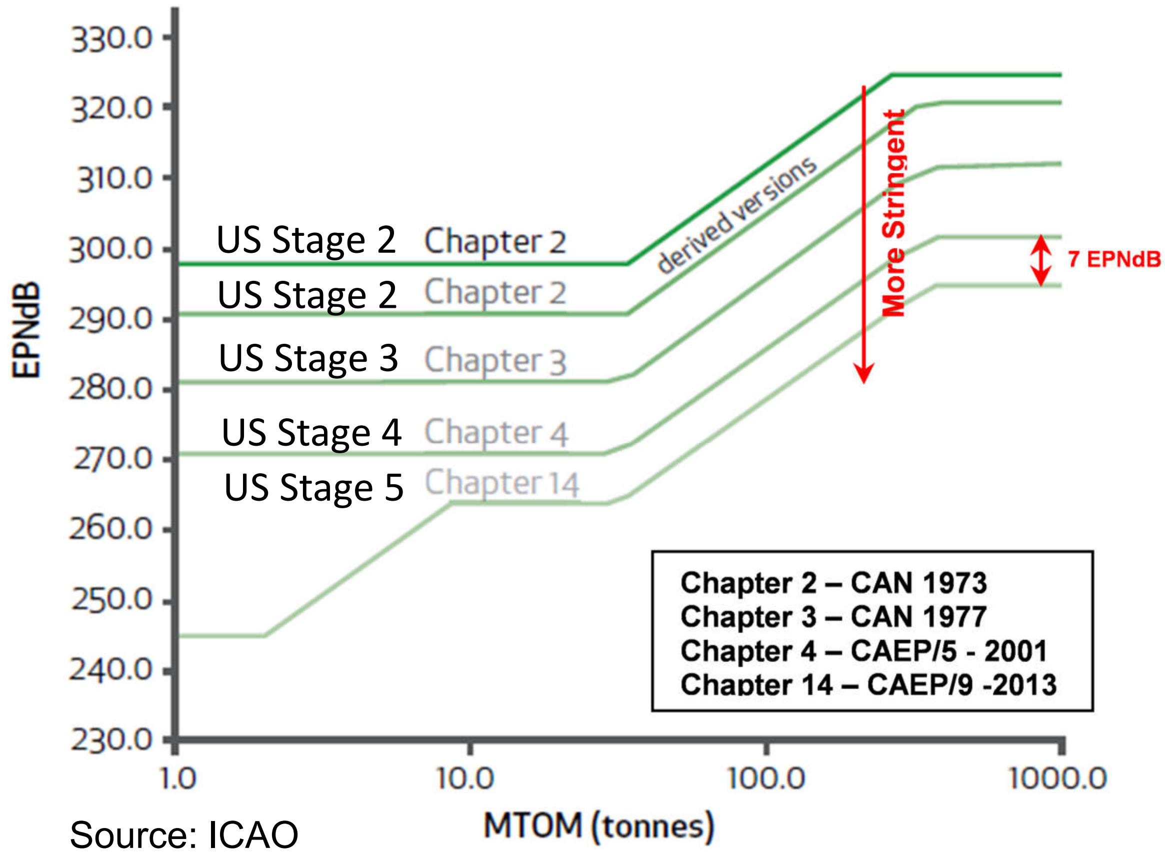
International Civil Aviation Organization (ICAO)

- Committee on Aviation Environmental Protection (CAEP) promoted more stringent noise certification standards
- CAEP agreed on and forwarded to the full ICAO assembly new Chapter 14 noise levels
- The new levels went into effect for newly manufactured large aircraft on January 1, 2018
- The new standard is 7 EPNdB below the Stage 4 standard

Copyright 2019 Environmental Science Associates

Regulating Aviation Noise

International Civil Aviation Organization (ICAO)



Source: ICAO

Copyright 2019 Environmental Science Associates

14 CFR Part 91 – General Operating and Flight Rules

- Addresses the operation of aircraft in flight
- Establishes airspace classifications
- Establishes operating conditions (IFR, VFR, etc.)
- Addresses the operation of supersonic aircraft within the United States
- Amended in 1990 to address the phase-out of large Stage 2 aircraft

Copyright 2019 Environmental Science Associates

U.S. Department of Transportation Aviation Noise Abatement Policy (1976)

- Set forth noise abatement authorities and responsibilities of the federal government, airport proprietors, state and local governments, air carriers, air travelers and shippers, and airport area residents and prospective residents
- FAA’s primary role is regulating noise at its source (the aircraft), plus supporting local efforts to develop noise abatement plans
- Role of state and local governments, along with airport proprietors, to undertake land use and operational actions to promote compatibility

Copyright 2019 Environmental Science Associates

Aviation Safety and Noise Abatement Act of 1979

- Further strengthened FAA’s supporting role in noise compatibility planning
- Stated purpose “To provide assistance to airport operators to prepare and carry out noise compatibility programs.”
- Established funding for noise compatibility planning
- Sets requirements by which airport operators can apply for funding
- Does not require any airport to develop a noise compatibility program

Copyright 2019 Environmental Science Associates

14 CFR Part 150 – Airport Noise Compatibility Planning

- Adopted FAA regulations for implementing the Aviation Safety and Noise Abatement Act of 1979
- Published noise and land use compatibility charts to be used for land use planning with respect to aircraft noise
- Residential land use deemed acceptable for noise exposure up to 65 dB DNL
- Allows airport sponsors to access federal funds for noise mitigation programs

Copyright 2019 Environmental Science Associates

Airport Noise and Capacity Act of 1990 (ANCA)

- Established a method to review aircraft noise, airport use, or access restrictions imposed by airport proprietors
- Instituted a program to phase-out Stage 2 aircraft over 75,000 lbs. by December 31, 1999
- No phase-out of Stage 2 aircraft under 75,000 lbs.
  - The FAA Modernization and Reform Act of 2012 instituted a phase-out of Stage 1 and Stage 2 aircraft under 75,000 lbs. by January 1, 2017

Copyright 2019 Environmental Science Associates

Airport Noise and Capacity Act of 1990 (ANCA)

- Applies to all local noise restrictions that were proposed after October 1990
- Grandfathered all aircraft noise and access restrictions that existed prior to November 1990
- Established a process for proposed aircraft noise and access restrictions (14 CFR Part 161)

Copyright 2019 Environmental Science Associates

14 CFR Part 161 – Notice and Approval of Airport Noise and Access Restrictions

- Defines the requirements for enacting noise and access restrictions on Stage 2 and Stage 3 aircraft greater than 75,000 lbs.
- Severely limits an airport proprietor's ability to enact restrictions on aircraft operations
- Encourages voluntary agreements to control aircraft noise
- Airport proprietor imposed restrictions must be considered a last resort when all other efforts have failed to eliminate the incompatible land uses

Copyright 2019 Environmental Science Associates

14 CFR Part 161– Notice and Approval of Airport Noise and Access Restrictions

- Identifies three types of restrictions
  - Negotiated restrictions
  - Stage 2 aircraft restrictions
  - Stage 3 aircraft restrictions
- Each type of restriction is treated differently
- Even though the ANCA phase-out did not apply to aircraft under 75,000 lbs., the FAA has determined that 14 CFR Part 161 applies to smaller aircraft with regard to proprietors' restrictions authority

Copyright 2019 Environmental Science Associates

FAA Orders 5050.4B and 1050.1F

- Guidelines developed by the FAA pertaining to environmental analysis under the National Environmental Policy Act (NEPA)
- FAA Order 1050.1F provides overall NEPA guidance for all FAA divisions
- FAA Order 5050.4B provides guidance to the Airports Division of the FAA which oversees the review of airport development projects
- The FAA's 1050.1F Desk Reference provides additional information regarding compliance with NEPA and special purpose laws

Copyright 2019 Environmental Science Associates

FAA Orders 5050.4B and 1050.1F

- FAA considers only those noise impacts that occur at 65 dB DNL/CNEL or greater
- Increases in noise levels for noise sensitive areas over 1.5 dB DNL/CNEL, within the 65 dB DNL/CNEL contour, are considered "significant"
- If an action causes a significant impact over noise sensitive areas, additional analysis should be conducted between 60 dB DNL/CNEL and 65 dB DNL/CNEL to determine if an increase of 3 dB DNL/CNEL occurs
- A 3-dB increase is not considered "significant", but must be disclosed for informational purposes

Copyright 2019 Environmental Science Associates

FAA Orders 5050.4B and 1050.1F

- Areas where quiet is an expected characteristic of the setting such as such as national parks, wildlife refuges, and cultural/historical sites may require special consideration below 65 dB DNL
- The FAA official responsible for the project decides which supplemental metrics, if any, should be used in noise impact analysis
- Airport proprietors/communities should work with the FAA to identify those metrics

Copyright 2019 Environmental Science Associates

FAA Order 5100.38D – AIP Handbook

- Provides guidance and requirements for FAA funding of noise-related projects:
  - Noise and land use planning studies, sound insulation, noise barriers, ground run-up enclosures, mitigation measures, noise monitoring systems, land acquisition
- Defines solicitation and selection process
- Identifies performance standards for project funding
- Incorporates the guidance in Program Guidance Letter 12-09

Copyright 2019 Environmental Science Associates

Federal Aviation Administration Program Guidance Letter (PGL) 12-09

- Clarified guidance on sound insulation program funding
- Requires a dwelling unit be within the 65 dB DNL/CNEL contour and have an interior noise level greater than 45 DNL/CNEL
- Eliminated homes assumed to be previously eligible
- This clarification is incorporated into FAA Order 5100.38D

Copyright 2019 Environmental Science Associates

14 CFR Part 158 – Passenger Facility Charges

- Implements the provisions of ANCA related to the creation of a passenger facility charge (PFC)
- Reducing noise or mitigating noise is eligible for PFC funding at a level of $1, $2, or $3 per Section 158.15 of FAR Part 158
- An application has to be approved for the amount of the PFC, but unlike AIP grants, airport proprietors may use PFC funds for noise mitigation without an FAA-approved 14 CFR Part 150 Noise Compatibility Program, as long as the airport's noise exposure maps have been prepared under the procedures specified in 14 CFR Part 150

Copyright 2019 Environmental Science Associates

Advisory Circular 150/5020-1, Noise Control and Compatibility Planning for Airports

- Provides general guidance for noise control and compatibility planning for airports
- Provides specific guidance for preparation of airport noise exposure maps and airport noise compatibility programs in accordance with 14 CFR Part 150
- The FAA is currently in the process of updating the Advisory Circular which was issued in 1983

Copyright 2019 Environmental Science Associates

Advisory Circular 150/5020-1, Noise Control and Compatibility Planning for Airports

- The premise of the update is to catch up with the current state of the regulations and to provide a “How to Prepare a Part 150 Study” manual
- Aviation industry groups have provided input to the FAA supported by consultants and airports that have gone through the FAR Part 150 process
- Look for this revised Advisory Circular in the future

Copyright 2019 Environmental Science Associates

Airport Cooperative Research Program (ACRP)

- Funded by the FAA and administered by the National Academy of Sciences
- Research on a variety of aviation issues including aircraft noise
  - Improvements in aircraft noise modeling
  - Helicopter noise research
  - Sound insulation programs
  - Public outreach

Copyright 2019 Environmental Science Associates

Recent Aviation Noise-Related Legislation

- The FAA Reauthorization Act of 2018, which was signed on October 5, 2018, contains 13 aviation noise-related provisions
- Subtitle D, Airport Noise and Environmental Streamlining, of the Act contains the following noise provisions:

Recent Aviation Noise-Related Legislation

- Section 172. Authorization of certain flights by Stage 2 aircraft.
  - Establishes a pilot program for the operation of Stage 2 aircraft between not more than 4 medium hub or nonhub airports, with specific characteristics.
- Section 173. Alternative airplane noise metric evaluation deadline.
  - Requires that the FAA complete an evaluation of alternative metrics to the current Day Night Average Sound Level (DNL) 65 standard within one year of the date of enactment.

Source: Airports Council International – North America, October 2018

Recent Aviation Noise-Related Legislation

- Section 174. Updating airport noise exposure maps.
  - Builds on the current requirement that a noise exposure map – for those airports that have one – must be updated when there is a change in the surrounding area, such as a significant new noncompatible use, or a change in the operation of the airport would significantly reduce noise over existing noncompatible uses. Additional language has been added clarifying that if one of the listed changes occurs, an updated noise exposure map is only required if the change either comes into effect during the forecast period of the existing noise exposure map, or during the implementation period of the airport operator's noise compatibility program.

Source: Airports Council International – North America, October 2018

Recent Aviation Noise-Related Legislation

- Section 175. Addressing community noise concerns.
  - Requires the FAA to consider the feasibility of implementing dispersal headings for new RNAV departure procedures below 6,000 AGL if: (1) the airport requests it, (2) it would not have safety or efficiency implications, and (3) it would not significantly increase noise over other noise-sensitive areas.
- Section 176. Community involvement in FAA NextGen projects located in metroplexes.
  - Requires the FAA to prepare a review (within 180 days) of FAA's community involvement practices for NextGen projects located in Metroplexes. That review is to be followed by a report (within 60 days) containing: (1) recommendations for improving community involvement for NextGen projects in Metroplexes; (2) discussion of how and when the FAA will engage airports and communities in PBN proposals, and (3) lessons learned from NextGen projects.

Source: Airports Council International – North America, October 2018

Recent Aviation Noise-Related Legislation

- Section 179. Airport noise mitigation and safety study.
  - Requires the FAA to conduct a study to review and evaluate existing studies and analyses of the relationship between jet aircraft approach and takeoff speeds and corresponding noise impacts on communities surrounding airports. It would also look at whether reduced approach or takeoff speeds would jeopardize aviation safety and/or: cause the National Airspace System (NAS) to operate less efficiently; impact capacity; and increase fuel burn.
- Section 180. Regional ombudsmen.
  - Requires the FAA to designate a Regional Ombudsman for each region who would serve as a liaison with the public to address “issues regarding aircraft noise, pollution, and safety” and make recommendations to the Regional Administrators to address concerns raised by the public.

Source: Airports Council International – North America, October 2018

Recent Aviation Noise-Related Legislation

- Section 181. FAA leadership on civil supersonic aircraft.
  - Directs the FAA Administrator to exercise leadership in the creation of Federal and international policies, regulations, and standards relating to the certification and safe and efficient operation of civil supersonic aircraft. It directs the FAA to obtain aerospace industry stakeholders input regarding regulatory framework, and issues related to standards and regulations for the type certification and safe operation of civil supersonic aircraft, including noise certification. This provision also directs FAA to exercise international leadership. FAA is required to issue a notice of proposed rulemaking by March 31, 2020, for civil supersonic noise standards.

Source: Airports Council International – North America, October 2018

Recent Aviation Noise-Related Legislation

- Section 186. Stage 3 aircraft study.
  - Directs GAO to undertake a review of the potential benefits, costs, and other impacts that would result from a phase out of covered Stage 3 aircraft. The review must include:
    - Inventory of covered Stage 3 aircraft
    - Benefits, costs, and impacts to a variety of stakeholders, including air carriers, GA operators, airports, communities surrounding airports, and the general public
    - Lessons learned from the phase out of Stage 2 aircraft
    - Costs and logistical challenges associated with recertifying Stage 3 aircraft capable of meeting Stage 4 noise levels
    - Stakeholder views on the feasibility and desirability of phasing out covered Stage 3

Source: Airports Council International – North America, October 2018

Recent Aviation Noise-Related Legislation

- Section 187. Aircraft noise exposure.
  - Requires the FAA to conduct a review of the impact of noise exposure on communities around airports. The FAA would be required to submit a report to Congress on their findings within 2 years, including FAA's recommendations for revisions to their land use compatibility guidelines in Part 150 of Title 14 CFR.
- Section 188. Study regarding day-night average sound levels.
  - Directs the FAA to evaluate alternative metrics to the current average day-night level standard. (Note, this is similar to Section 173, except that it adds the requirement of consideration of actual noise sampling and other methods, and an accelerated schedule.)

Source: Airports Council International – North America, October 2018

Recent Aviation Noise-Related Legislation

- Section 189. Study on potential health and economic impacts of overflight noise.
  - Requires the FAA to engage a university to conduct a health study in a number of metropolitan areas (Boston, Chicago, the District of Columbia, New York, the Northern California Metroplex, Phoenix, the Southern California Metroplex, Seattle, or such other area as may be identified by the FAA), focusing on "incremental health impacts on residents living partly or wholly underneath flight paths most frequently used by aircraft flying at an altitude lower than 10,000 feet, including during takeoff or landing"; and "an assessment of the relationship between a perceived increase in aircraft noise, including as a result of a change in flight paths that increases the visibility of aircraft from a certain location, and an actual increase in aircraft noise, particularly in areas with high or variable levels of non-aircraft-related ambient noise."

Source: Airports Council International – North America, October 2018

Recent Aviation Noise-Related Legislation

- Section 190. Environmental mitigation pilot program.
  - Provides for FAA grants of up to $2.5 million to six airports to carry out pilot environmental mitigation programs that would "measurably reduce or mitigate aviation impacts on noise, air quality, or water quality at the airport or within 5 miles of the airport." The federal share of this project would be up to 50%, and projects must be carried out by a consortium of entities that includes two or more of the following: businesses, educational or research organizations, state or local governments, and/or federal laboratories.

Source: Airports Council International – North America, October 2018

Summary

- Introduction
- Airport Noise – Roles and Responsibilities
- Regulatory Framework
- Federal Aviation Noise Regulations
- Recent Aviation Noise-Related Legislation
- Summary

Copyright 2019 Environmental Science Associates

Questions?

Copyright 2019 Environmental Science Associates

2019 UC Davis
Aviation Noise & Emissions Symposium

Mitigating Aviation Noise

Presented by:

Steve Alverson, ESA

March 3, 2019

Copyright 2019 Environmental Science Associates

ESA

ESA is where
solutions and
service meet.

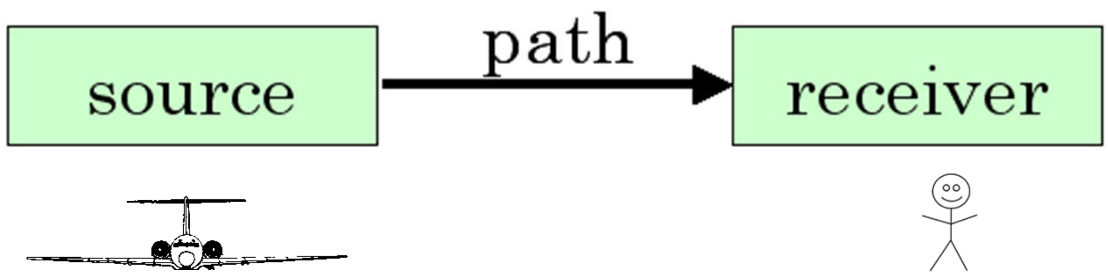
Presentation Outline

- Principles of Aircraft Noise Control
- Noise Abatement Options
  - Airfield Design
  - Operational
  - Restrict Operations
  - Management
- Noise Mitigation Options
  - Preventive
  - Remedial

Copyright 2019 Environmental Science Associates

Principles of Aircraft Noise Control

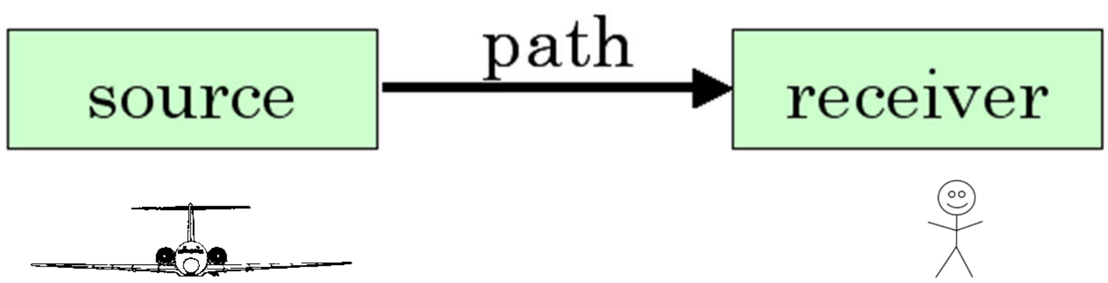
- Source
- Path
- Receiver



Copyright 2019 Environmental Science Associates

Principles of Aircraft Noise Control

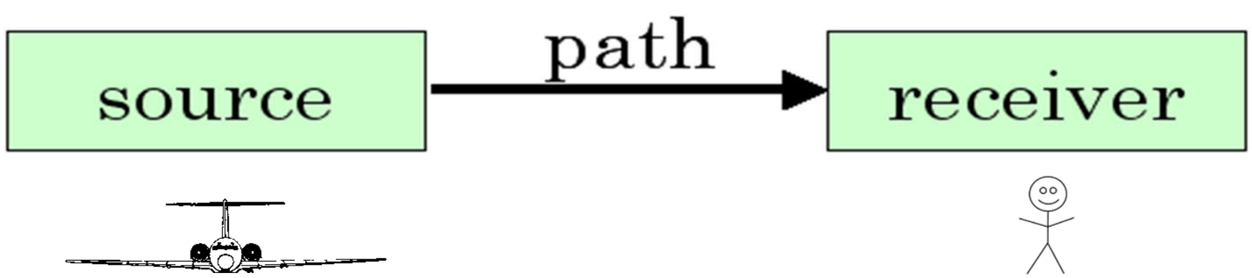
- Reduce the source level
  - FAA is responsible for aircraft noise certification
  - Pilots may use reduced thrust
  - Ground crews can minimize APU use
  - Reduce or eliminate engine runups



Copyright 2019 Environmental Science Associates

Principles of Aircraft Noise Control

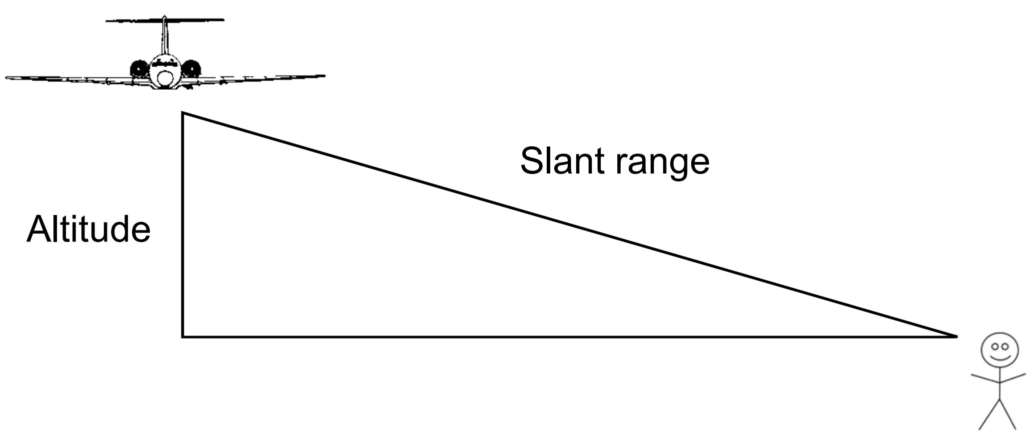
- Move the source or the receiver
  - Relocated runways, relocated taxiway, relocated run-up areas
  - Displaced takeoff or landing thresholds
  - Relocate noise sensitive uses



Copyright 2019 Environmental Science Associates

Principles of Aircraft Noise Control

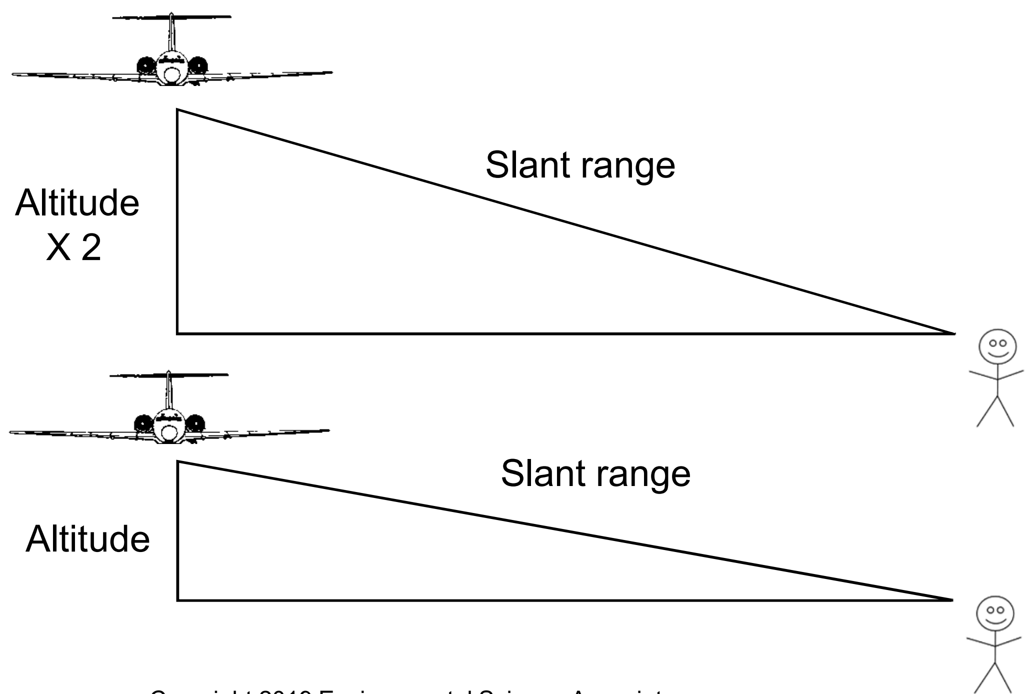
- When moving aircraft away from residents, it takes a doubling of the distance to achieve a 6-dB reduction in the noise level
- Except for direct overflight, *slant range* is more important than *altitude*



Copyright 2019 Environmental Science Associates

Noise Abatement – Aircraft in Flight

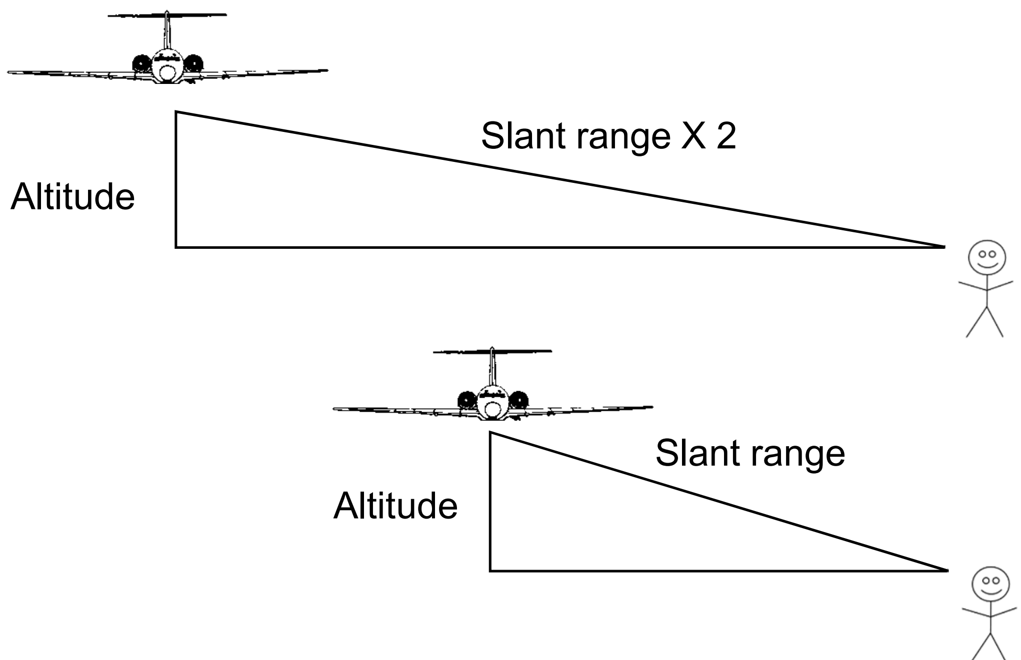
- Example: Double the altitude



Copyright 2019 Environmental Science Associates

Noise Abatement – Aircraft in Flight

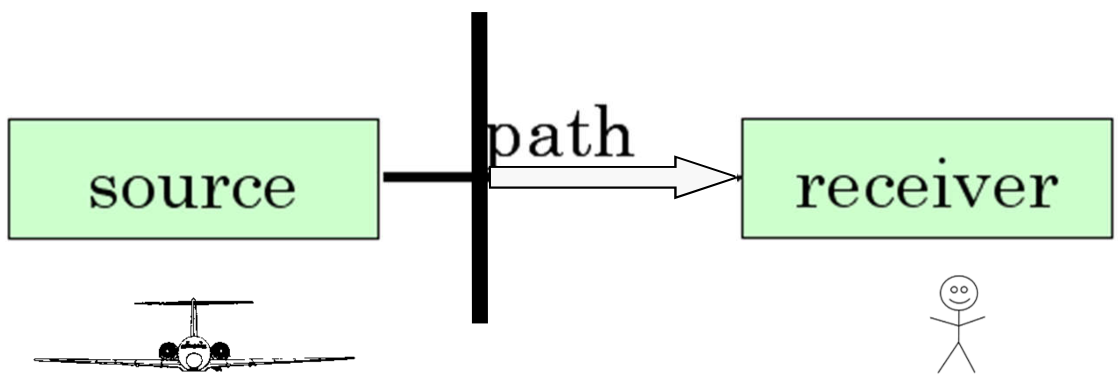
- Example: Double the slant range



Copyright 2019 Environmental Science Associates

Principles of Aircraft Noise Control

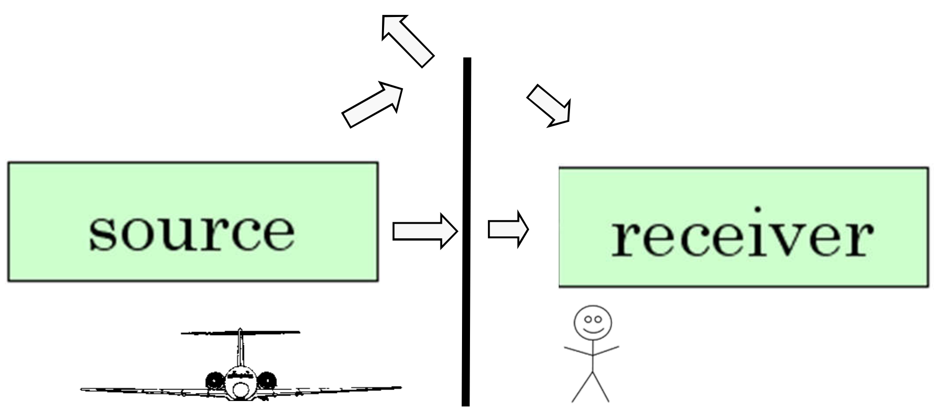
- Block the path – insertion loss
  - Barriers, berms, buildings



Copyright 2019 Environmental Science Associates

Principles of Aircraft Noise Control

- Maximum insertion loss is achieved when the source and receiver are close to the barrier
  - Highway noise barriers, ground run-up enclosures



Copyright 2019 Environmental Science Associates

NCP Measures That Are Required to Be Considered (14 CFR Part 150, Section B150.7)

Noise Abatement	Noise Mitigation
Preferential runway system	Property acquisition and avigation easements
Noise abatement flight procedures and flight tracks	Noise barriers and acoustical shielding
Aircraft operating restrictions based on noise characteristics*	
Other actions to control or abate noise recommended by stakeholders	
Other actions recommended for airport-specific analysis by the FAA	

* Subject to further notice, review, and approval requirements in 14 CFR Part 161.

Copyright 2019 Environmental Science Associates

Major NCP Strategy Options

Noise Abatement

- Noise abatement flight tracks
- Preferential runway use
- Arrival/departure procedures
- Airport layout modifications
- Runup enclosures
- Use restrictions*
- Other actions proposed by stakeholders

Land Use

- Remedial Mitigation
  - Land acquisition
  - Sound insulation
  - Avigation easements
- Preventative Mitigation
  - Land use controls
  - Zoning
  - Building codes
  - Comprehensive plans
  - Real estate disclosures
- Other actions proposed by stakeholders

Programmatic

- Implementation tools
- Promotion, education, signage, etc.
- Monitoring
- Reporting
- NEM update
- NCP revision
- Other actions proposed by stakeholders

* Subject to further notice, review, and approval requirements in 14 CFR Part 161.

Copyright 2019 Environmental Science Associates

Noise Abatement Options

- Noise abatement techniques can be applied to address:
  - Ground noise
  - Noise from aircraft in flight

- Techniques should be safe, cost effective, environmentally balanced, and capable of being implemented to be successful

Copyright 2019 Environmental Science Associates

Noise Abatement Options

- Standard evaluation criteria
  - Level of noise reduction
  - Effects on airfield capacity and aircraft delay
  - Effects on airspace/air traffic control procedures
  - Consistency with FAA safety and other standards
  - Other environmental effects (e.g., air quality)
  - Operational effects and costs
  - Financial feasibility
  - Consistency with policies adopted by Airport Proprietor

Copyright 2019 Environmental Science Associates

Noise Abatement Options

- Airfield Design
  - Runway extensions, new runway construction
  - Decommission existing runways
  - Relocate runway thresholds
- Operational
  - Dispersing departure flight tracks
  - Advanced navigational technologies
  - Change departure flight profiles
  - Modify arrival flight profiles
  - Rotational runway use
  - Ground run-up facility

Copyright 2019 Environmental Science Associates

Noise Abatement Options

- Restrict operations*
  - Ground run-up restrictions
  - Curfews
  - Noise level restrictions
  - Noise budget
  - Limit number of operations

*Subject to ANCA and potentially 14 CFR Part 161.

Copyright 2019 Environmental Science Associates

Noise Abatement Options

- Management
  - Pilot awareness program
  - Fly Quiet program
  - Noise sensitive areas noted in navigation charts

Copyright 2019 Environmental Science Associates

Noise Abatement Options

- Ground noise can come from several sources:
  - Start of takeoff roll
  - Aircraft taxiing on the airfield
  - Reverse thrust on landing roll out
  - Maintenance activities on the airfield
  - Ground equipment for aircraft servicing
  - Auxiliary power units

Copyright 2019 Environmental Science Associates

Noise Abatement Options

- Noise abatement techniques to consider for addressing noise from taxiing aircraft:
  - Changes in runway location, length, or strength
  - Installation of high-speed exit taxiways
  - Terminal relocation
  - Noise barriers or berms
  - Establish preferential runway use
  - Establish restrictions on ground aircraft movement
  - Establish use restrictions (e.g., single-engine taxiing)
  - Tug to runway ends or into gates

Copyright 2019 Environmental Science Associates

Noise Abatement Options

- Noise abatement techniques to consider for addressing noise from ground support equipment:
  - Relocation of terminals or aircraft parking stands
  - Ground power plug-ins
  - Noise barriers
  - Establish limits on the use of ground equipment
  - Establish use restrictions

Copyright 2019 Environmental Science Associates

Noise Mitigation Options

- Remedial
  - Property acquisition
  - Redevelopment programs
  - Sound insulation
  - Avigation easements
  - Transaction assistance
- Preventive
  - Comprehensive planning
  - Growth management
  - Noise overlay zones
  - Property disclosure statements

Copyright 2019 Environmental Science Associates

Noise Mitigation Options

Property Acquisition

- This strategy is generally used for properties located within areas exposed to the highest noise levels (> 75 dB DNL)
- Properties are purchased and residents are relocated
- Some local communities dislike this practice because the purchase of the property removes it from the local tax roll
- However, the new compatible uses can be tax generating

Copyright 2019 Environmental Science Associates

Noise Mitigation Options

Property Acquisition (cont.)

- Need to evaluate the potential for fragmentation or elimination of neighborhoods
- Only way airport operator can be assured of long-term protection for compatible land use
- This strategy can be very costly
- Public relations value of the program can be very positive or very negative

Copyright 2019 Environmental Science Associates

Noise Mitigation Options

Sound Insulation

- This strategy is generally used for properties located within noise levels between 65 DNL and 75 DNL and interior noise levels greater than 45 DNL
- Homes receive new doors, windows, sealing of leaks, and other treatments to bring the interior noise level in the home to 45 DNL
- The general condition, age, and home state of repair will determine degree of soundproofing needed

Copyright 2019 Environmental Science Associates

Noise Mitigation Options

Sound Insulation (cont.)

- FAA also requires at least a 5-dB reduction in the exterior-to-interior sound level

- FAA Order 5100.38D requires that the home be both within the FAA-accepted 65 DNL contour and the interior noise level be greater than 45 dB DNL

Copyright 2019 Environmental Science Associates

Noise Mitigation Options

Sound Insulation (cont.)

- Avigation Easements are often secured in return for accepting the sound insulation package, the homeowner will not sue the airport over aircraft noise levels

- This strategy is generally favored by most airports due to lower cost and community acceptance when compared to acquisition, but can be costly

Copyright 2019 Environmental Science Associates

Noise Mitigation Options

Avigation Easements

- Airport operator pays the property owner a monetary sum in exchange an agreement that the property owner will not sue the airport for damages associated with aircraft noise
- Not a popular option with most airports because it does not change the incompatibility with aircraft noise levels
- FAA has stopped funding this option for the reason stated above

Copyright 2019 Environmental Science Associates

Noise Compatibility Programs

- All measures must:
  - Reduce incompatible land use and prevent or reduce future incompatible land use
  - Ensure safety and efficiency
  - Be consistent with the powers and duties of the FAA
  - Be subject to revision if necessary

Copyright 2019 Environmental Science Associates

Noise Compatibility Programs

- Noise restrictions or rules must:
  - Not unjustly discriminate
  - Not impose an undue burden on interstate commerce (requires balancing of interests)
  - Meet both local needs and national air transportation system needs

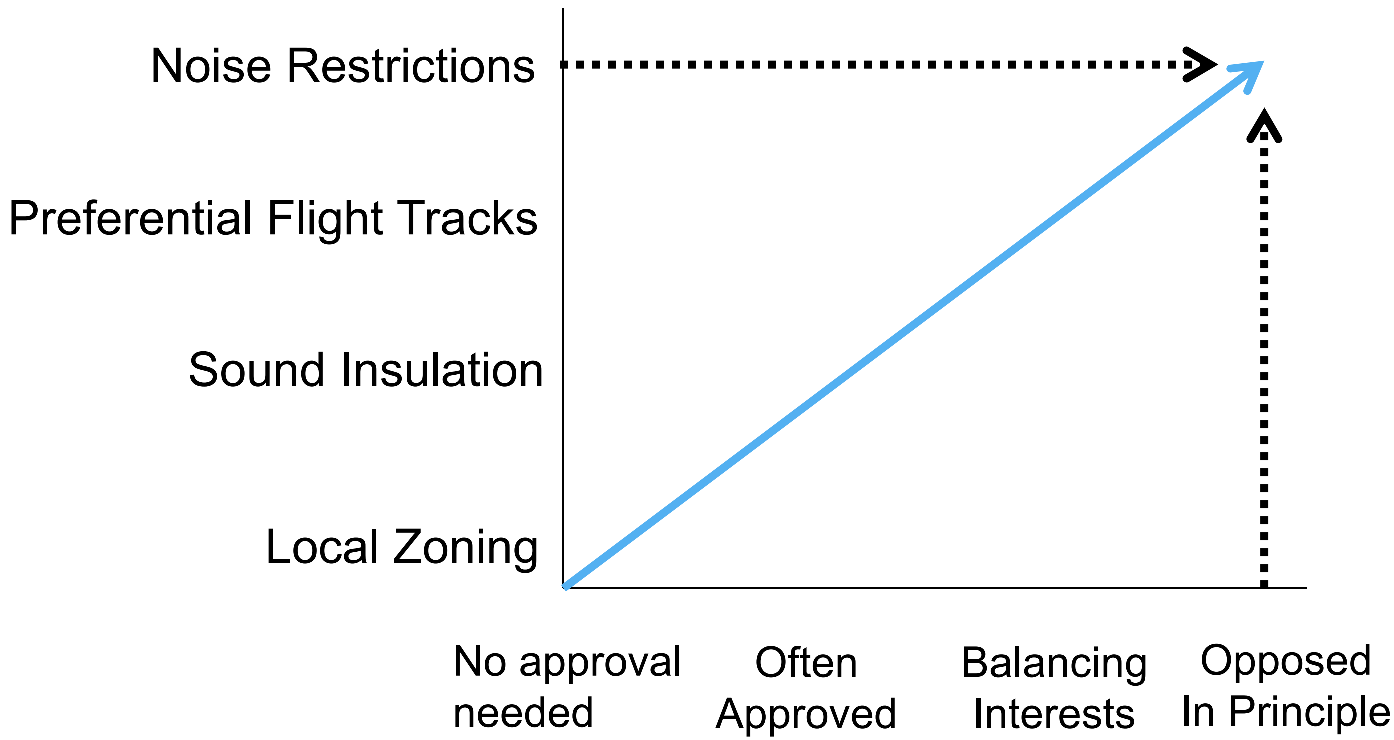
Copyright 2019 Environmental Science Associates

Noise Compatibility Programs

- May be subject to ANCA and 14 CFR Part 161
  - Curfews, noise limits, etc.
  - FAA does not approve noise rules and restrictions through the 14 CFR Part 150 process
- Even if not subject to 14 CFR Part 161, must withstand rigorous scrutiny
  - Reduce existing land use incompatibility above DNL 65
  - Be reasonable and not unjustly discriminatory
  - No undue burden on interstate commerce

Copyright 2019 Environmental Science Associates

Noise Compatibility Programs
Difficulty of Obtaining FAA Approval



Copyright 2019 Environmental Science Associates

Presentation Outline

- Principles of Aircraft Noise Control
- Noise Abatement Options
  - Airfield Design
  - Operational
  - Restrict Operations
  - Management
- Noise Mitigation Options
  - Preventive
  - Remedial

Copyright 2019 Environmental Science Associates

Questions?

Copyright 2019 Environmental Science Associates

NextGen 101

John Brandt / Nazanin Bonds

UC Davis Aviation Noise & Emissions Symposium 2019

March 3, 2019

Approved for Public Release; Distribution Unlimited. Public Release Case Number 19-0681

MITRE

Agenda

- Introduction
- Air Traffic Control (ATC) Overview
- NextGen Overview
- Environmental Perspective
- Summary
- Q & A

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Introduction

© 2019 The MITRE Corporation. All rights reserved.

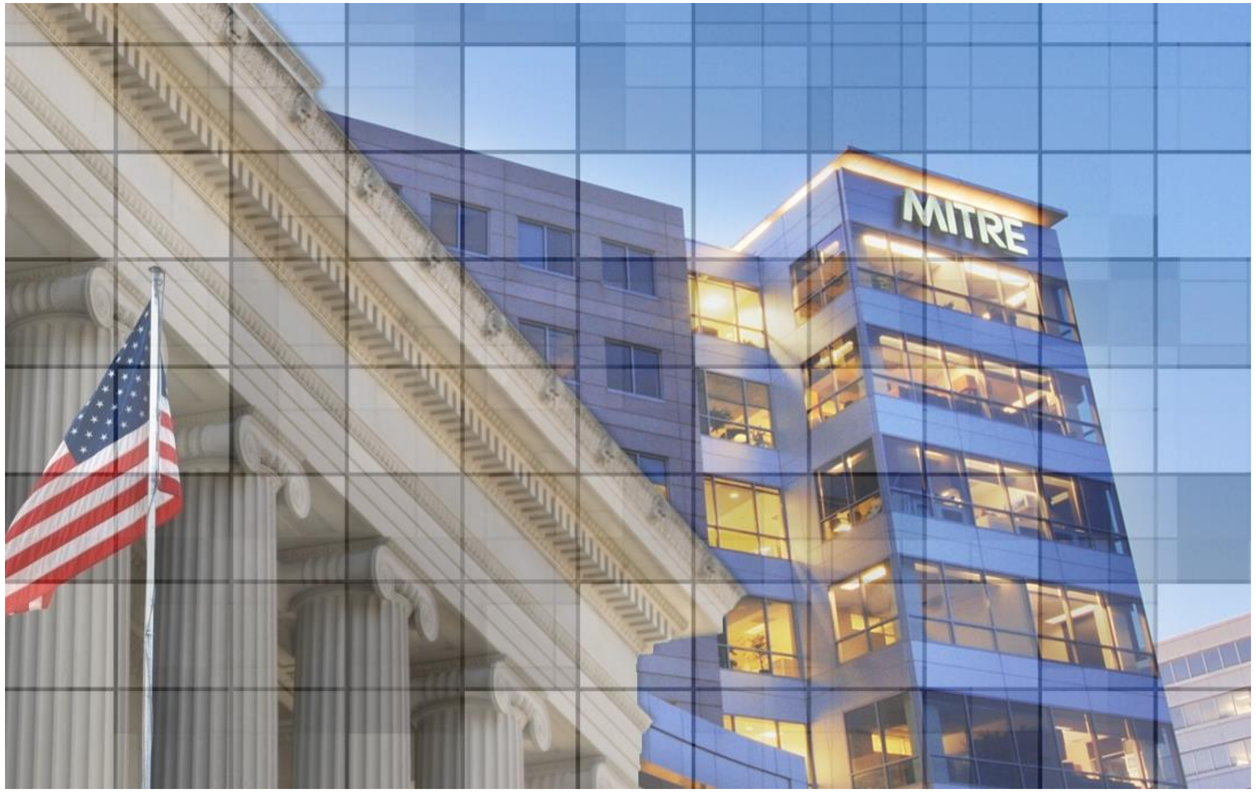
MITRE is Unique

objectivity & **independence**

public interest

long-term relationship

strategic partner



established **1958**

not-for-profit

conflict-free environment

science & **technology**

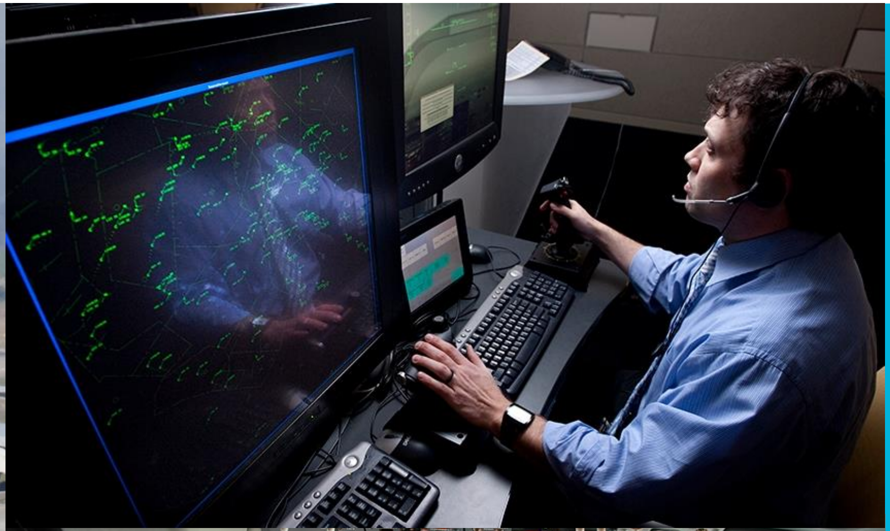
7 centers since 1958

1958	1990	1998	2009	2010	2012	2014
Department of Defense	Federal Aviation Administration	Treasury – Internal Revenue Service	Department of Veterans Affairs; U.S. Department of Homeland Security	Administrative Office of the United States Courts	Department of Health & Human Services	NIST

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Center for Advanced Aviation System Development (CAASD) Federally Funded Research and Development Center (FFRDC)



OUR MISSION:

To serve the public interest by advancing the **safety, security, effectiveness, and efficiency** of aviation in the **United States and around the world** by conducting a continuing program of research, development, and engineering **in collaboration with the aviation community**

© 2019 The MITRE Corporation. All rights reserved.

MITRE

NextGen 101 Training

- **Objective: Provide a broad overview of the National Airspace System (NAS) and FAA's Next Generation Air Transportation System (NextGen) modernization efforts**

- **Key messages:**
  – What is NextGen?
  – Why is it needed?
  – What are the implications and opportunities?

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Approach to Training

- **Ask questions throughout**
- **If we don't know the answers, we will try to get them**
- **Briefing materials will be made available afterwards so no need to write things down**

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Air Traffic Control (ATC) Overview

© 2019 The MITRE Corporation. All rights reserved.

MITRE

What is the National Airspace System (NAS)?

The NAS is:

- **The airspace, navigation facilities, and airports of the United States**
- **The associated information, services, rules, regulations, policies, procedures, personnel, and equipment**

Image Source: FAA

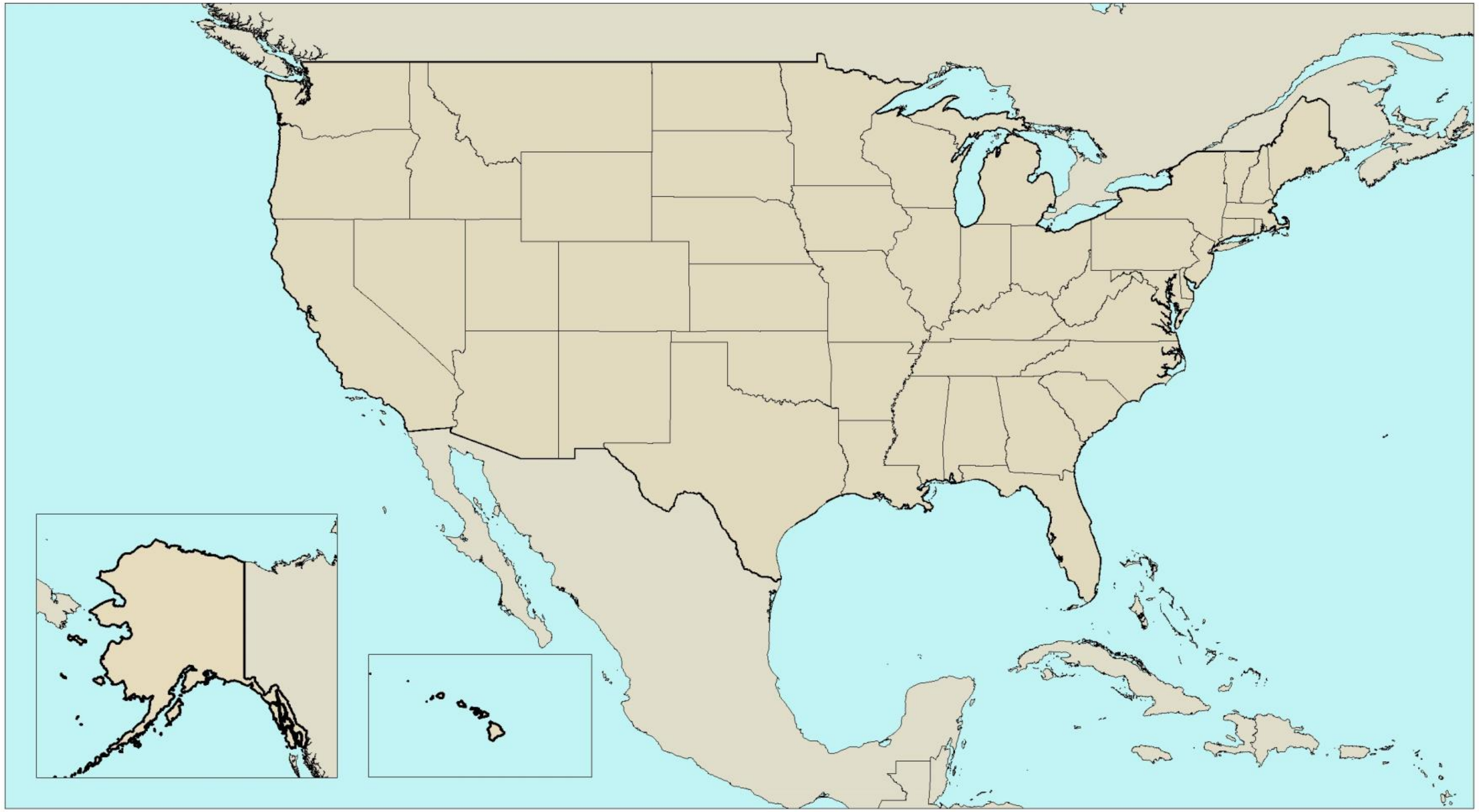
© 2019 The MITRE Corporation. All rights reserved.

How Big is the NAS?

Image Source: FAA

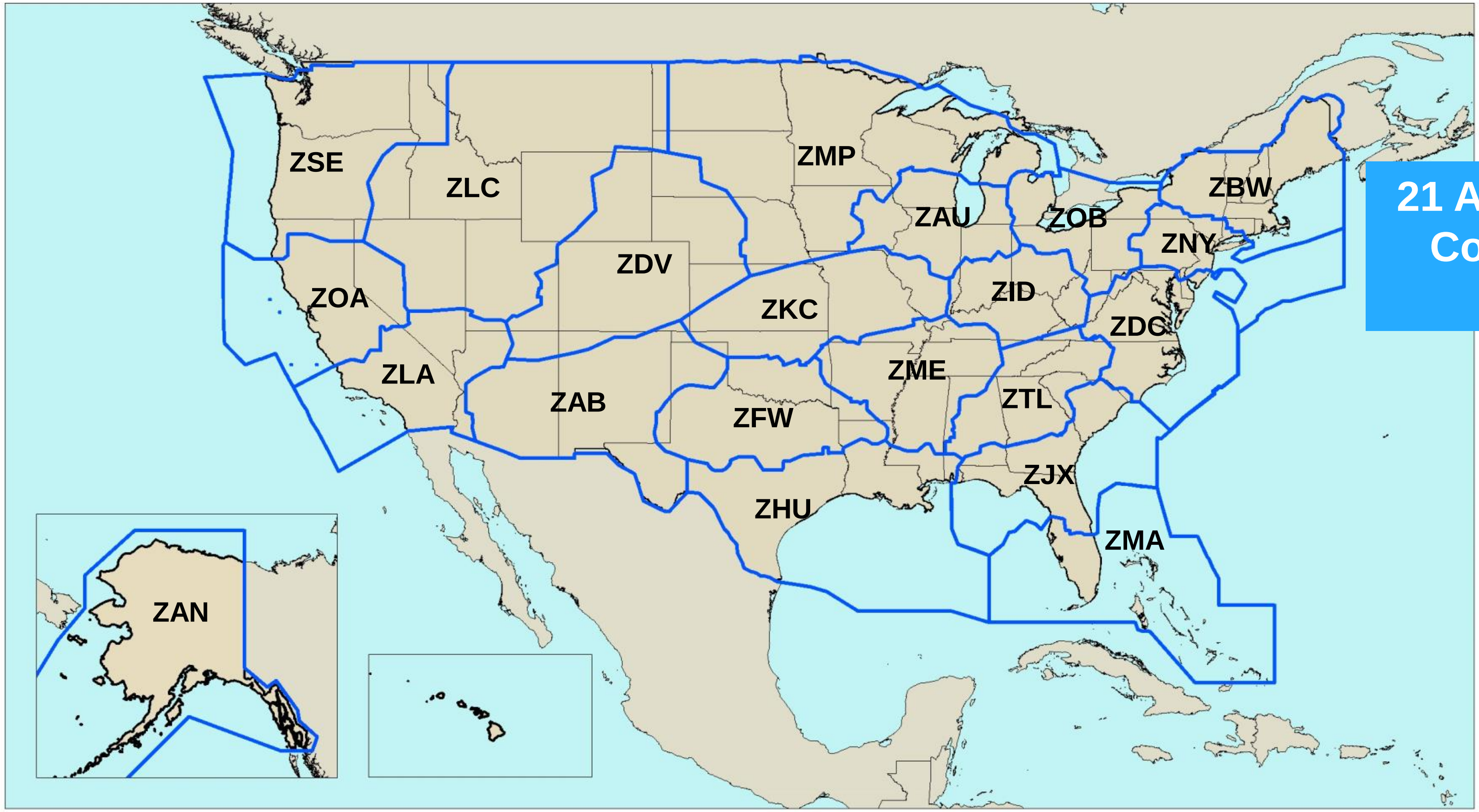
© 2019 The MITRE Corporation. All rights reserved.

What Types of Facilities are in the NAS?



© 2019 The MITRE Corporation. All rights reserved.

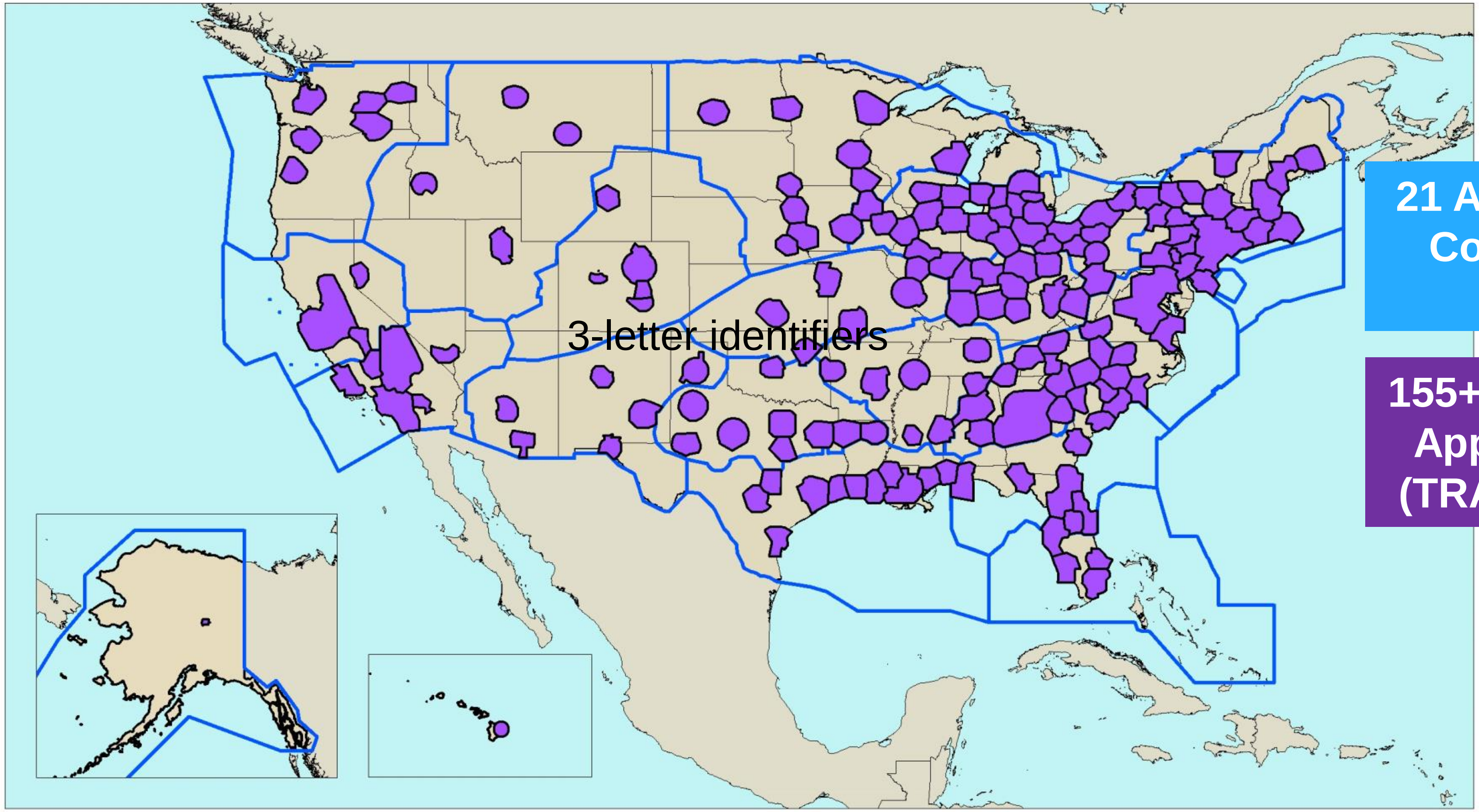
What Types of Facilities are in the NAS?



21 Air Route Traffic Control Centers (ARTCCs)

© 2019 The MITRE Corporation. All rights reserved.

What Types of Facilities are in the NAS?

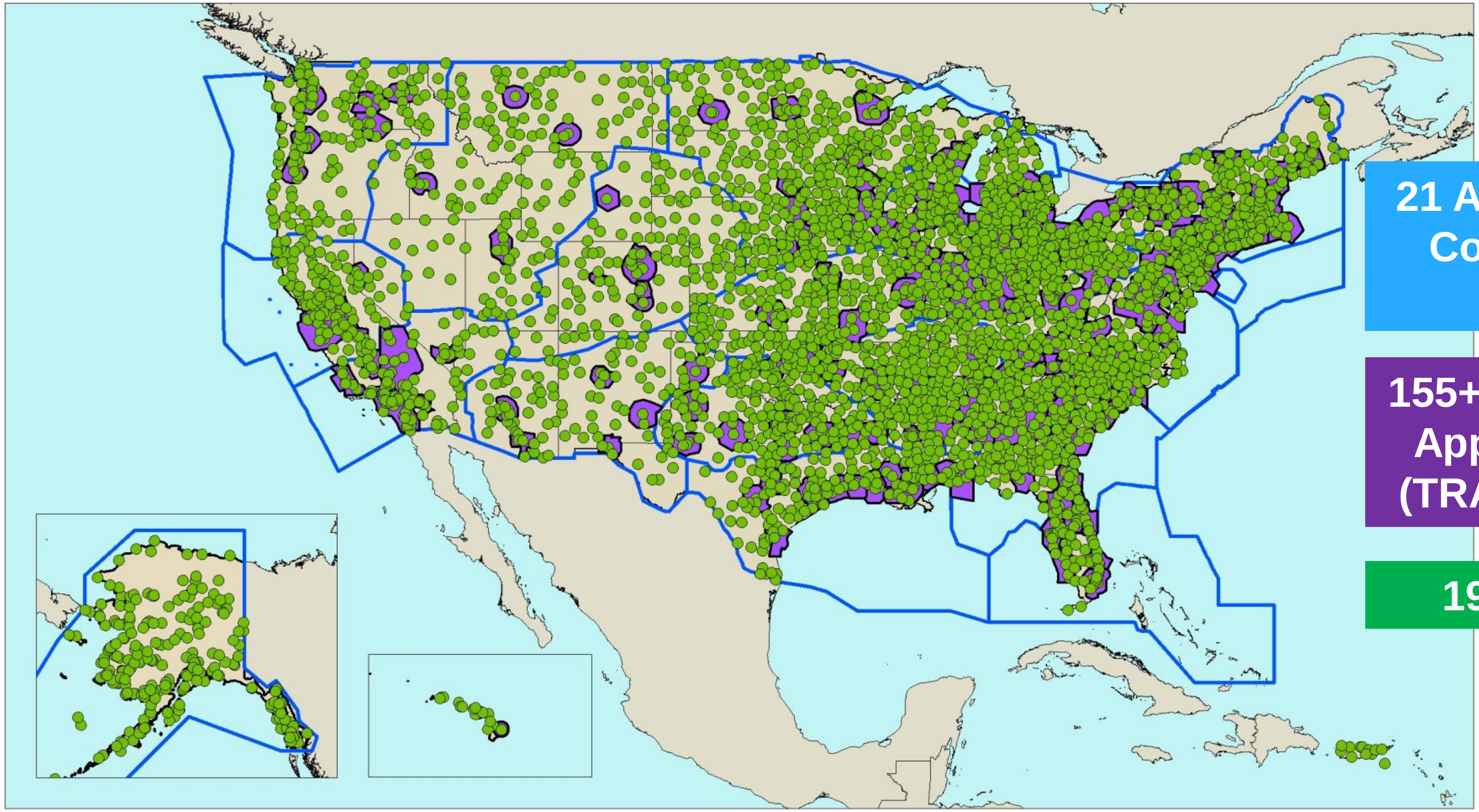


21 Air Route Traffic Control Centers (ARTCCs)

155+ Terminal Radar Approach Control (TRACON) facilities

© 2019 The MITRE Corporation. All rights reserved.

What Types of Facilities are in the NAS?



21 Air Route Traffic Control Centers (ARTCCs)

155+ Terminal Radar Approach Control (TRACON) facilities

19,000 Airports

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Who Operates the NAS Using What Equipment?

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

MITRE

How Many Operations Are in the NAS?

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

Who are the NAS Consumers / Users?

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

Additional Facts

- **The NAS is comprised of several types of airspace that govern the rules and regulations that controllers and pilots must follow**

- **The National Air Traffic Controller's Association (NATCA) is the exclusive bargaining unit representative for FAA air traffic controllers, including traffic management coordinators and some support staff**

- **Most U.S. airports are not managed by air traffic controllers and are considered "uncontrolled"**

- **Air traffic control facilities take many forms and often have unique operational needs**

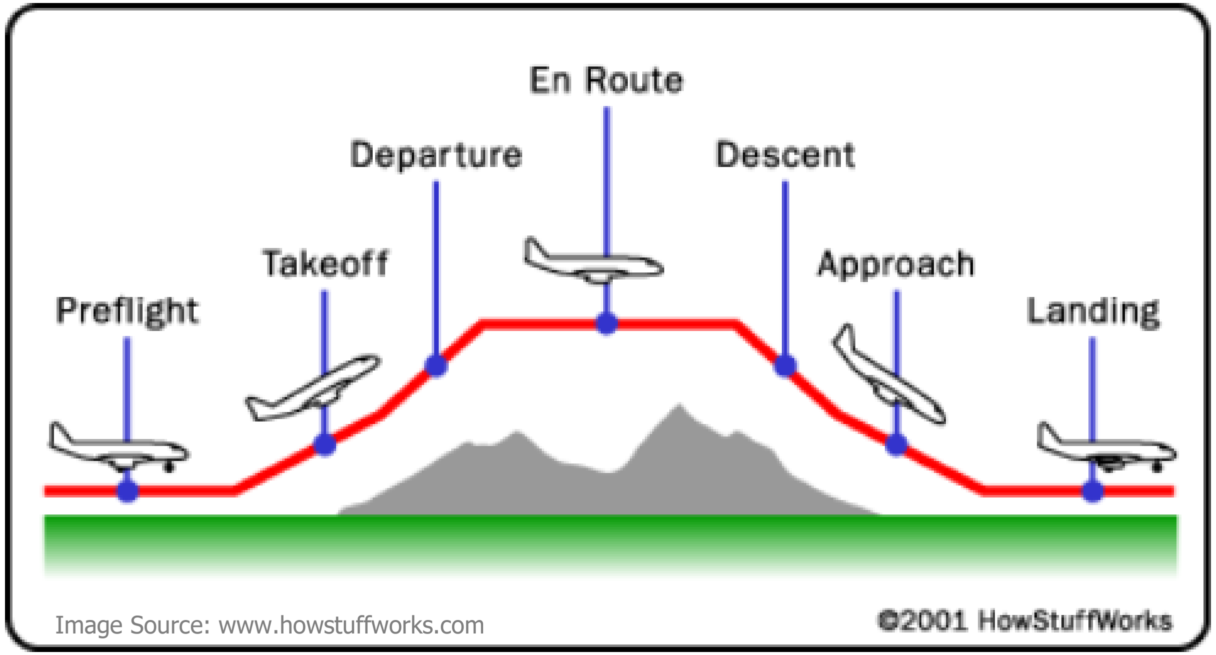
© 2019 The MITRE Corporation. All rights reserved.

Air Traffic Facilities

© 2019 The MITRE Corporation. All rights reserved.

Phases of Flight

Typical profile of a commercial airline flight:



- **Preflight:** Starts on the ground and includes flight checks, push-back from the gate and taxi to the runway
- **Takeoff:** The pilot powers up the aircraft and speeds down the runway
- **Departure:** The plane lifts off the ground and climbs to a cruising altitude
- **En route:** The aircraft travels through one or more center airspaces and nears the destination airport
- **Descent**: The pilot descends and maneuvers the aircraft to the destination airport
- **Approach**: The pilot aligns the aircraft with the designated landing runway
- **Landing**: The aircraft lands on the designated runway, taxis to the destination gate and parks at the terminal

© 2019 The MITRE Corporation. All rights reserved.

Air Traffic Facilities

Tower (Departure)

- Controls aircraft on the ground
- Gives departure clearance
- Controls aircraft in the air within 5 miles

TRACON

- Controls aircraft in the terminal airspace
- 5 to 40 miles from the airport or until an altitude of above ~10,000 feet

ARTCC(s)

- Controls aircraft in its specific airspace
- Airspace is divided into sectors
- The control of aircraft is handed from one sector to another and from one ARTCC to another when a boundary is crossed

TRACON

- Controls aircraft in the terminal airspace
- 5 to 40 miles from the airport or until handed off to Tower

Tower (Arrival)

- Controls aircraft on the final approach to the airport
- Gives clearance to land
- Controls aircraft on the ground

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

Air Traffic Control Towers (ATCTs)

- **Tower with Radar**
  - Located at an airport (not all airports have ATCTs)
  - Provides advisories, spacing, sequencing, and separation services to Visual Flight Rule (VFR) and Instrument Flight Rule (IFR) aircraft operating in the vicinity of the airport
  - Uses a combination of radar and direct observations
- **Combination Tower with Radar and Radar Approach Control**
  - Two functional areas that are located within the same facility or in close proximity to one another
    - Tower positions
    - Radar approach control positions
  - Provides radar-control service to aircraft arriving or departing the primary airport and adjacent airports, and to aircraft transitioning the terminal's airspace
- **Other**
  - Tower without radar
  - Combination non-radar approach control and tower without radar

Tower

Combined Tower and TRACON

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

Terminal Radar Approach Control Facilities (TRACONs)

- **Provide radar-control service to aircraft arriving or departing the primary airport and adjacent airports and to aircraft transitioning the TRACON's airspace**
- **Responsible for airborne aircraft ~5-40 miles from origin/destination**
- **FAA TRACON Types:**
  - Standalone TRACON
  - Combined TRACON and Tower with Radar
  - Combined Control Facility
  - Combined TRACON

Combined TRACON

Combined Tower and TRACON

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Air Route Traffic Control Centers (ARTCCs or Centers)

- **Provide air traffic control service to aircraft operating under Instrument Flight Rules (IFR) flight plans within controlled airspace and principally during the en route phase of flight**
- **Area of Operation:**
  - The control room is divided into areas of operation
  - Each area consists of a group of sectors (basic unit in each area of operation)
    - Classified as radar, non-radar, or oceanic
    - Subclassified by altitude strata
  - Number of areas is based on ARTCC's requirements and staffing needs

Indianapolis ARTCC (ZID)
Image Source: FAA

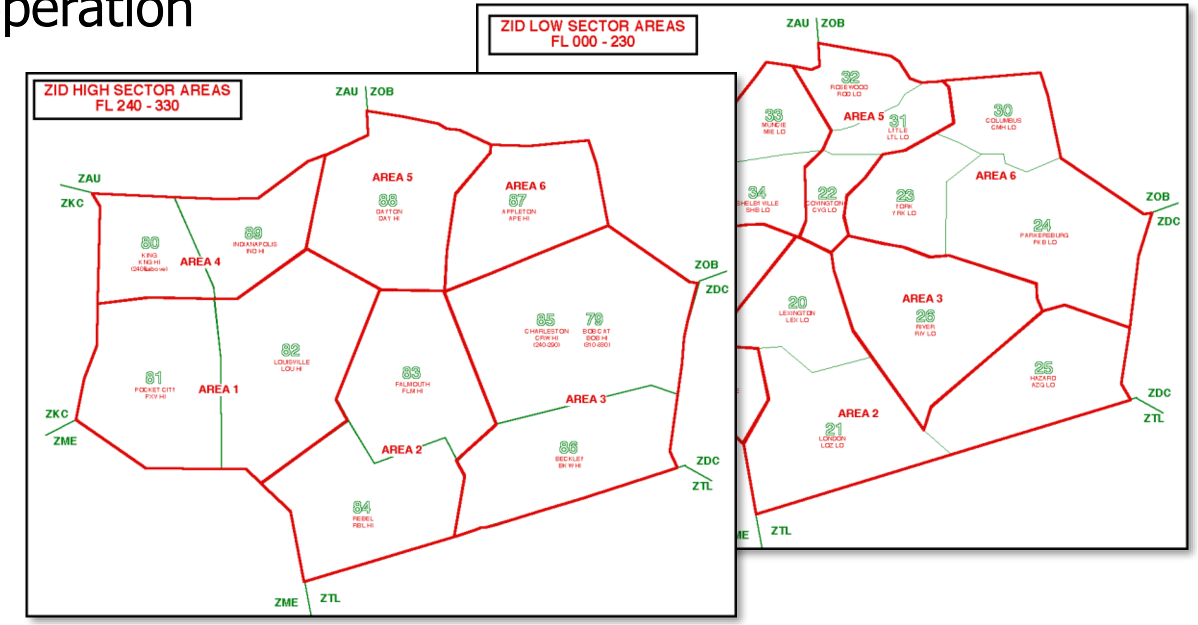


Image Source: www.pointsixtyfive.com

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Air Traffic Control System Command Center (ATCSCC) (aka Command Center)

- **Located in Warrenton, VA**
- **Became operational in May 1994 and is the largest, most sophisticated facility of its kind in the world**
- **Works in collaboration with ARTCCs, TRACONs, ATCTs, and Aviation Industry Partners**
- **Responsible for the strategic aspects of the NAS**
- **Balances air traffic demand with system capacity**

Image Source: AviationWeek.com

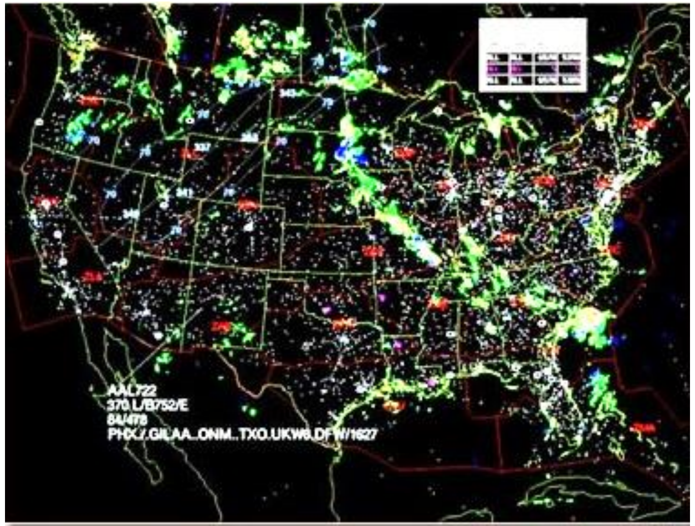


Image Source: FAA

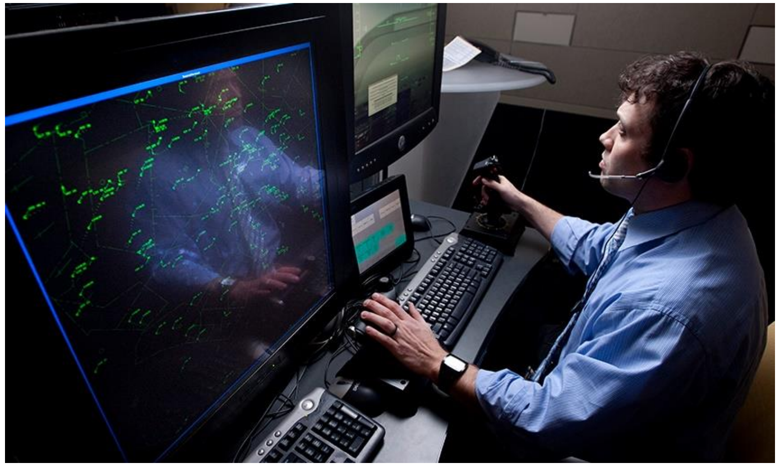
© 2019 The MITRE Corporation. All rights reserved.

MITRE

Air Traffic Management (ATM)

© 2019 The MITRE Corporation. All rights reserved.

Air Traffic Management (ATM)



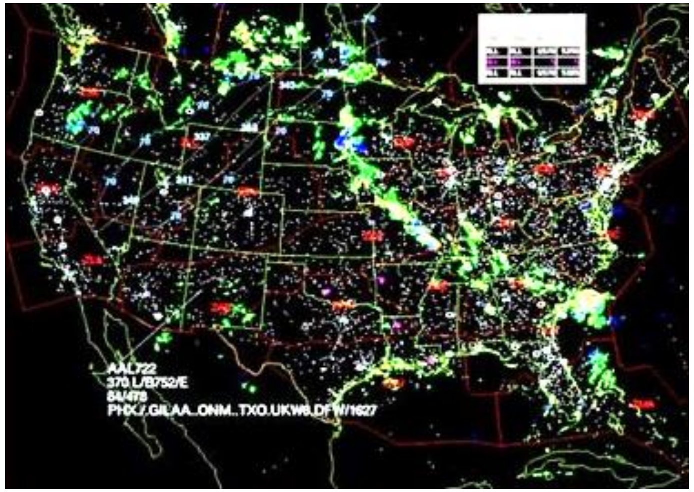


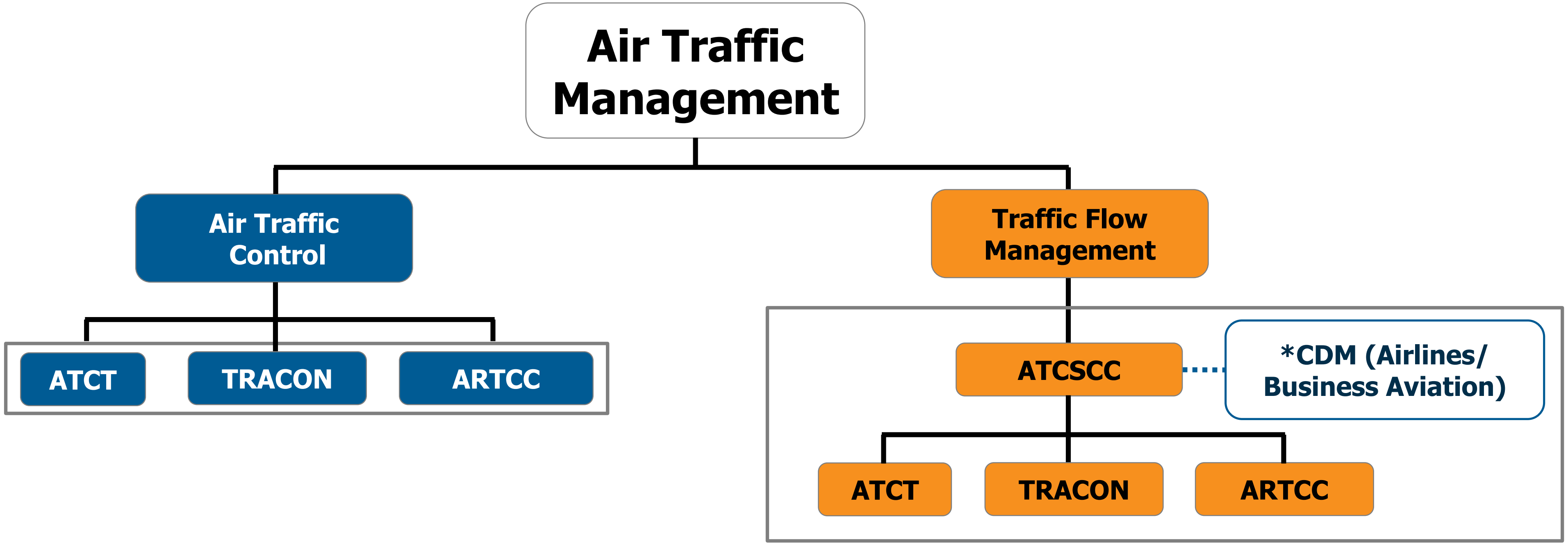
Image Source: FAA

- **Air Traffic Control (ATC)**
  - Provides for safe separation of aircraft for each phase of flight
  - Controllers speak directly with pilots

- **Traffic Flow Management (TFM)**
  - Develops and implements strategies to address situations where demand exceeds capacity
  - "System approach" to managing traffic

© 2019 The MITRE Corporation. All rights reserved.

Facilities Involved in ATM



* Collaborative Decision Making (CDM) – a joint government / industry initiative aimed at improving air traffic flow management through increased information exchange among aviation community stakeholders

© 2019 The MITRE Corporation. All rights reserved.

Tactical vs Strategic Traffic Flow Management

Tactical traffic flow management typically refers to the tasks or procedures that are carried out in a relatively short amount of time (< 2 hours) in a localized area

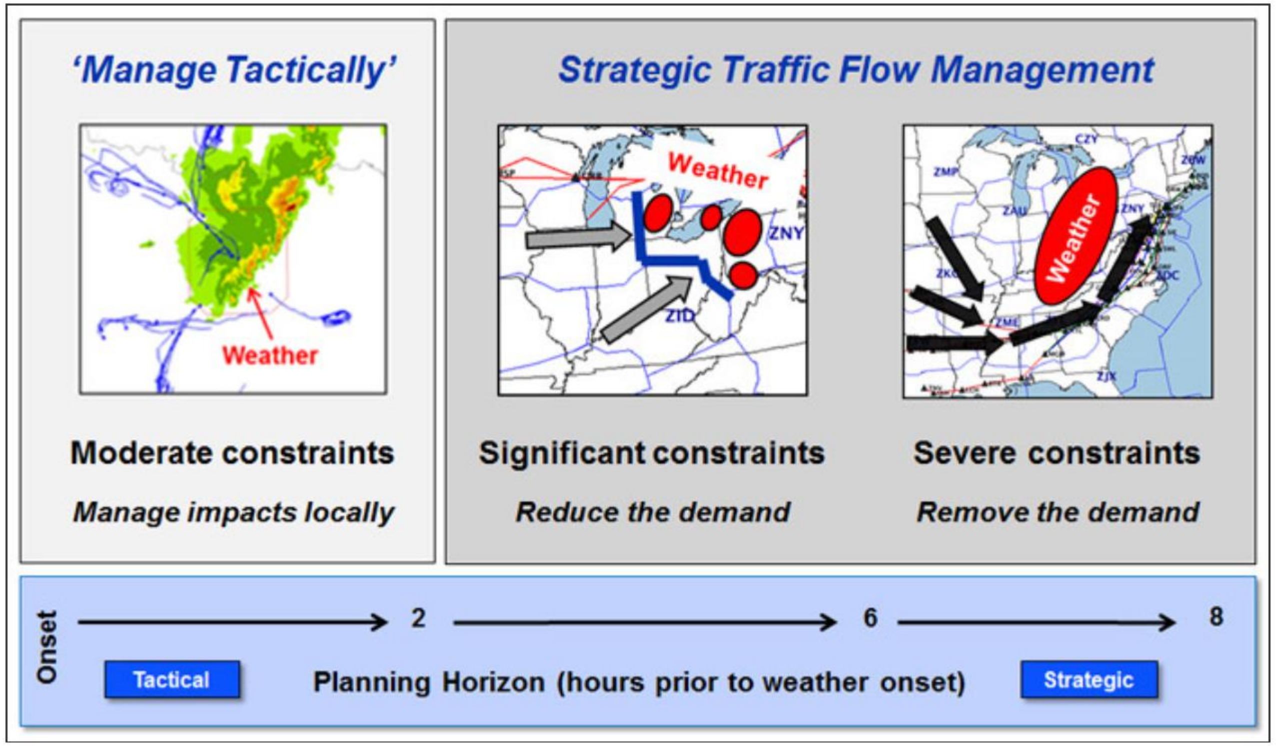


Image Source: FAA

Strategic traffic flow management refers to a longer-range planning effort (2-8 hours) at a larger, perhaps regional or national scale

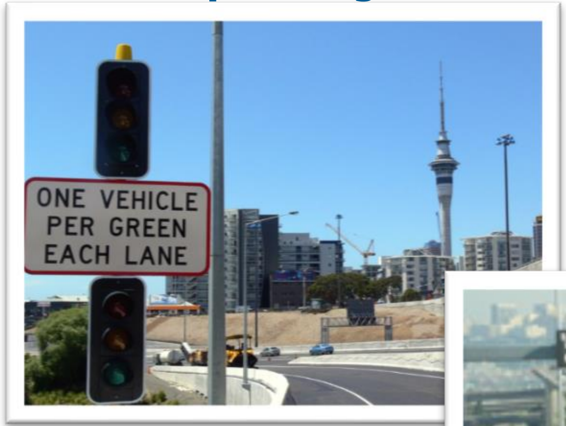
© 2019 The MITRE Corporation. All rights reserved.

Traffic Management Initiatives (TMIs)

- **Traffic managers impose TMIs to account for congestion, weather, special activity airspace, or other constraints**

- **Examples of TMIs:**
  - Ground Delay Program (GDP)
  - Airspace Flow Program (AFP)
  - Ground Stop (GS)
  - Miles-in-Trail (MIT)
  - Holding
  - Vectoring
  - Rerouting
  - Fix Balancing
  - …

On Ramp Management



Speed Control

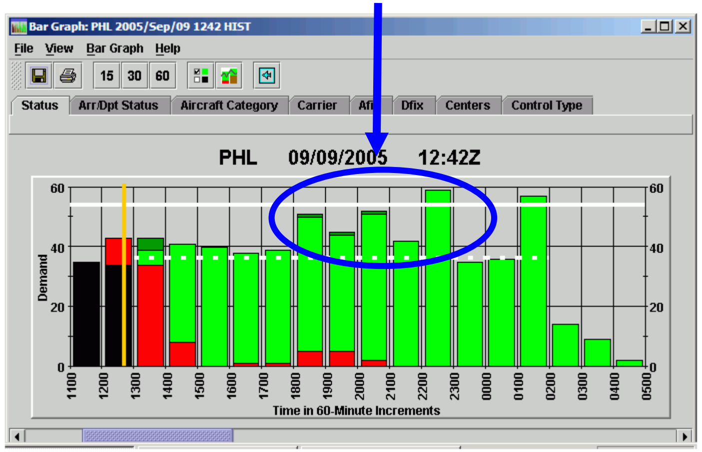
Image Source: Washington DoT

© 2019 The MITRE Corporation. All rights reserved.

Ground Delay Program (GDP)

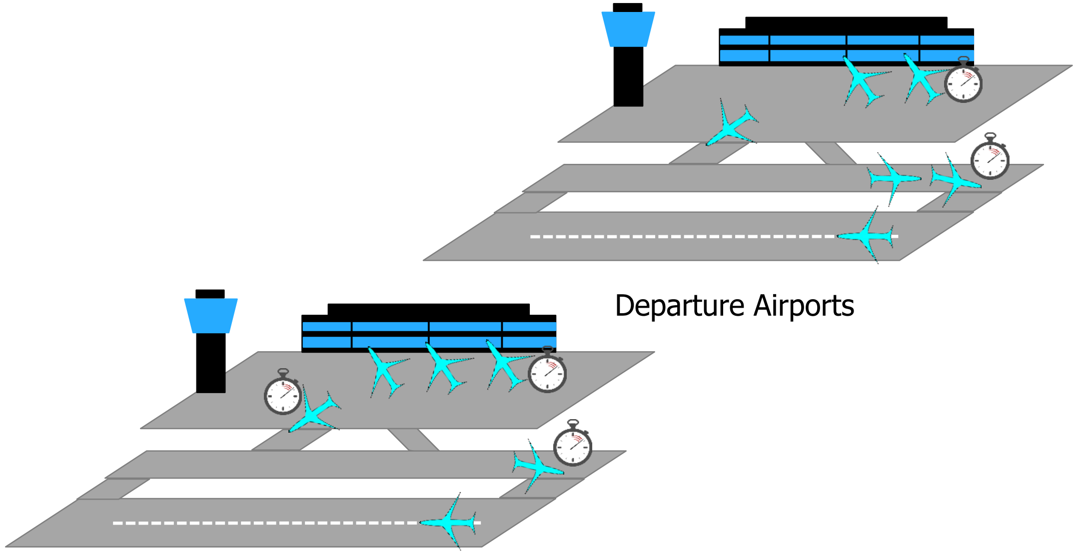
- **Used to control excess arrival demand to an airport**
  – Traffic demand is expected to exceed the airport's acceptance rate for a lengthy period of time
- **Aircraft are delayed at their departure airport in order to reconcile demand with capacity at the arrival airport**
  – Flights are assigned expect departure clearance times (EDCTs), which ensure that they arrive at the affected airport when they can be accommodated

Excess demand …



Arrival Airport

Image Source: FAA



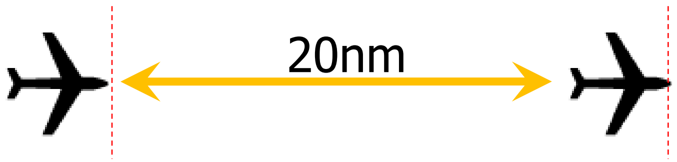
© 2019 The MITRE Corporation. All rights reserved.

MITRE

Miles-in-Trail (MITs)

- **Used to manage arrival flows**
  - Often used to manage reduced capacity or high volume
- **Involves slowing down or speeding up traffic to maintain a certain amount of space between aircraft**
  - Allows room for tactical deviations
  - Reduces sector loading

FRFAC	TOFAC	AIRPORT	ENTRY_TIME	RSTN_START	RSTN_STOP	MITVAL	DURATION	REASON_TXT
ZHU	ZFW	HOU	06/09/2018 21:32	06/10/2018 00:15	06/10/2018 01:15	20	60	WX:THUNDERSTORMS

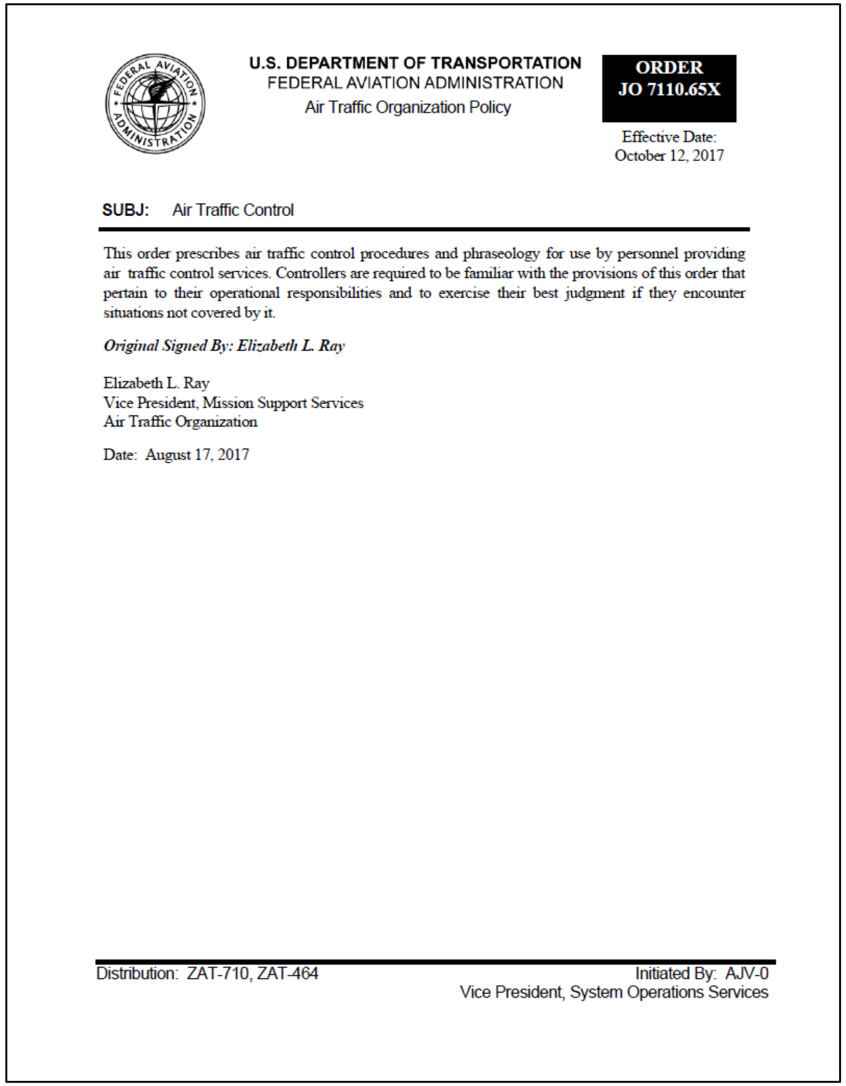


Flights destined to HOU from ZFW will have 20 miles-in-trial for 60 minutes, beginning 06/10/18 00:15 Zulu, due to thunderstorms. ZHU is the requesting facility and entered the request at 06/09/18 21:32 Zulu

© 2019 The MITRE Corporation. All rights reserved.

Separation Rules

- **VFR vs IFR**
- **Radar vs Non-Radar**
- **Wake Turbulence**
- **Departure Rules**
- **Arrival Rules**



U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Air Traffic Organization Policy

ORDER JO 7110.65X

Effective Date:
October 12, 2017

SUBJ: Air Traffic Control

This order prescribes air traffic control procedures and phraseology for use by personnel providing air traffic control services. Controllers are required to be familiar with the provisions of this order that pertain to their operational responsibilities and to exercise their best judgment if they encounter situations not covered by it.

Original Signed By: Elizabeth L. Ray

Elizabeth L. Ray
Vice President, Mission Support Services
Air Traffic Organization

Date: August 17, 2017

Distribution: ZAT-710, ZAT-464

Initiated By: AJV-0
Vice President, System Operations Services

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Meteorological Conditions

Visual Meteorological Conditions (VMC)

A lot hinges on the weather in which we operate:

- Equipment
- Training
- Airport Capacity

Instrument Meteorological Conditions (IMC)

© 2019 The MITRE Corporation. All rights reserved.

Visual Flight Rules (VFR) | Instrument Flight Rules (IFR)

VFR

- ATC contact not always required
- See and avoid (other aircraft, clouds, terrain)
- Pilots generally control and navigate by visual reference
- May or may not have a flight plan

IFR

- ATC contact required
- ATC provides separation services
- Pilots control and navigate by reference to instruments
- Must have a flight plan

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Basics of Oceanic ATC

- **FAA is allocated the majority of the worlds oceanic controlled airspace**
- **Oceanic air traffic control differs from domestic air traffic control largely because**
  - There is little radar tracking of aircraft
  - Direct radio communication between pilot and controller is rare
- **Oceanic air traffic controllers must rely on other sources of aircraft position information to ensure separation**
  - Relay of aircraft position reports via High Frequency/Radio Operator
  - Satellite-derived position reports via Automatic Dependent Surveillance-Contract (ADS-C) or Controller-Pilot Data Link Communications (CPDLC)
- **Oceanic airspace is managed collaboratively through International Civil Aviation Organization (ICAO) regional working groups**

© 2019 The MITRE Corporation. All rights reserved.

U.S. Airspace Classes at a Glance

- Class A, B, C, D, E is controlled airspace where ATC service is provided
- Class A is controlled airspace where traffic is Instrument Flight Rules (IFR)
- Class B separates VFR traffic from IFR traffic and around busy towered airports
- Class C and D is controlled airspace at an airport with a tower
- Class E is controlled airspace that is not Class A, B, C, or D
- Class G is uncontrolled airspace where no ATC services are provided

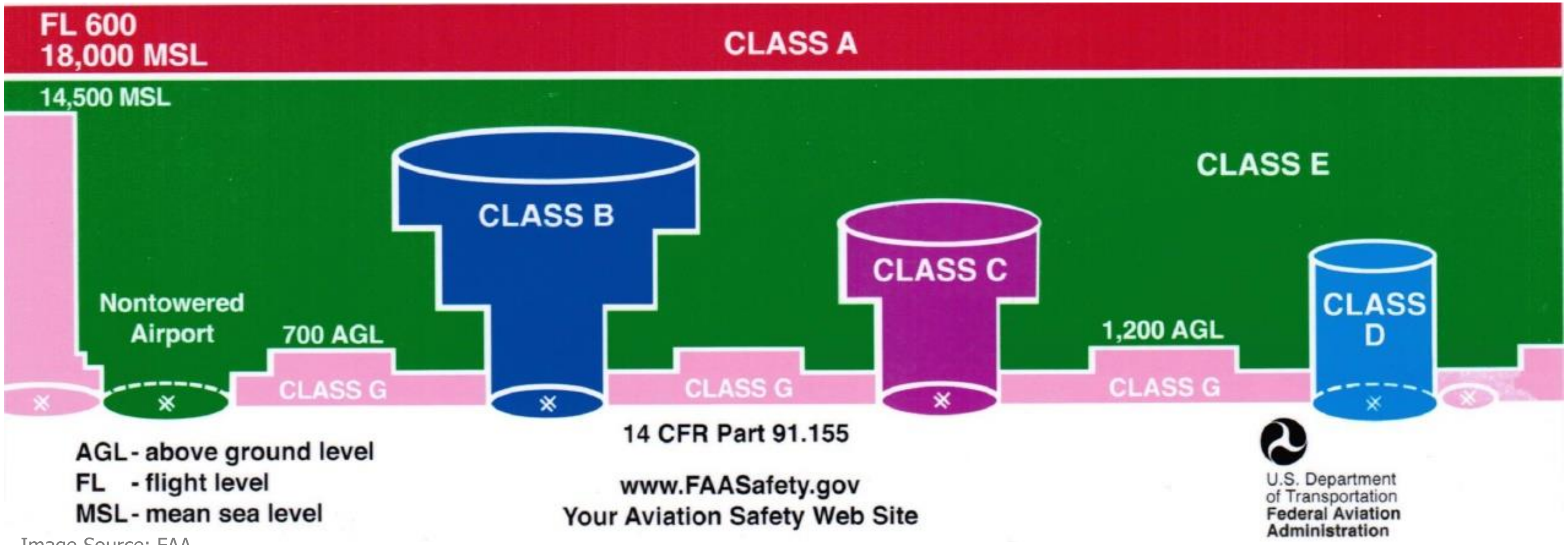


Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

Next Generation Air Transportation System (NextGen) Overview

© 2019 The MITRE Corporation. All rights reserved.

What is the Next Generation Air Transportation System (NextGen)?

Image Source: FAA

- **FAA-led modernization of our nation's air transportation system**
  – Focused on increasing safety, efficiency, capacity, predictability, and resiliency
- **<u>Not</u> a single technology, product, or goal**
  – Collection of innovative technologies, capabilities, and procedures
- **Better information and tools for airlines, general aviation operators, pilots, and air traffic controllers**
  – Help passengers and cargo arrive at their destinations more quickly
  – Help aircraft consume less fuel and produce fewer emissions

© 2019 The MITRE Corporation. All rights reserved.

NextGen Overview

- **NextGen is transforming the NAS through a number of operational improvements that are being achieved through an ongoing rollout**
- **Each improvement is implemented through a series of capabilities, or increments, that provide individual benefits**
- **Combined, these improvements are transforming the way the NAS is operated**
- **This transformation began in 2007, and all major components should be in place by 2025**

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

Evolution of NextGen

Video Source: https://www.faa.gov/nextgen/faqs/#q5

© 2019 The MITRE Corporation. All rights reserved.

Where is NextGen?

- **NextGen technologies and procedures are in place across the country:**
  - In the skies and on the ground
  - In air traffic control facilities
  - In aircraft cockpits

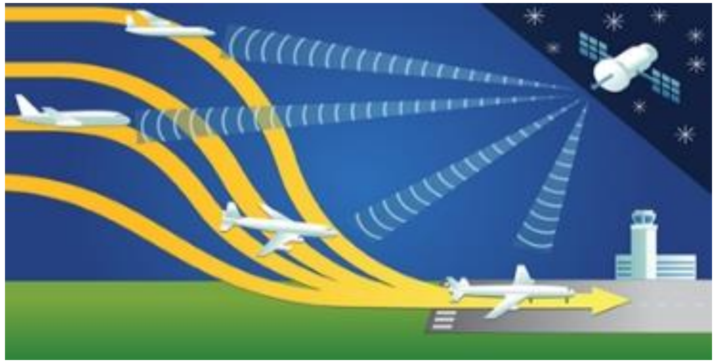


Image Source: FAA

- **Through research, innovation, and collaboration, NextGen is setting standards around the world and further establishing the FAA's global leadership in aviation**

© 2019 The MITRE Corporation. All rights reserved.

NextGen as a Whole: See, Navigate, Communicate

Video Source: https://www.faa.gov/nextgen/how_nextgen_works/

© 2019 The MITRE Corporation. All rights reserved.

MITRE

NextGen Programs and Portfolios

- The FAA uses a comprehensive, cross-agency portfolio approach to implement NextGen capabilities
- This approach recognizes NextGen as an integrated effort, rather than a series of independent programs

Image Source: FAA/MITRE

© 2019 The MITRE Corporation. All rights reserved.

NextGen Benefits

(1 of 2)

Improvements within each portfolio provide different benefits in ICAO defined *Key Performance Areas (KPAs)*

- **Access:** Ensures all airspace users have access to the air traffic resources they need to meet their specific operational requirements, and that shared use of airspace by different users can be achieved safely
- **Capacity:** Provides capacity to meet airspace user demands while minimizing restrictions on traffic flow, increasing to respond to future growth along with efficiency, flexibility, and predictability, while ensuring that there are no adverse impacts on safety and giving due consideration to the environment
- **Environment:** Contributes to environmental protection by considering noise, emissions, and other environmental issues in the implementation and operation of the aviation system

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

NextGen Benefits

(2 of 2)

- **Efficiency:** Addresses the operational and economic cost-effectiveness of gate-to-gate flight operations so airspace users can depart and arrive at the times they select and fly optimal trajectories
- **Flexibility:** Ensures all airspace users can dynamically modify flight trajectories and adjust departure and arrival times, thereby permitting them to take advantage of operational opportunities as they occur
- **Predictability:** Enables airspace users and air traffic service providers to deliver consistent and dependable levels of performance, essential to users as they develop and operate their schedules
- **Safety:** Systematically provides uniform safety standards and risk / safety management practices, ensuring implementations are assessed against proper criteria, and according to appropriate and globally standardized safety management processes

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

NextGen Priorities

(1 of 2)

- **Collaboration between FAA and aviation stakeholders**
  - Identify high-benefit, high-readiness NextGen capabilities for implementation in the near term
  - Implement specific capabilities at certain locations by specific dates to increase safety, reduce impact on the environment, enhance controller productivity, and increase predictability, airspace capacity and efficiency
  - Documented in the FAA's NextGen Priorities Joint Implementation Plan
- **Began in 2014**

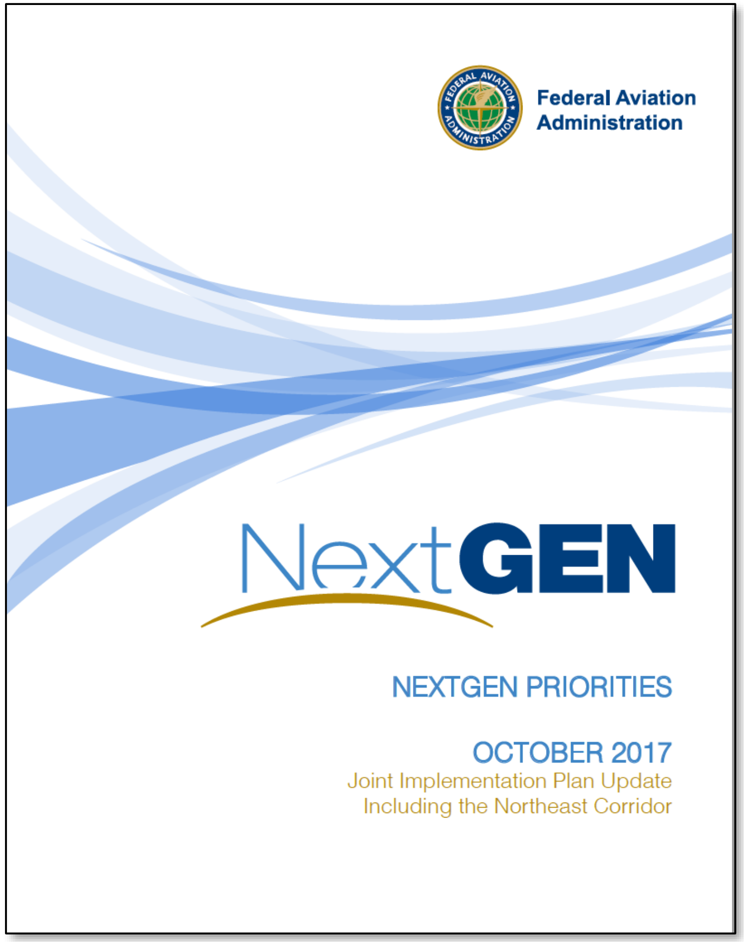


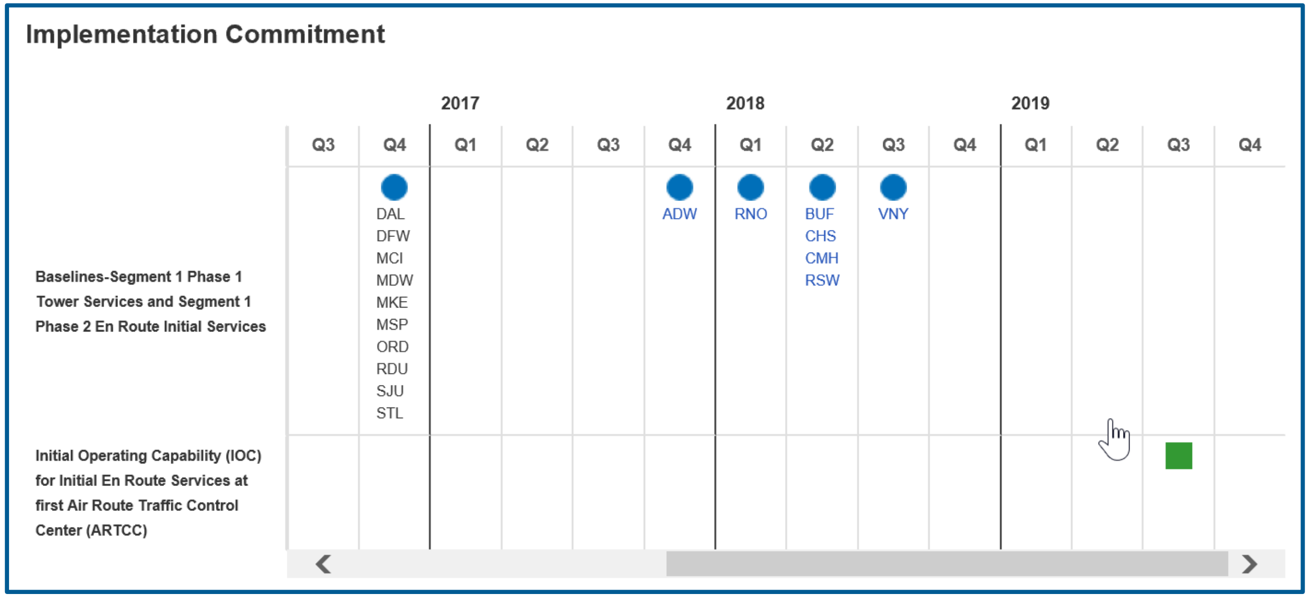
Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

NextGen Priorities
(2 of 2)

5 NextGen Priority Focus Areas

- Multiple Runway Operations
- Performance Based Navigation
- Northeast Corridor
- Surface Operations and Data Sharing
- Data Communications



Industry, Pre-Implementation, and Implementation Commitments are tracked on the NextGen Performance Snapshots website (https://www.faa.gov/nextgen/snapshots/)

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

MITRE

NextGen Programs

- Automatic Dependent Surveillance-Broadcast (ADS-B)
- Automation
- Data Communications (Data Comm)
- Decision Support Systems (DSS)
- NAS Voice System (NVS)
- Performance Based Navigation (PBN)
- System Wide Information Management (SWIM)
- Weather

© 2019 The MITRE Corporation. All rights reserved.

Automatic Dependent Surveillance-Broadcast (ADS-B) Program

- ADS-B provides real-time precision, shared situational awareness, and advanced applications for pilots and controllers
- Functions with satellite rather than radar technology to more accurately observe and track air traffic
- Improves safety and efficiency in the air and on runways, reduces costs, and lessens harmful effects on the environment

Video Source: https://www.faa.gov/tv/?mediaId=1793

- Aircraft equipped with an ADS-B Out transmitter send their position, altitude, heading, ground speed, vertical speed, call sign, and ICAO identifier to a network of ground stations that relays the information to air traffic control displays

© 2019 The MITRE Corporation. All rights reserved.

Automation Program

Video Source: https://www.faa.gov/tv/?mediaId=1520

- **New, state-of-the-art computer systems have been deployed to FAA air traffic control facilities across the country**
- **The Standard Terminal Automation Replacement System (STARS) and En Route Automation Modernization (ERAM) are enabling NextGen capabilities at all phases of flight**
- **STARS and ERAM enable NextGen capabilities such as ADS-B and Data Comm**
  - STARS is a digital automation system capable of tracking all aircraft within the defined airspace using information from available surveillance systems
  - ERAM enables controllers to track, direct, and separate aircraft within their area of responsibility. It also has an improved conflict detection capability and helps reduce aircraft separation from 5 nautical miles to 3 nautical miles under certain conditions
- **These platforms will play a key role in the transition to Trajectory Based Operations (TBO), a time-based form of air traffic management**

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Data Communications (Data Comm) Program

Video Source: https://www.faa.gov/tv/?mediaId=1526

Data Communications departure clearances are available at 62 airports

© 2019 The MITRE Corporation. All rights reserved.

Decision Support Systems (DSS) Program

- **DSS programs and products help manage strategic flow, en route flow, terminal flow and airport surface movement**
- **The primary tools, often referred to as the "3Ts" are:**

Traffic Flow Management System (TFMS)

Decision support system for planning and mitigating demand-capacity imbalances in the NAS.

Terminal Flight Data Management (TFDM)

A new decision support system for airport surface management and ATC tower functions.

Time-Based Flow Management (TBFM)

Decision support system for metering based on time to optimize the flow of aircraft.

- **DSS tools combine modeling and analysis with traditional data access and retrieval to enable traffic managers to make decisions in rapidly changing environments**
- **The tools alert operators to conditions that require a decision and help to develop and analyze possible courses of action**

© 2019 The MITRE Corporation. All rights reserved.

Terminal Flight Data Manager (TFDM)

Image Source: FAA; Video Source: https://www.faa.gov/tv/?mediaId=1714

© 2019 The MITRE Corporation. All rights reserved.

NAS Voice System (NVS) Program

- **NVS is a digital telecommunications network that will**
  - Provide state-of-the-art digital voice communication services to ATC facilities
  - Replace and standardize the FAA's aging analog voice communication system
  - Enable voice communication with operators of Unmanned Aircraft Systems
- **Benefits:**
  - Air-to-ground voice communication is no longer limited by geographical facility boundaries
  - Provides greater flexibility for developing and using airspace/traffic assignments
- **NVS software is in the development and testing phase**

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

MITRE

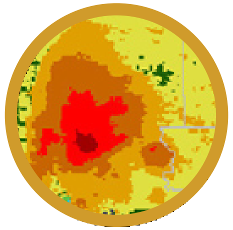
System Wide Information Management (SWIM) Program

- **SWIM is the digital data delivery platform that turns raw NAS data into meaningful information for aviation stakeholders**
  - Replaces outdated system of multiple dedicated computer interfaces
  - Creates a single connection through a secure FAA telecommunications system where consumers can retrieve data from producers
- **Users gain access to data products with improved bandwidth and security**

Video Source: https://www.faa.gov/tv/?mediaId=1528

© 2019 The MITRE Corporation. All rights reserved.

Weather Program



- **Collaboration between FAA, National Oceanic and Atmospheric Administration (NOAA), and National Aeronautics and Space Administration (NASA)**
- **Help reduce the impact of weather on aviation, resulting in safer, more efficient and more predictable day-to-day NAS operations**
- **Provides tailored aviation weather products, helping controllers and operators develop reliable flight plans, make better decisions, and improve on-time performance**

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

NextGen Portfolios

- **There are eleven portfolios**
  - Eight implementation portfolios
  - Three supporting activities portfolios

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Collaborative Air Traffic Management (CATM) Portfolio

- **Improvements designed to:**
  – Coordinate flight and flow decision-making by flight planners and FAA traffic managers to improve overall efficiency of the NAS
  – Provide greater flexibility to flight planners
  – Make the best use of available airspace and airport capacity
- **Targeted to deliver a combination of:**
  – Increased information on the users' preferred alternative routes
  – Enhanced tools for assessing the impact of rerouting decisions
  – Improved communications and display of instructions to air traffic controllers
- **Main benefit areas: Capacity, Efficiency, Flexibility, Predictability**

© 2019 The MITRE Corporation. All rights reserved.

Improved Approaches and Low-Visibility Operations Portfolio

- **Improvements are designed to increase:**
  - Airport approach and arrival access
  - Flexibility
- **Accomplished through a combination of:**
  - Procedural changes
  - Improved aircraft capabilities
  - Improved precision approach guidance

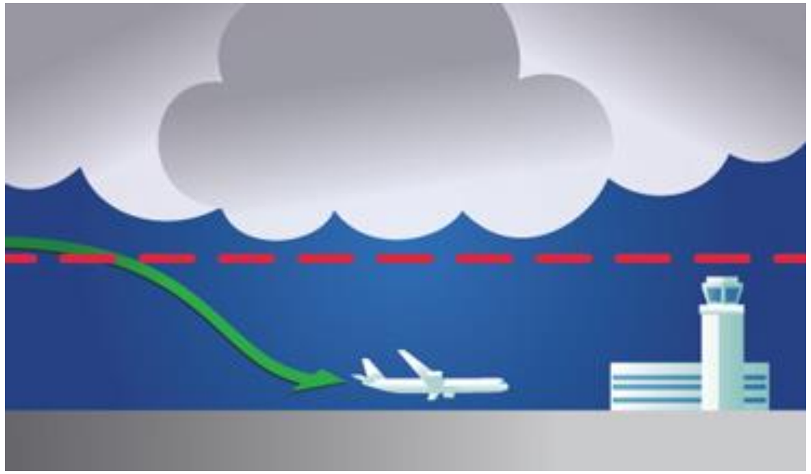


Image Source: FAA

- **Vertical navigation and other flight deck capabilities provide access to more runways when visibility is low, leading to increased throughput and reduced delay**
- **Main benefit areas: Access, Capacity**
- **Example of portfolio improvements:**
  - Expanded Low-Visibility Operations Using Lower Runway Visual Range Minima

© 2019 The MITRE Corporation. All rights reserved.

Improved Multiple Runway Operations Portfolio

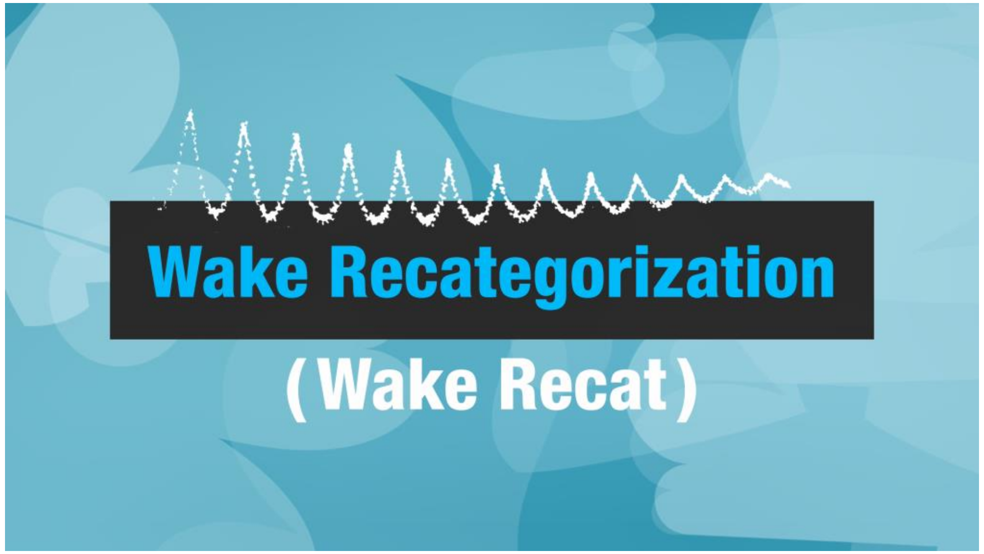
- **Improvements are designed to improve access to closely spaced parallel runways by:**
  - Enabling the use of simultaneous approaches (two aircraft arriving side-by-side) during periods of reduced visibility
  - Decreasing the required separation between aircraft on dependent approaches (staggered aircraft arrivals on parallel runways)
  - Alleviating the effects of wake turbulence that normally require increased separation between aircraft in terminal airspace (airspace surrounding airports)
- **Main benefit areas: Capacity, Efficiency**
- **Example of portfolio improvements:**
  - Amend Standards for Simultaneous Independent Approaches — Triple

Image Source: FAA

MITRE

Separation Management Portfolio

- **Improvements will enhance aircraft separation assurance by safely reducing separation between aircraft**
- **Capabilities in this portfolio will provide air traffic controllers with tools and procedures to separate aircraft in a mixed environment with various types of navigation equipment and wake performance capabilities**
- **Main benefit areas: Access, Capacity, Efficiency, Safety**
- **Example of portfolio improvements:**
  – Wake Recategorization



Video Source: https://www.faa.gov/tv/?mediaId=1689

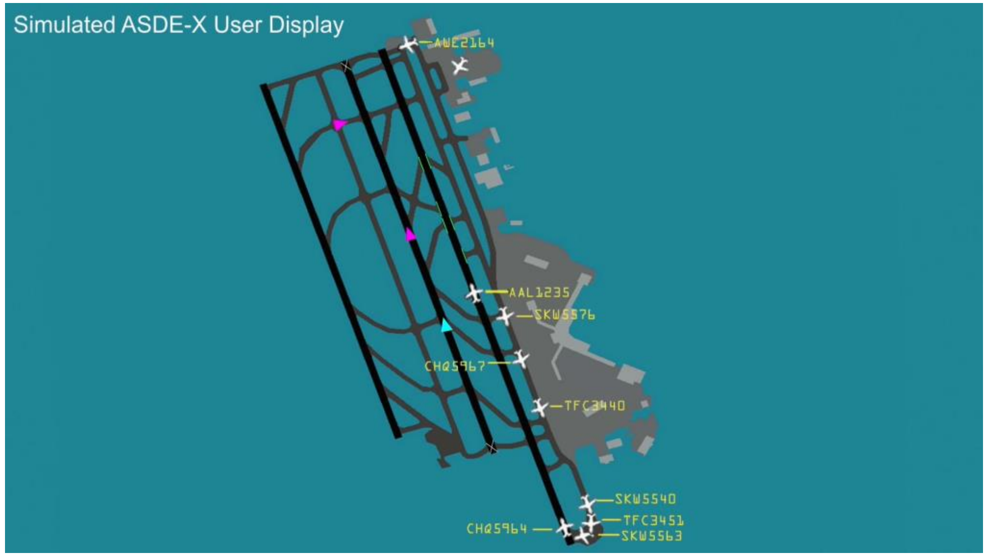
© 2019 The MITRE Corporation. All rights reserved.

Improved Surface Operations Portfolio

- **Improvements are designed to:**
  - Track the movement of surface vehicles and aircraft, incorporating the movement data into the airport surveillance infrastructure, and sharing the information with air traffic controllers, pilots and airline operations managers
  - Support the exchange of information that occurs from before the aircraft pushes back from the gate up to departure and after landing from exiting the runway to arriving at the terminal gate

- **Main benefit areas: Capacity, Efficiency, Environment, Flexibility, Predictability, Safety**

- **Example of portfolio improvements:**
  - Airport Surface Detection Equipment-Model X (ASDE-X)



Video Source: https://www.faa.gov/about/office_org/headquarters_offices/ang/offices/tc/library/storyboard/detailedwebpages/asdex.html

© 2019 The MITRE Corporation. All rights reserved.

On-Demand NAS Information Portfolio

- Improvements provide flight planners, air traffic controllers, air traffic managers, and flight crews consistent and complete information related to changes in the airspace system

- The capabilities in this portfolio will be realized through access to and exchange of aeronautical and flight information using common data formatting and information exchange standards

- Main benefit areas: Environment, Flexibility, Safety

© 2019 The MITRE Corporation. All rights reserved.

NAS Infrastructure Portfolio

- **Supporting activity portfolio**
- **Contains key transformational and infrastructure sustainment capabilities that are critical to the success of NextGen across multiple portfolios**
- **Includes technical refreshes of current infrastructure**
- **Capabilities fall into the following infrastructure categories:**
  - Communications
  - Oceanic
  - Information Management
  - Weather

© 2019 The MITRE Corporation. All rights reserved.

System Safety Management Portfolio

- **Supporting activity portfolio**
- **Aims to develop and implement the policies, processes, and analytical tools that the FAA and industry will use to ensure the safety and security of the NAS**
  - Ensure that new capabilities either improve or maintain current safety levels while simultaneously improving capacity and efficiency in the NAS
- **This portfolio contains two projects that will define emerging safety requirements**
  1) Aviation Safety Information Analysis and Sharing (ASIAS)
  2) System Safety Management Transformation (SSMT)
- **Main benefit area: Safety**

© 2019 The MITRE Corporation. All rights reserved.

Environment and Energy Portfolio

- **Supporting activity portfolio**
- **Overcome the environmental constraints facing aviation**

NOISE　　AIR QUALITY　　CLIMATE　　ENERGY

- **Five-pillar approach**

Science and Tools
Operations
Technology
Policy
Alternative Fuels

- **Main Benefit Area: Environment**

© 2019 The MITRE Corporation. All rights reserved.

NextGen Environmental Goals

NOISE

Reduce the number of people exposed to significant noise around US airports in absolute terms, notwithstanding aviation growth, and provide additional measures to protect public health and welfare and national resources

AIR QUALITY

Achieve an absolute reduction of significant air quality health and welfare impacts attributable to aviation

CLIMATE

Limit the impact of aircraft carbon dioxide (CO2) emissions on the global climate by achieving carbon-neutral growth by 2020 compared to 2005, and net reductions of the climate impact from all aviation emissions over the longer term (by 2050)

ENERGY

Improve National Airspace System (NAS) energy efficiency and develop and deploy alternative jet fuels for commercial aviation

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Summary of Current Improvements and Increments

Science and Tools

Integrated Environmental Modeling
- Aviation Environmental Tools Suite

Technology

NextGen Environmental Engine and Aircraft Technologies
- Explore and Demonstrate New Technologies Under CLEEN

Alternative Fuels

Sustainable Alternative Jet Fuels
- Other Advanced Drop-In Aviation Alternative Jet Fuels
- Generic Methodology for Alternative Jet Fuel Approval
- Support Qualification and Deployment of Drop-In Alternative Jet Fuels

Policy

Environmental Policies, Standards, and Measures
- Environmental Performance and Targets
- EMS Data Management
- Analysis to Support International Environmental Standard-Setting

http://www.faa.gov/go/cleen

http://www.caafi.org

http://ascent.aero

© 2019 The MITRE Corporation. All rights reserved.

Performance Based Navigation Portfolio

- **Improvements are designed to:**
  - Address ways to leverage emerging technologies, such as Area Navigation (RNAV) and Required Navigation Performance (RNP), to improve access and flexibility for point-to-point operations
  - Help air traffic managers conduct Trajectory Based Operations (TBO)
  - Save time and fuel while reducing emissions
- **The FAA has already published more than 9,300 Performance Based Navigation (PBN) procedures and routes**
- **Main Benefit Areas: Access, Efficiency, Flexibility, Predictability**
- **Example of portfolio implementations:**
  - RNAV/RNP Procedures
  - Metroplex

Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

What is PBN?

<u>PBN is comprised of RNAV and RNP</u> and describes an aircraft's capability to navigate using performance standards

- <u>RNAV</u> enables aircraft to **fly on any desired flight path**
  - Paths are limited by the coverage of ground or spaced-based navigation aids and/or the limits of the aircraft's self-contained systems
  - RNAV aircraft have better access and flexibility for point-to-point operations
- <u>RNP</u> is RNAV with the addition of an **onboard performance monitoring and alerting capability**
  - The aircraft navigation system can monitor navigation performance and inform the crew if the requirement is not met during an operation
  - This onboard monitoring and alerting capability enhances the pilot's situation awareness and can enable reduced obstacle clearance

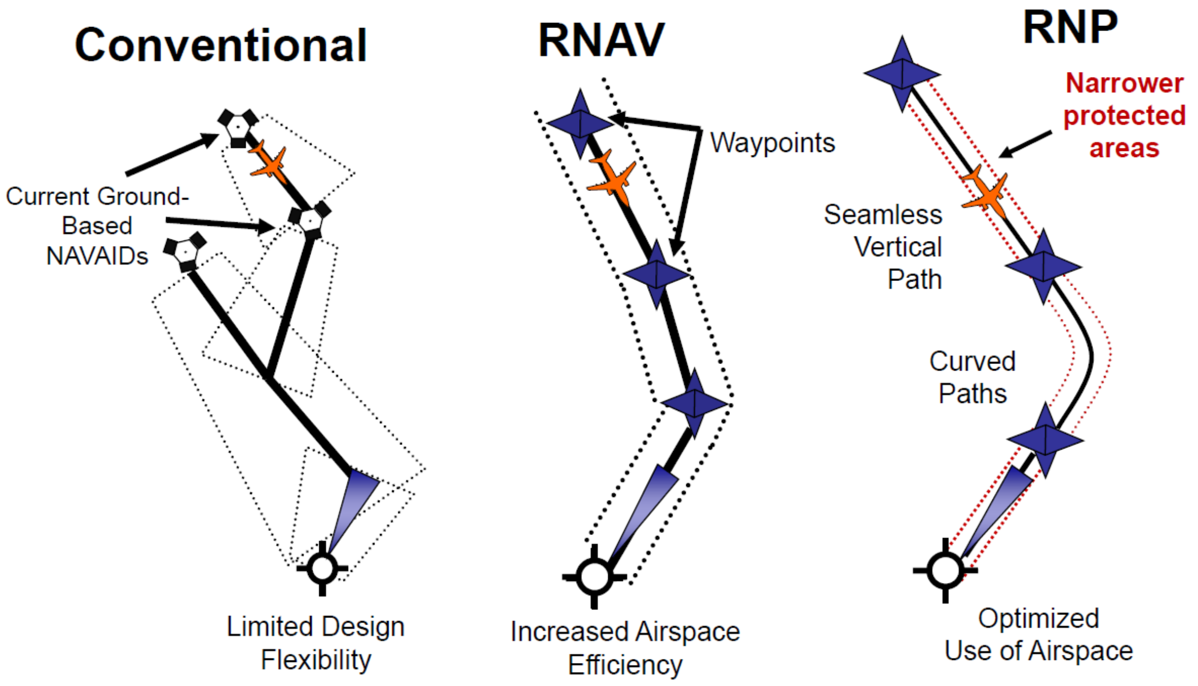


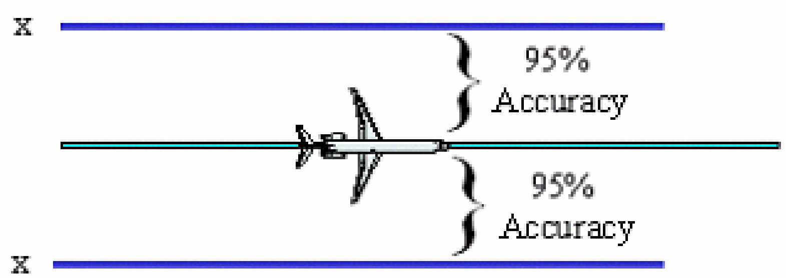
Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

MITRE

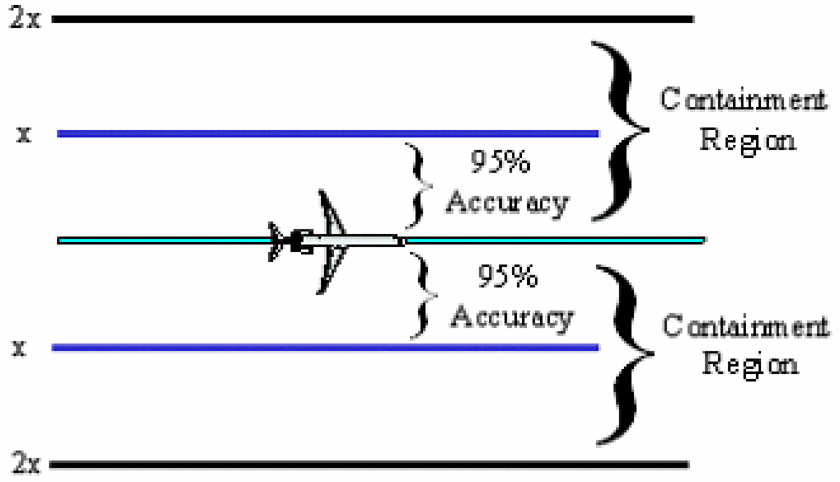
RNAV and RNP Accuracy and Containment

RNAV-X



RNP-X

(w/Containment)



© 2019 The MITRE Corporation. All rights reserved.

Takeoff-to-Touchdown PBN NAS

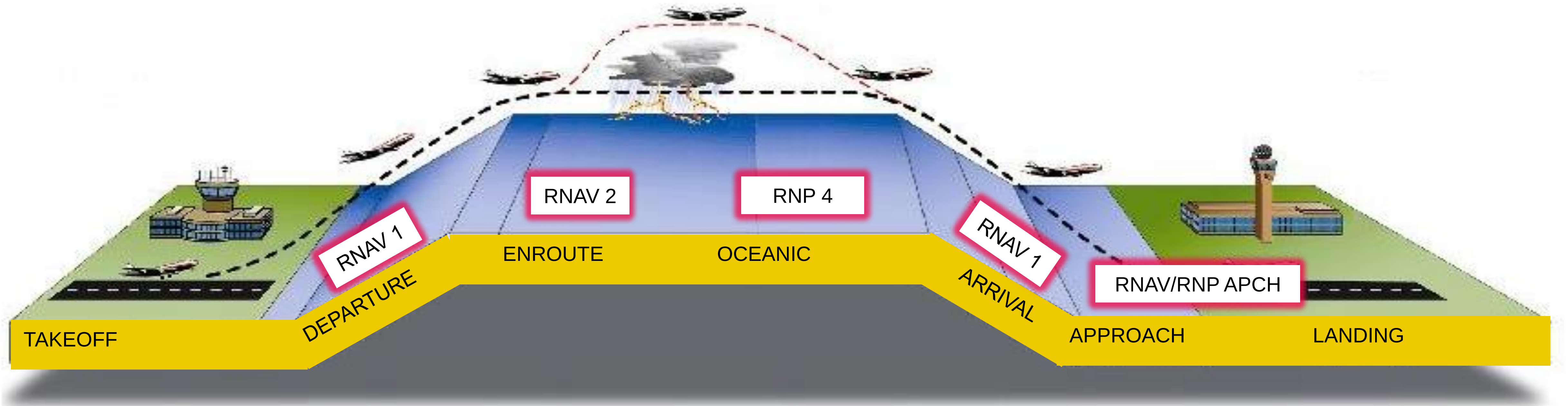


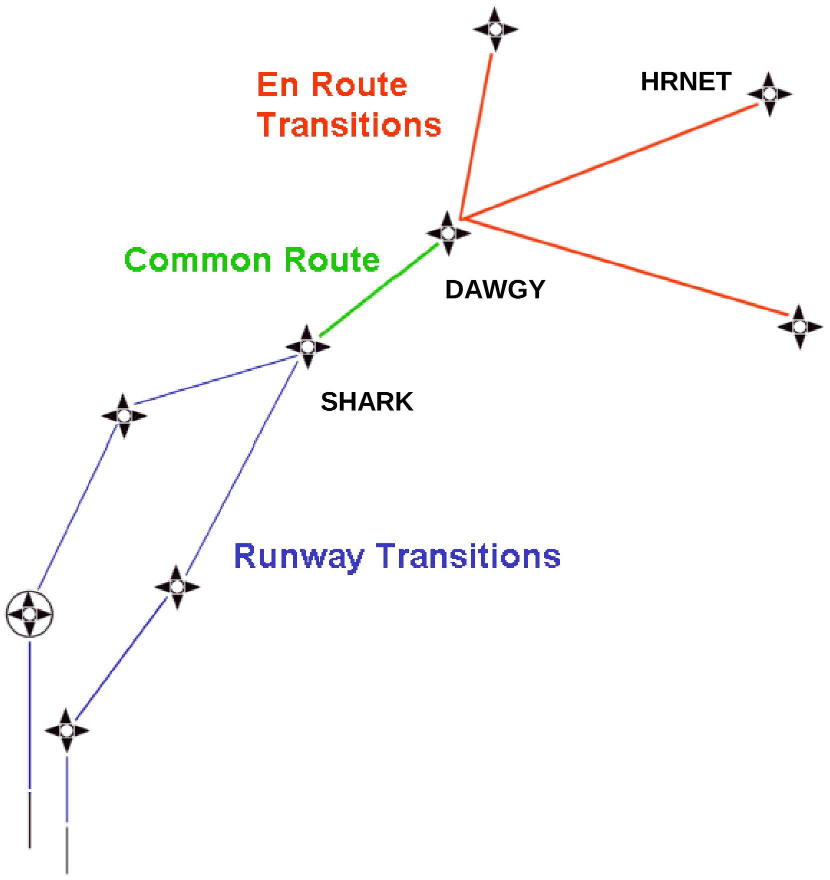
Image Source: FAA

- Departure: RNAV (and RNP) SIDs
- En-route: Q-routes, T-routes, TK-routes
- Arrival: RNAV STARs (RNP?)
- Approach: RNAV and RNP approaches

© 2019 The MITRE Corporation. All rights reserved.

Types of PBN Procedures – RNAV Standard Instrument Departures (SIDs)

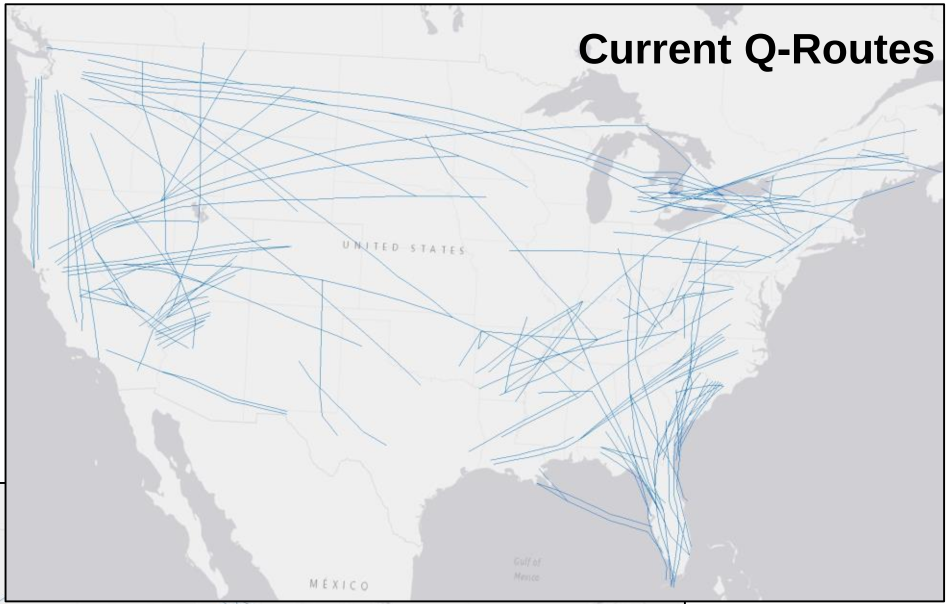
- Fixed, precise repeatable paths for aircraft from takeoff to en route
- Minimal level offs to reduce fuel consumption and noise
- Reduced pilot and controller task complexity in all weather
- Deconfliction of departing and arriving traffic
- More than 1,200 RNAV SIDs deployed to date

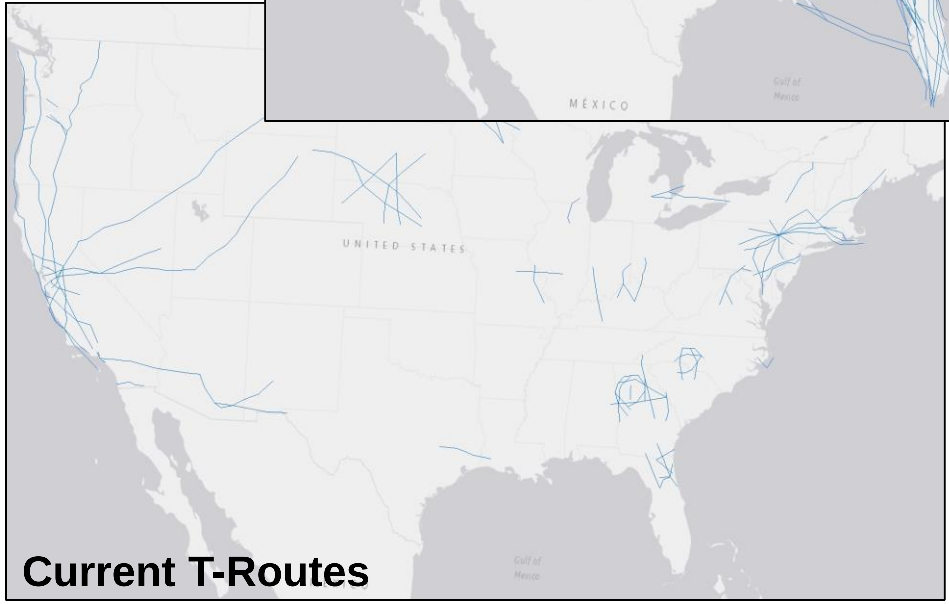


© 2019 The MITRE Corporation. All rights reserved.

Types of PBN Procedures – Q- and T-Routes

- **Replacements for high- and low-altitude routes that rely on ground-based navigation aids**
- **T-Routes**
  - Flown primarily via satellite navigation
  - Replacing many Victor routes in airspace from 1,200 to 18,000 feet
- **Q-Routes**
  - Flown using positioning from satellite signals or distance measuring equipment (DME) in case of a GPS outage
  - Replacing many Jet routes from 18,000 to 45,000 feet
- **More than 100 T-Routes and 145 Q-Routes deployed to date**

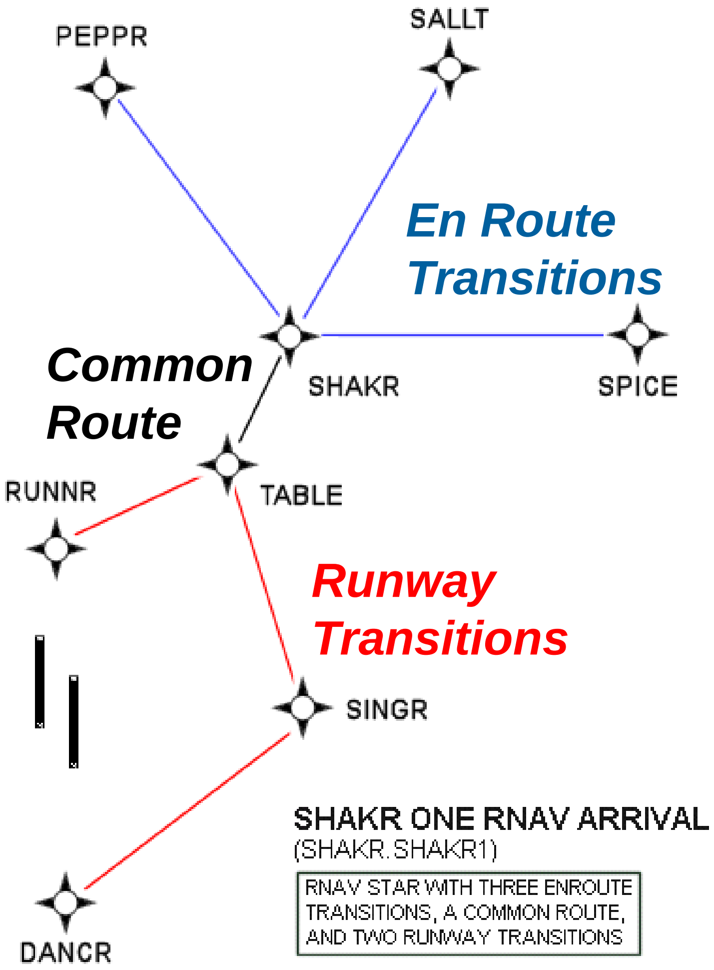




© 2019 The MITRE Corporation. All rights reserved.

Types of PBN Procedures – RNAV Standard Terminal Arrivals (STARs)

- **Fixed, precise repeatable paths for aircraft from en route to approach**
- **Potential for continuous descent from cruise altitude using optimized profile descents (OPDs) to save fuel and reduce emissions**
- **Reduced pilot and controller task complexity in all weather**
- **Deconfliction of arriving and departing traffic**
- **More than 860 RNAV STARs deployed to date**



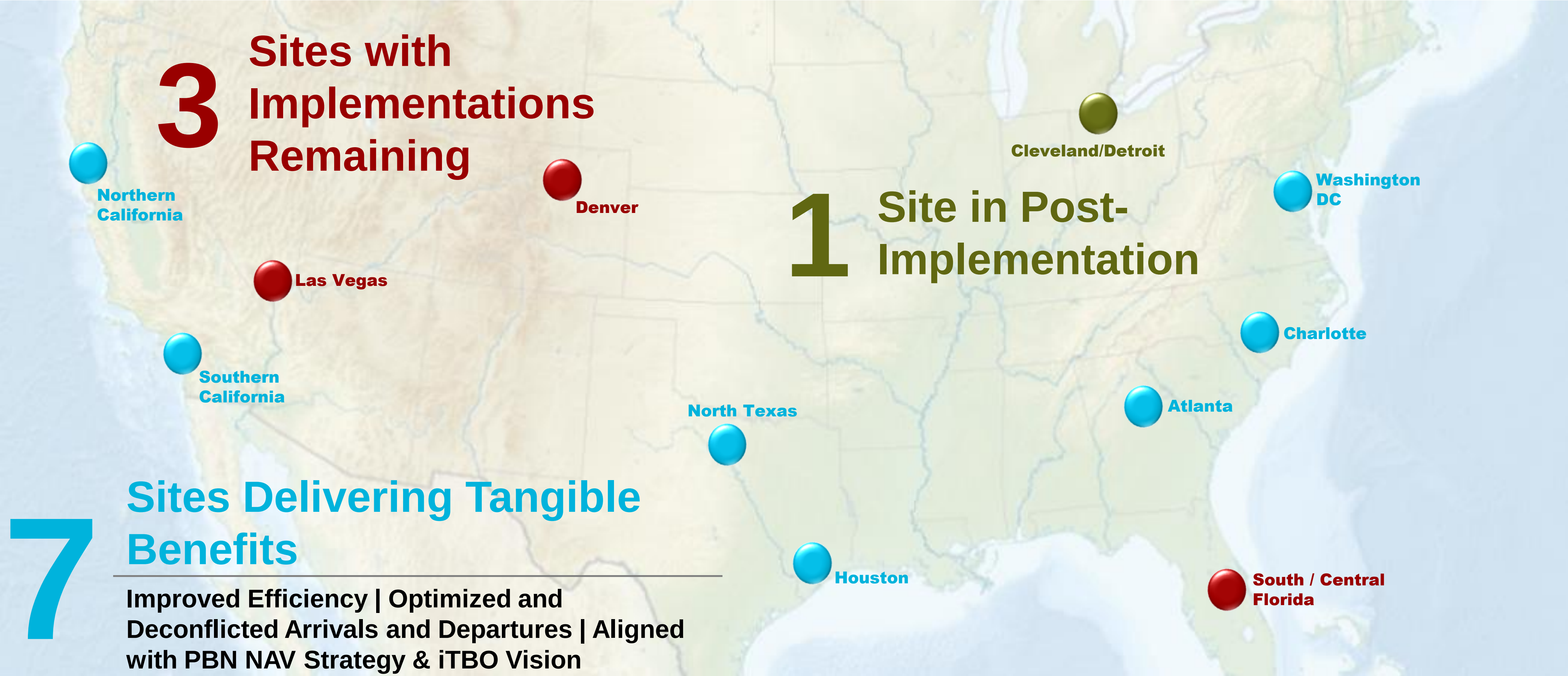
© 2019 The MITRE Corporation. All rights reserved.

Types of PBN Procedures – Approaches

- **RNAV (GPS) Approaches**
  - ICAO nomenclature is RNP Approaches
  - Serve aircraft equipped primarily with GPS or GPS enhanced by WAAS
  - More than 7,000 RNAV (GPS) approaches deployed to date
    - More than 3,800 LPV (localizer performance with vertical guidance) approach procedures at more than 1,880 airports, most of which do not have an ILS (minimums are similar)
    - More than 650 localizer performance approach procedures without vertical guidance at more than 490 airports
- **RNP Approaches with Authorization Required (RNP AR)**
  - Highly accurate approaches requiring special training and certification
  - May enable curved paths or provide greater precision near terrain or in congested airspace
  - More than 390 RNP AR approaches deployed to date

© 2019 The MITRE Corporation. All rights reserved.

Metroplex Program



© 2019 The MITRE Corporation. All rights reserved.

MITRE

Recent and Ongoing PBN Single Site Projects

© 2019 The MITRE Corporation. All rights reserved.

PBN NAS Navigation Strategy: Focus Areas

- **Operating with PBN throughout the NAS, using the right procedure to meet the need**
- **Using navigation structure where beneficial and flexibility where possible**
- **Shifting to time- and speed-based air traffic management**
- **Delivering and using resilient navigation services**
- **Modernizing the FAA navigation service delivery to reduce implementation time**
- **Enabling lower visibility access**
- **Innovating and continuously improving**

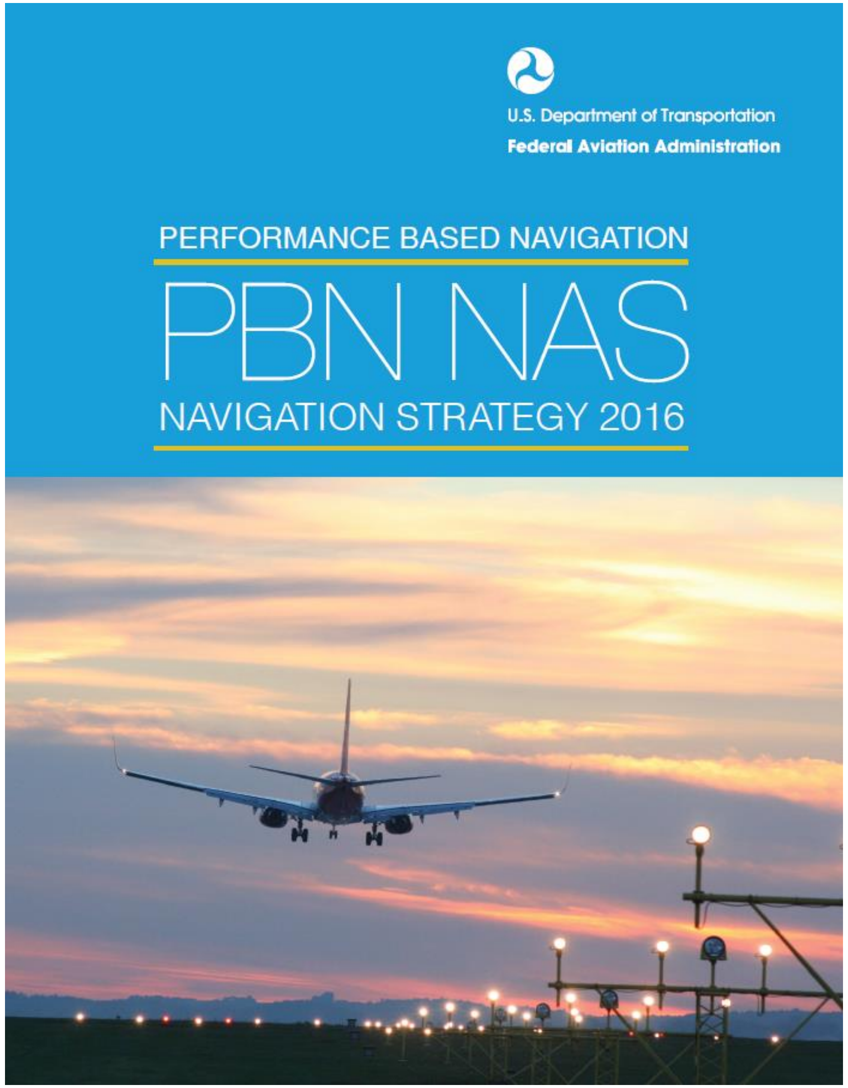


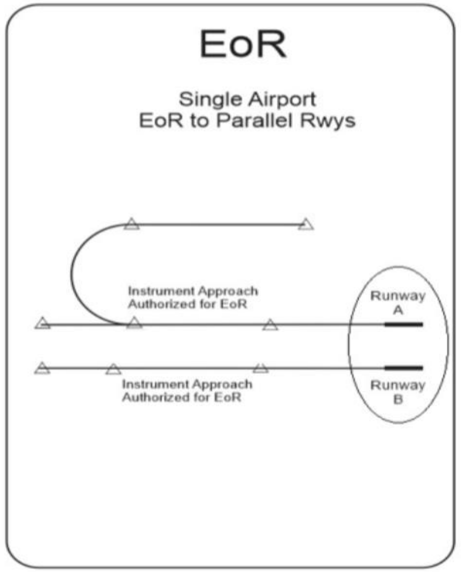
Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

PBN-Related Concepts

- **Trajectory-Based Operations (TBO)**
- **Enabling new en-route and terminal separation standards**
  - Reduced Divergence Departure (ELSO)
  - Established on RNP (EoR)
  - Multiple Airport Route Separation (MARS)

Video Source: https://www.faa.gov/nextgen/how_nextgen_works/new_technology/pbn/



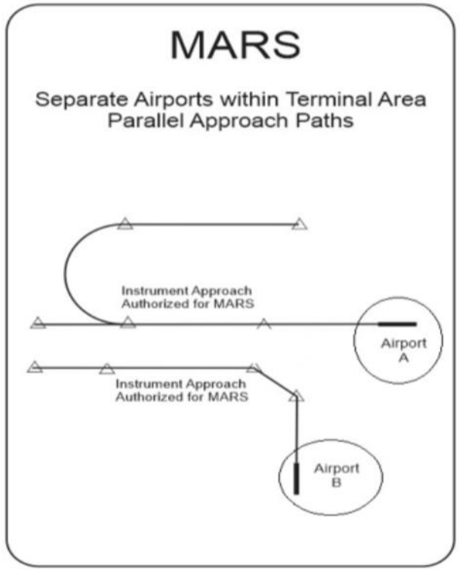


Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Time Based Flow Management Portfolio

- **Capabilities will enhance NAS efficiency by improving the capabilities of the TBFM decision-support tool, a system already deployed at all high altitude ARTCCs**
- **Capabilities will enable aircraft to maintain a spacing interval behind a preceding aircraft, further improving capacity and flight efficiency**
- **Improvements will also enable controllers to more accurately deliver aircraft to the TRACON facility while providing the opportunity for aircraft to fly optimized descents**
- **Main Benefit Areas: Capacity, Efficiency, Environment, Predictability**
- **Example of portfolio capabilities:**
  - Adjacent Center Metering (ACM)
  - Integrated Departure/Arrival Capability (IDAC)

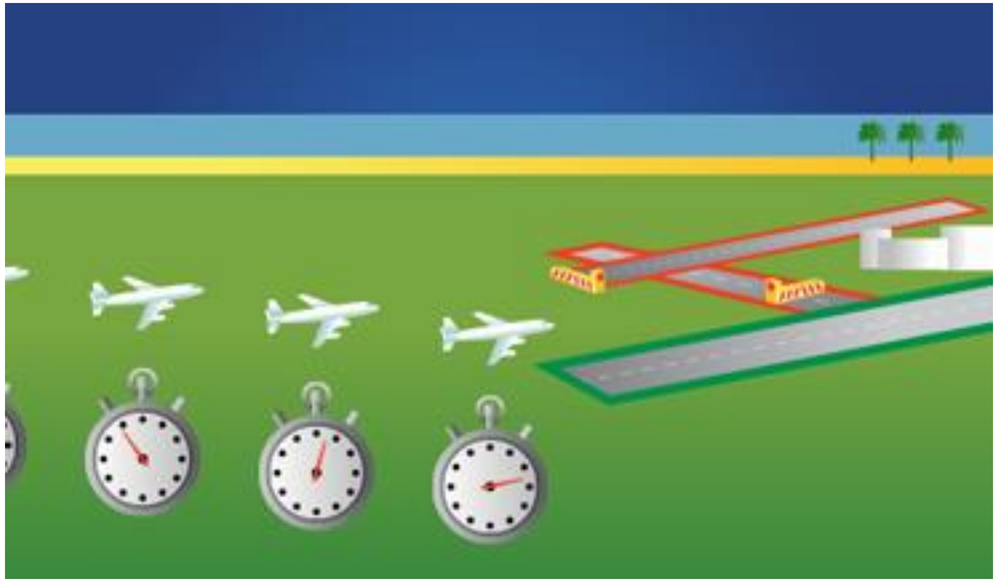


Image Source: FAA

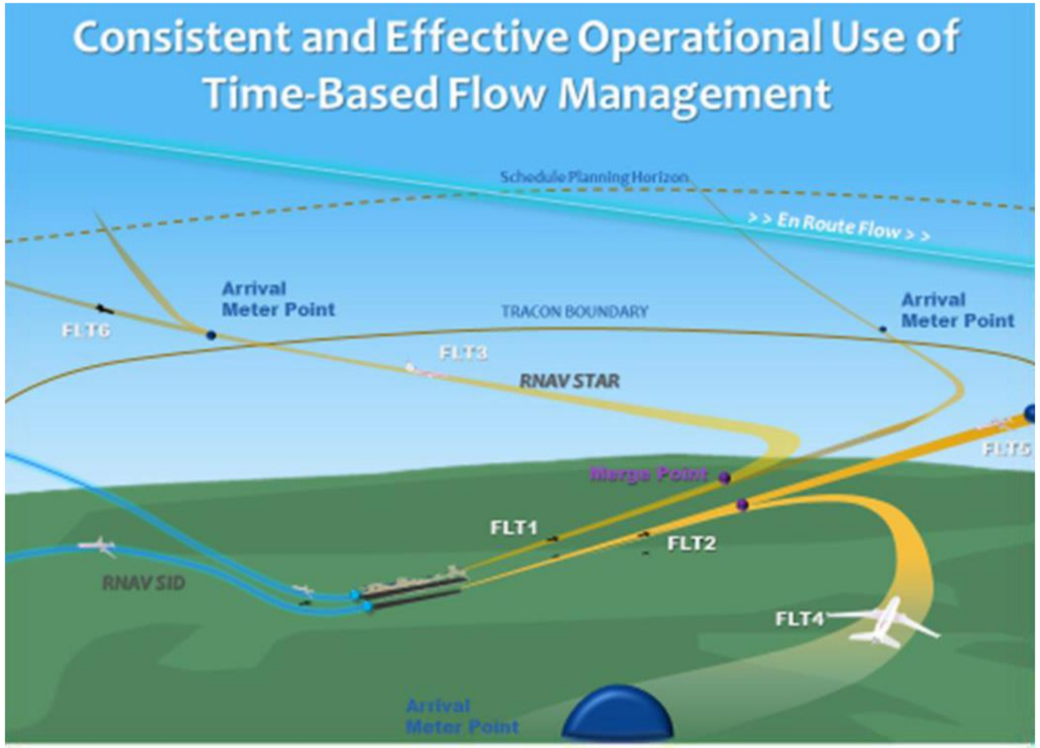
© 2019 The MITRE Corporation. All rights reserved.

What is TBFM?

- A system that provides continuous demand vs. capacity information
- A set of processes that rapidly generate a time-ordered sequence of operations to an adapted airport or constraint point
- An advanced decision support tool designed to help ATC deliver consistent traffic flows

Benefits:

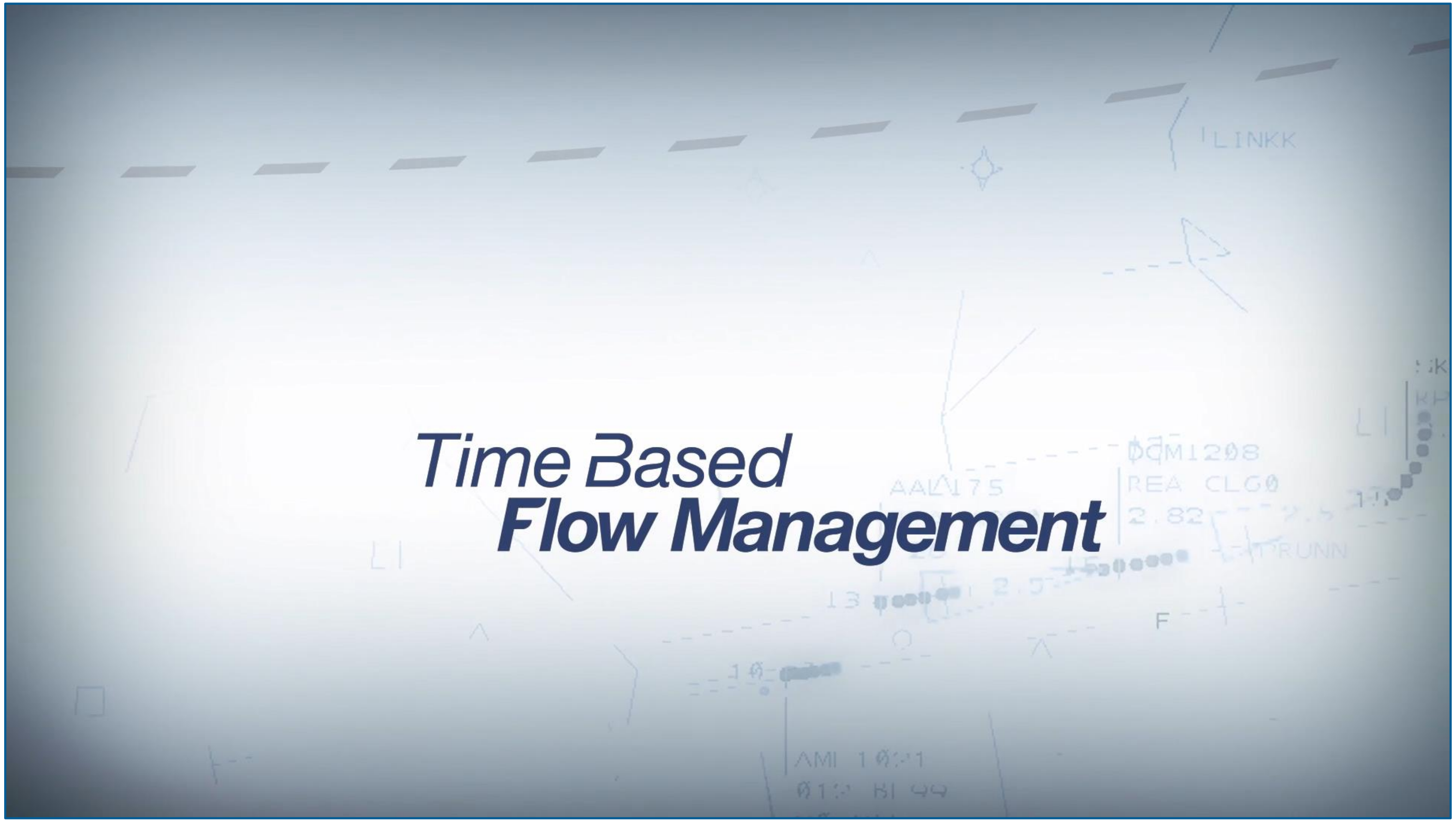
- More consistent traffic flows
- Improved operational awareness
- More accurate and dynamic than Miles-In-Trail (MIT)
- Can adapt to changing conditions and use airspace more efficiently



© 2019 The MITRE Corporation. All rights reserved.

MITRE

Time-Based Flow Management - TBFM



Video Source: https://www.faa.gov/tv/?mediaId=1426

© 2019 The MITRE Corporation. All rights reserved.

How do TBM & PBN Work Together to Support TBO?

WHEN

TBM is an air traffic management concept for using time as the common reference to coordinate operations across all phases of flight

WHERE

PBN is an advanced, satellite-enabled form of air navigation that enables flights to fly precise paths. Repeatable paths are defined with PBN procedures

© 2019 The MITRE Corporation. All rights reserved.

What is TBO?

Trajectory Based Operations (TBO) is an air traffic management method for strategically planning, managing, and optimizing flights throughout the operation

TBO works best when TBM and PBN work together

Time-Based Management (TBM)

Arrival Metering
Surface Metering
Terminal Metering
Departure Scheduling
Ground Delay Programs
...and more

Performance Based Navigation (PBN)

Area Navigation (RNAV)
Required Navigation Performance (RNP)
Flight Management System (FMS)
Optimal Profile Descents (OPD)
...and more

Enterprise Enablers

DataComm
System-Wide Information Management (SWIM)
Enhanced Data Exchange
Advanced Weather Products
Airborne Rerouting
...and more

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Why TBO?

	Throughput	More efficient use of system capacity by maximizing airspace and airport throughput using time-based management techniques and precise, repeatable PBN procedures
	Predictability	Improved operational predictability through more accurate and efficient end-to-end strategic planning and scheduling
	Flight Efficiency	Enhanced flight efficiency by delivering more efficient flows into and out of major metropolitan areas through integrated operations, including the continuous use of more PBN procedures
	Operator Flexibility	Increased operational flexibility through increased user collaboration regarding preferred trajectories and priorities to support business objectives

© 2019 The MITRE Corporation. All rights reserved.

How Does TBO Work?

- **TBO is about predicting where a flight will be and at what time**
  – This forms the basis for a 'strategic plan'

- **A trajectory is used as a reference for the flight and shared between systems and stakeholders**

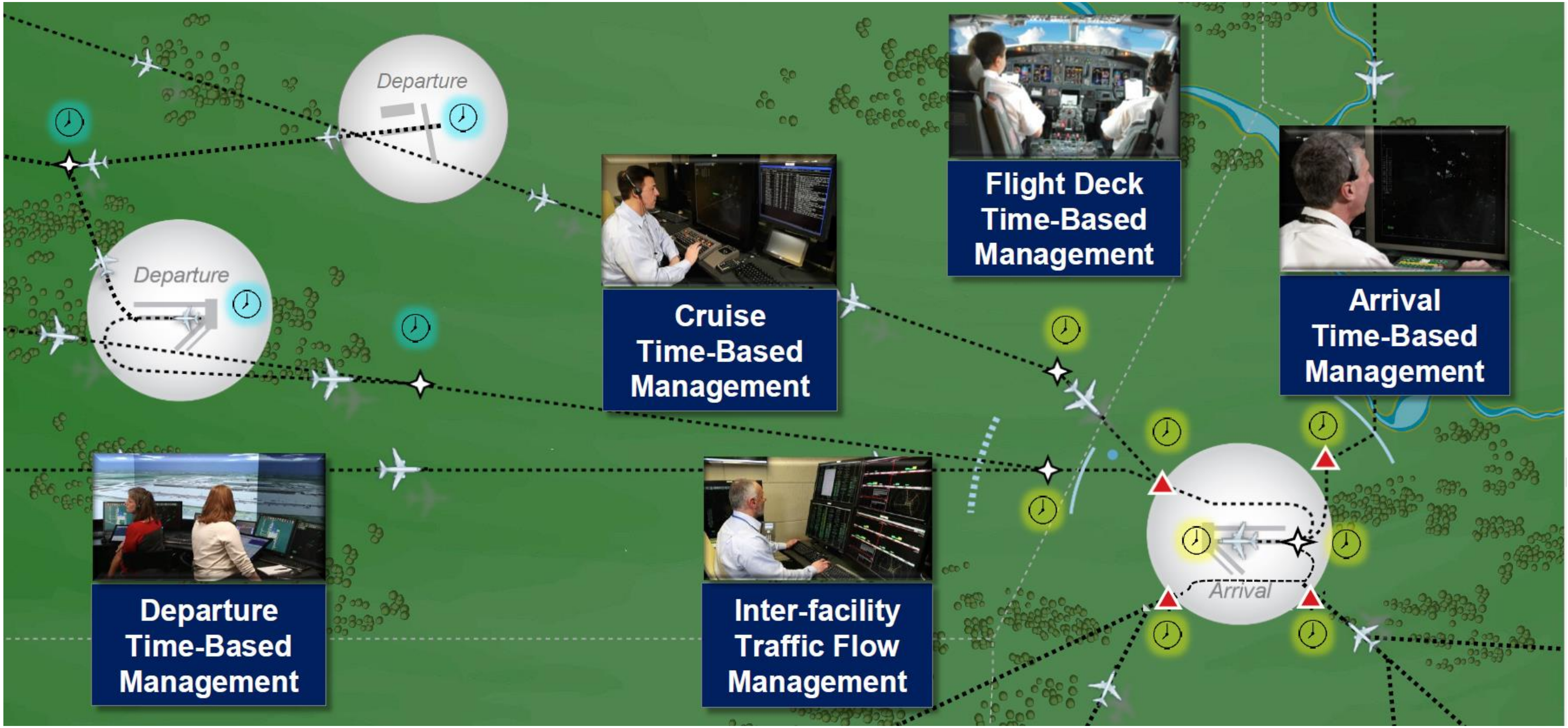
- **A trajectory is defined in four dimensions**
  – Latitude, Longitude, Altitude, and Time

- **The trajectory is updated as operations evolve over time and new information becomes available**

- **TBO is a collection of systems, capabilities, processes, and people working together to achieve operational objectives**

© 2019 The MITRE Corporation. All rights reserved.

TBO Integration



© 2019 The MITRE Corporation. All rights reserved.

MITRE

When is TBO?

Now	**Initial TBO (iTBO)**	Gate-to-gate operation enabled by a suite of operationally integrated capabilities deployed across air traffic domains enabled by improved data, and controller and traffic manager tools
2022	**Full TBO**	TBO will evolve to improve user collaboration, incorporate user preferences into time-based solutions, and leverage higher CNS equipage levels.
2025 +	**Dynamic TBO**	Advanced aircraft and ground automation will enable more flexible, flight-specific trajectories driven by operator negotiation given common understanding of NAS constraints.

© 2019 The MITRE Corporation. All rights reserved.

NextGen as a Whole: NextGen Flight 101

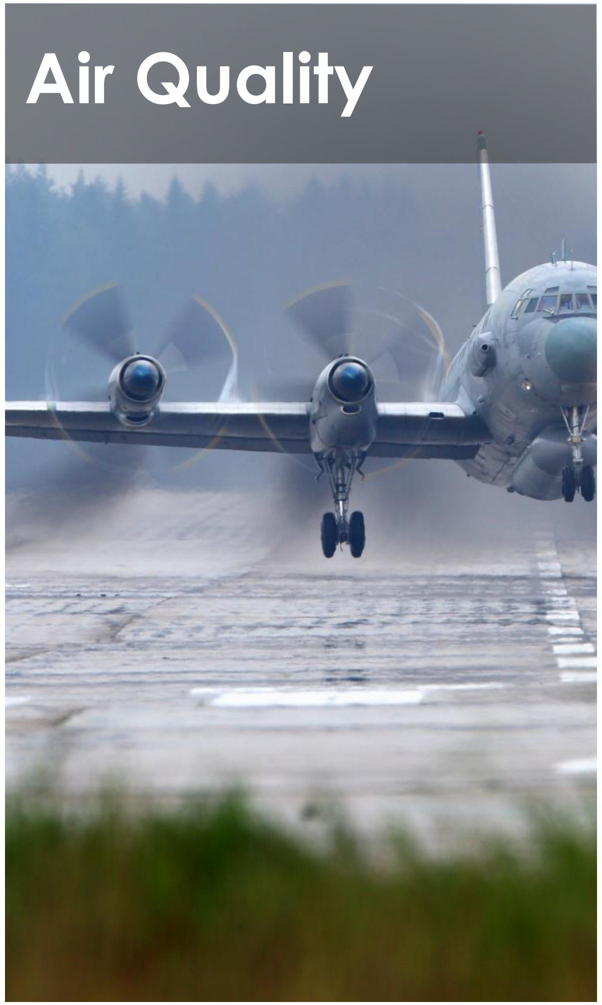
Video Source: https://www.faa.gov/tv/?mediaId=1437

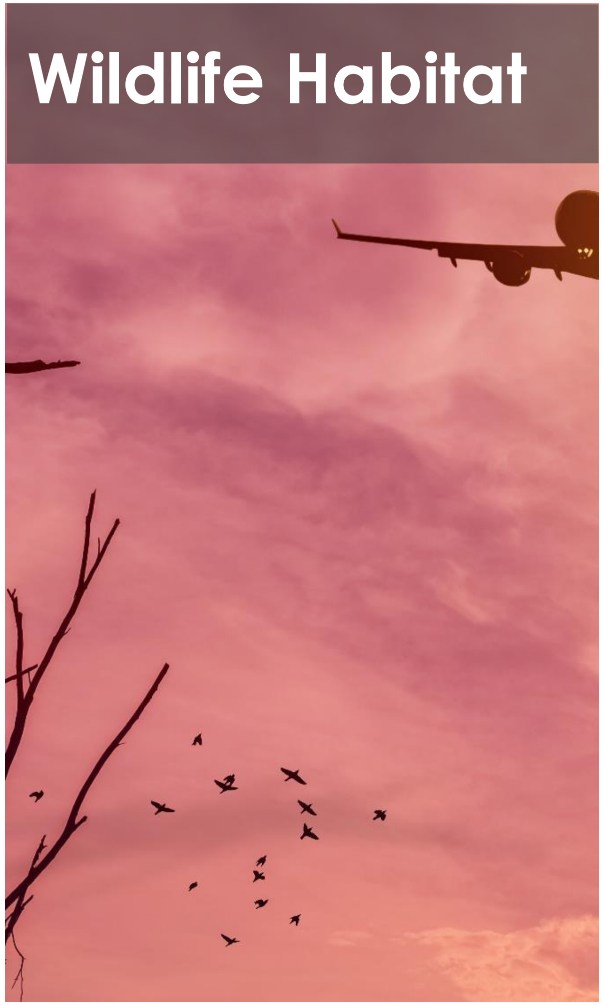
© 2019 The MITRE Corporation. All rights reserved.

Environmental Perspective

© 2019 The MITRE Corporation. All rights reserved.

Environmental Considerations are Becoming Increasingly Important

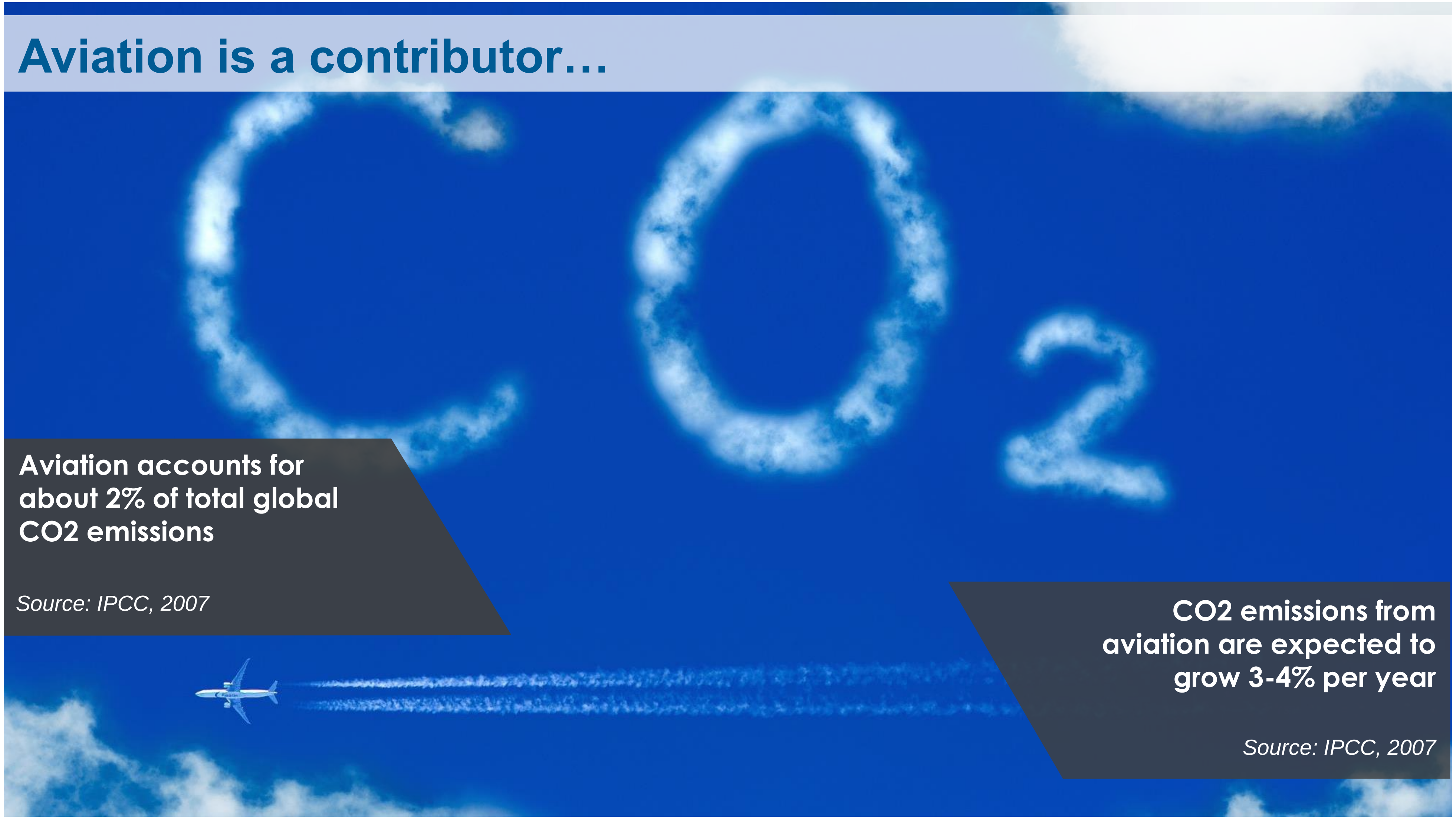




© 2019 The MITRE Corporation. All rights reserved.

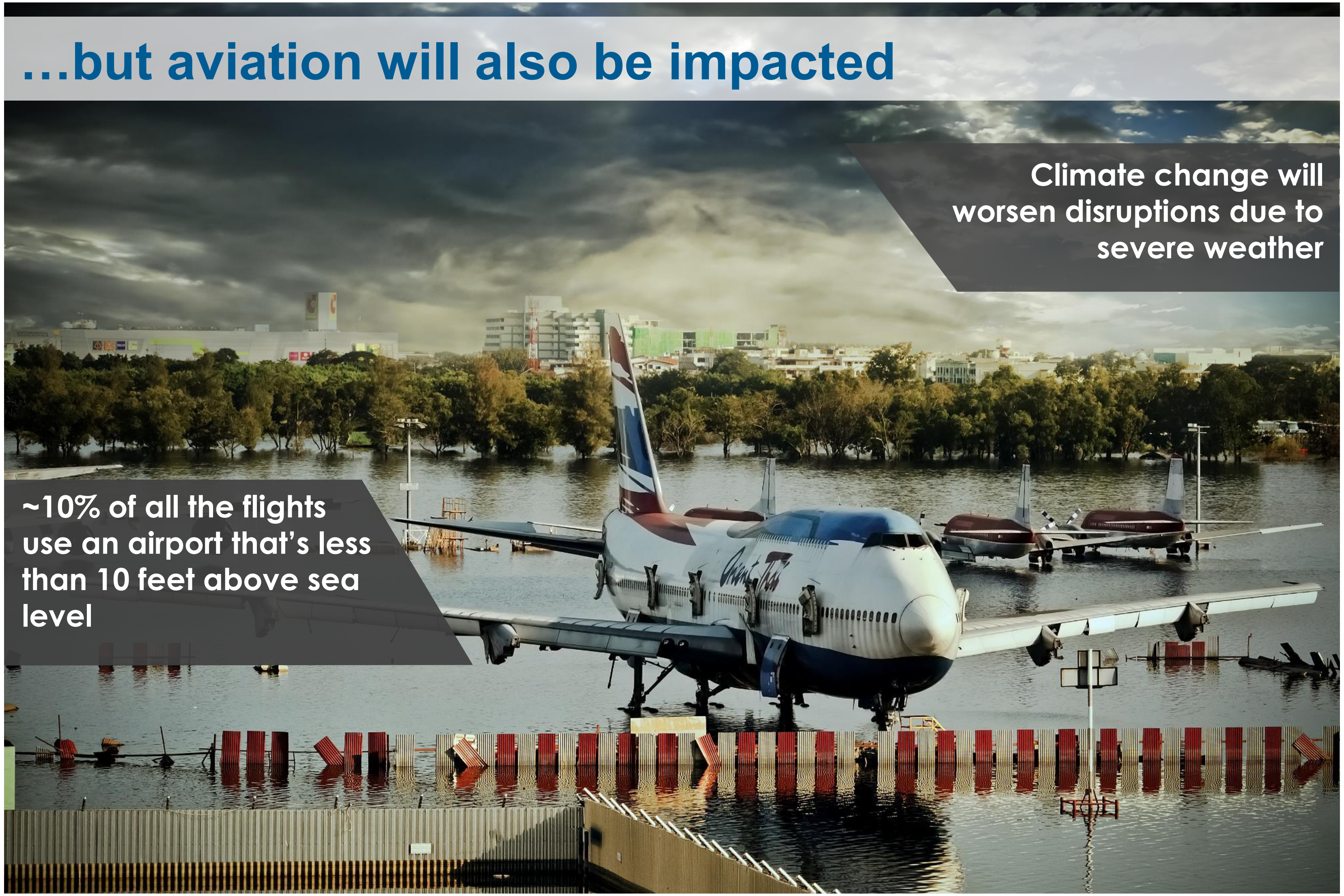
Climate Change is a Growing Consideration

(1 of 3)



© 2019 The MITRE Corporation. All rights reserved.

Climate Change is a Growing Consideration
(2 of 3)



© 2019 The MITRE Corporation. All rights reserved.

MITRE

Climate Change is a Growing Consideration

(3 of 3)

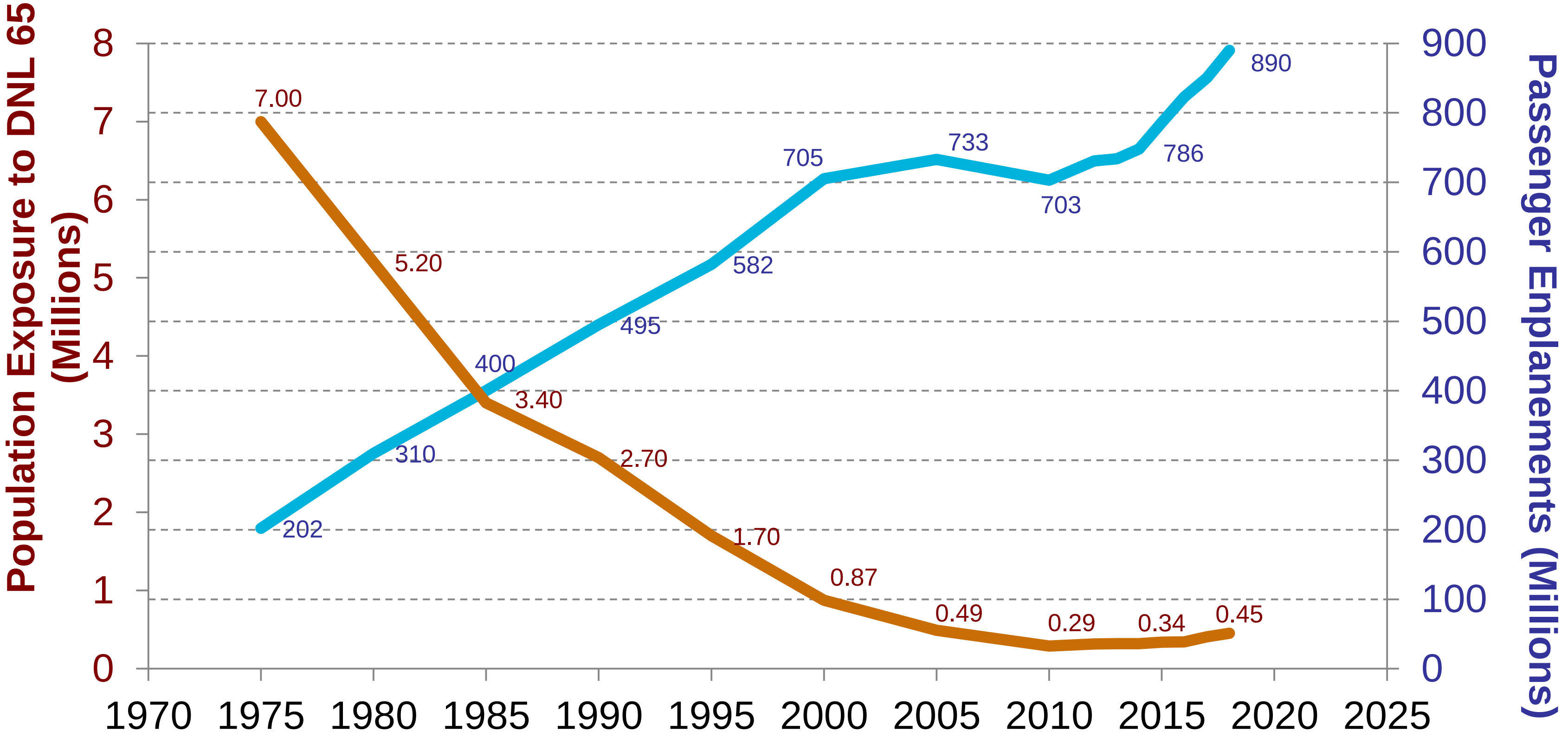
An ICAO-led effort to curb carbon emissions is underway

Image Source: ICAO

© 2019 The MITRE Corporation. All rights reserved.

MITRE

However, Noise is Still the Biggest Concern, Despite Significant Noise Exposure Reduction in the Last 40 Years



Source: FAA

DNL

Day-Night Average Sound Level

Time-average of the total sound energy over a 24-hour period. One nighttime event is equivalent to 10 daytime events.

© 2019 The MITRE Corporation. All rights reserved.

Increasing Community Concerns over PBN, Metroplex, and NextGen Noise Issues

- **PBN single-site implementations:**
  - LGA TNNIS
  - PHX SIDs
- **Metroplex projects:**
  - Northern California
  - Southern California
  - Charlotte
  - Washington DC
- **Communities are making their voices heard**

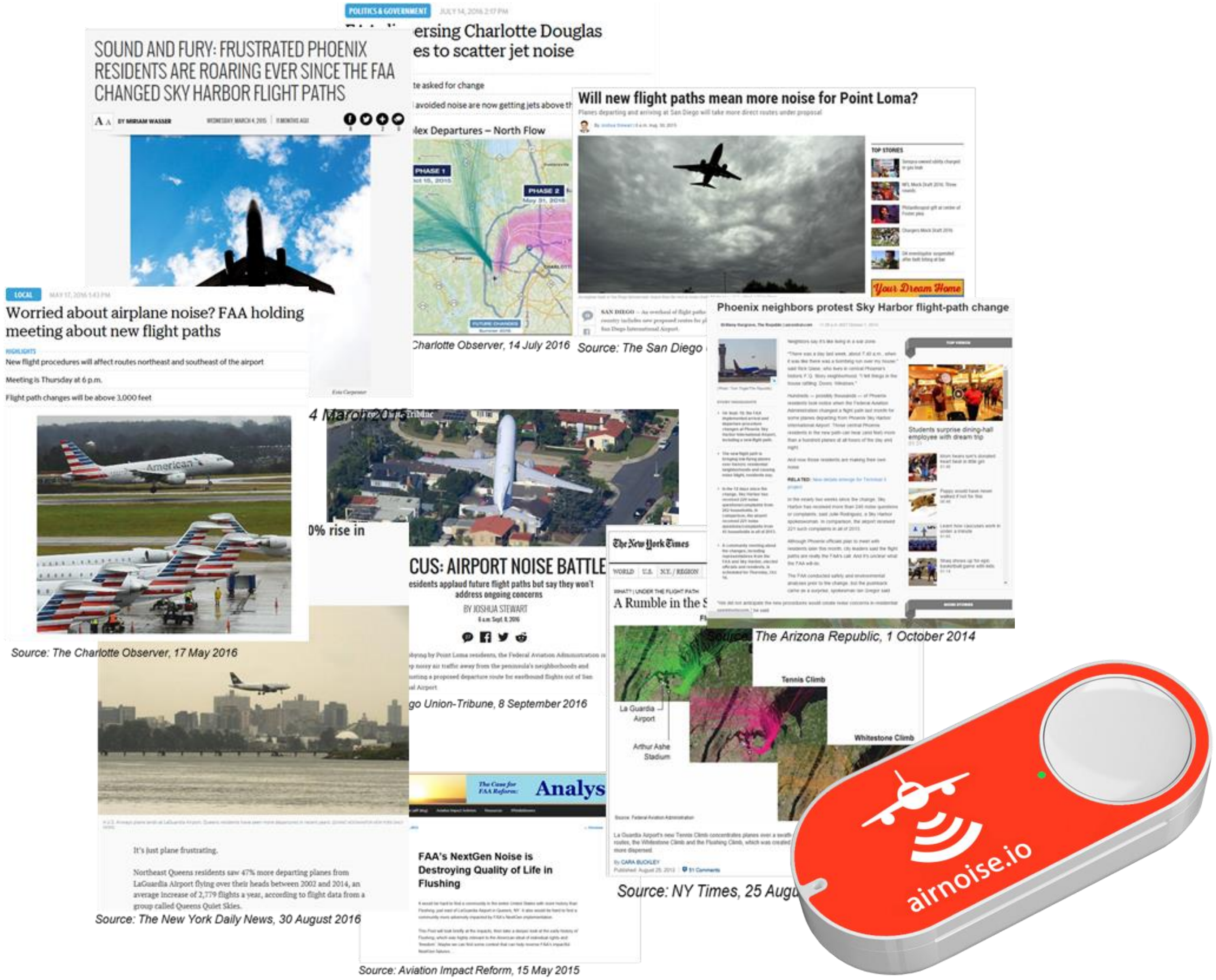


Image Source: MITRE (compiled from multiple web sites)

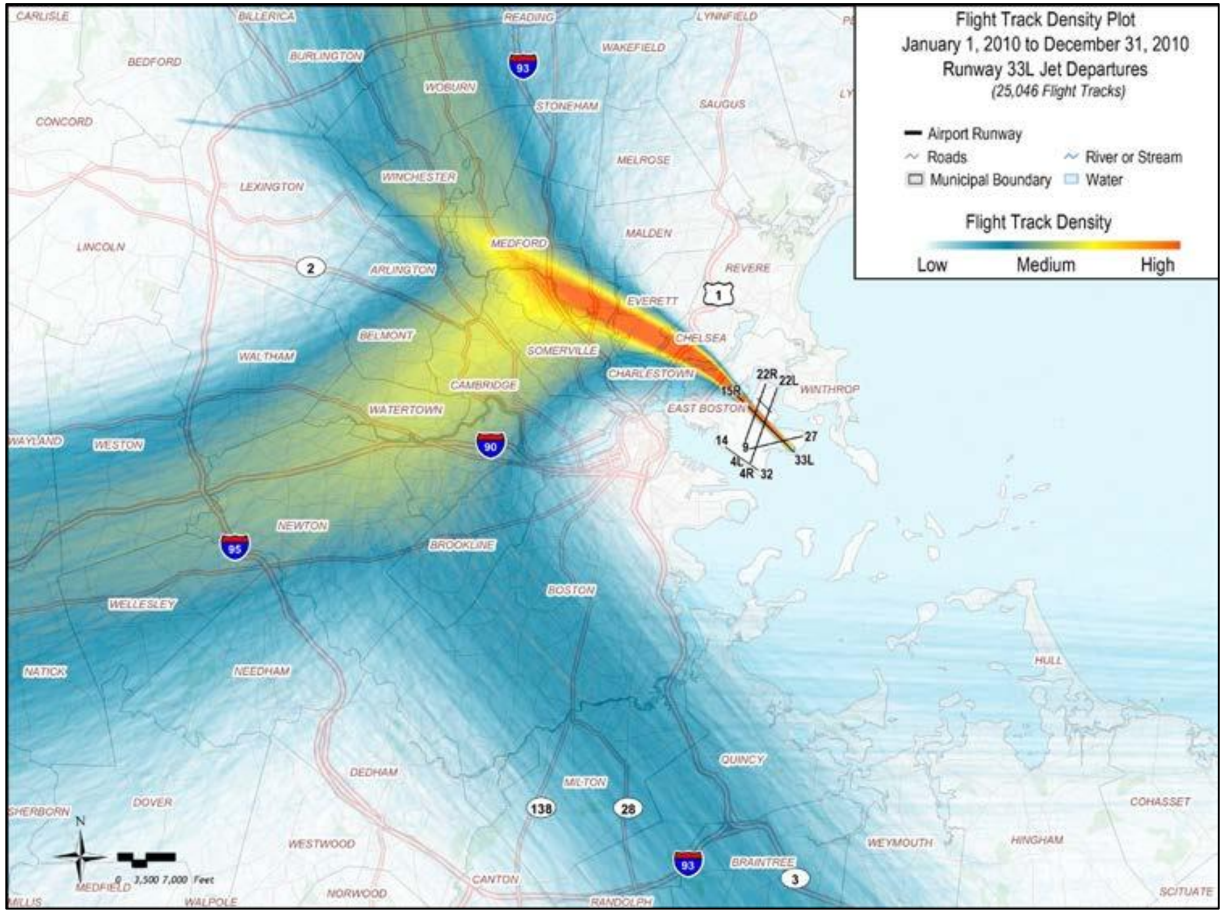
Image Source: https://airnoise.io/

© 2019 The MITRE Corporation. All rights reserved.

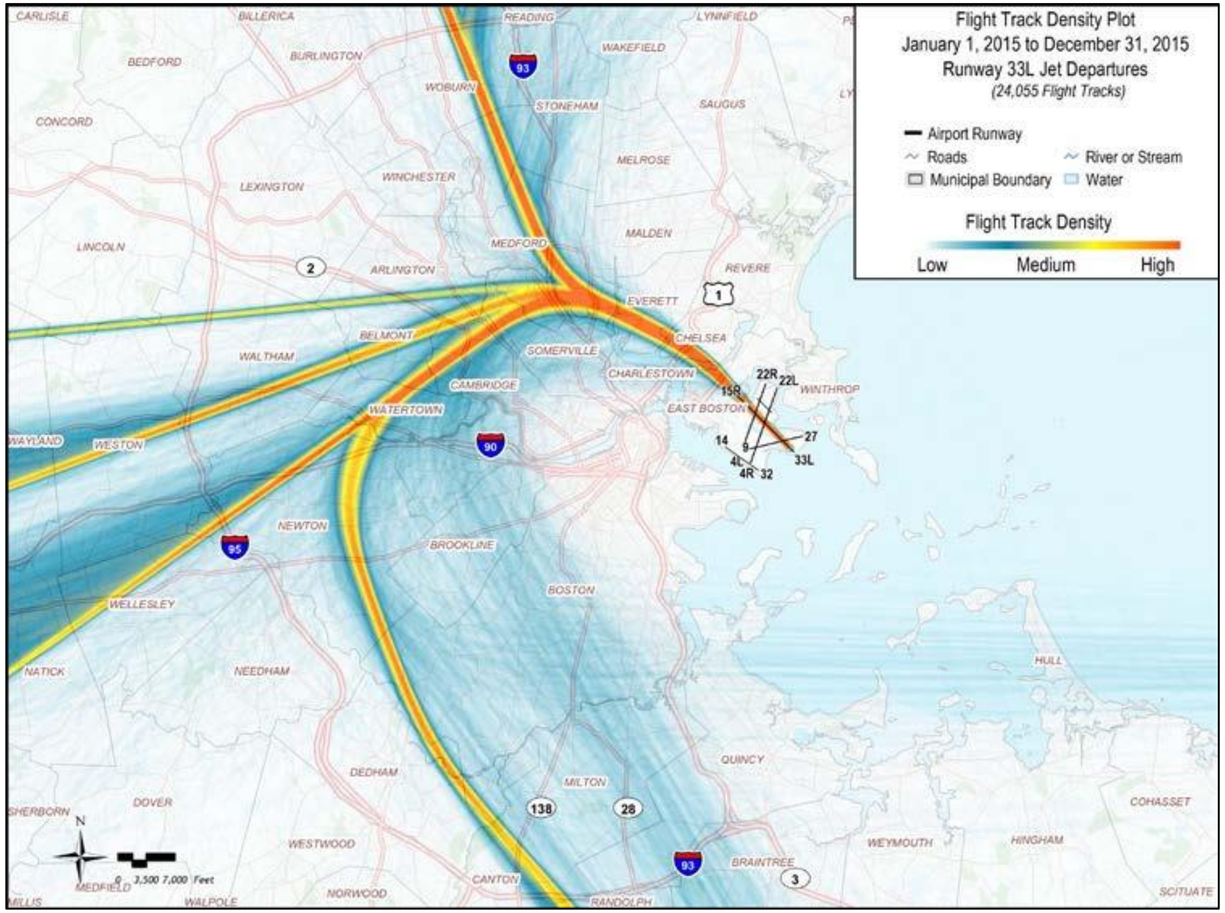
MITRE

Flight Concentration is Driving Some Community Concerns…

Before Procedure Change (2010)



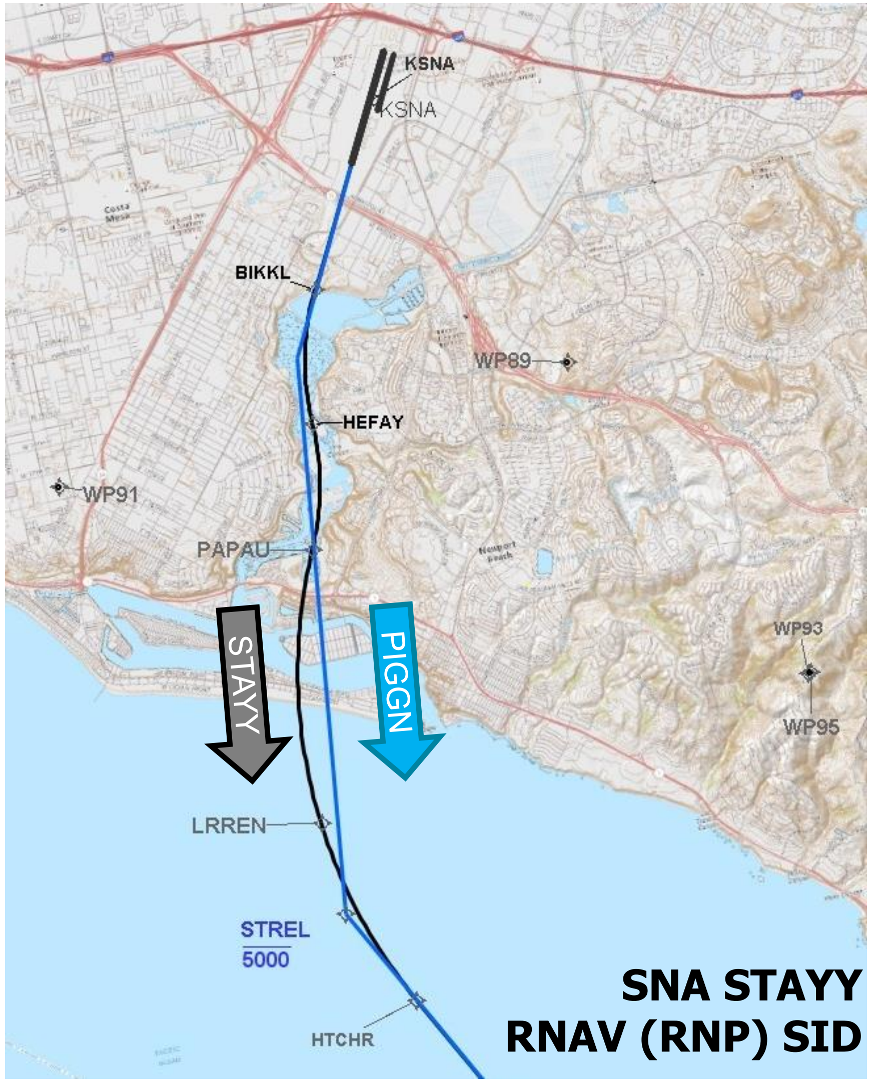
After Procedure Change (2015)

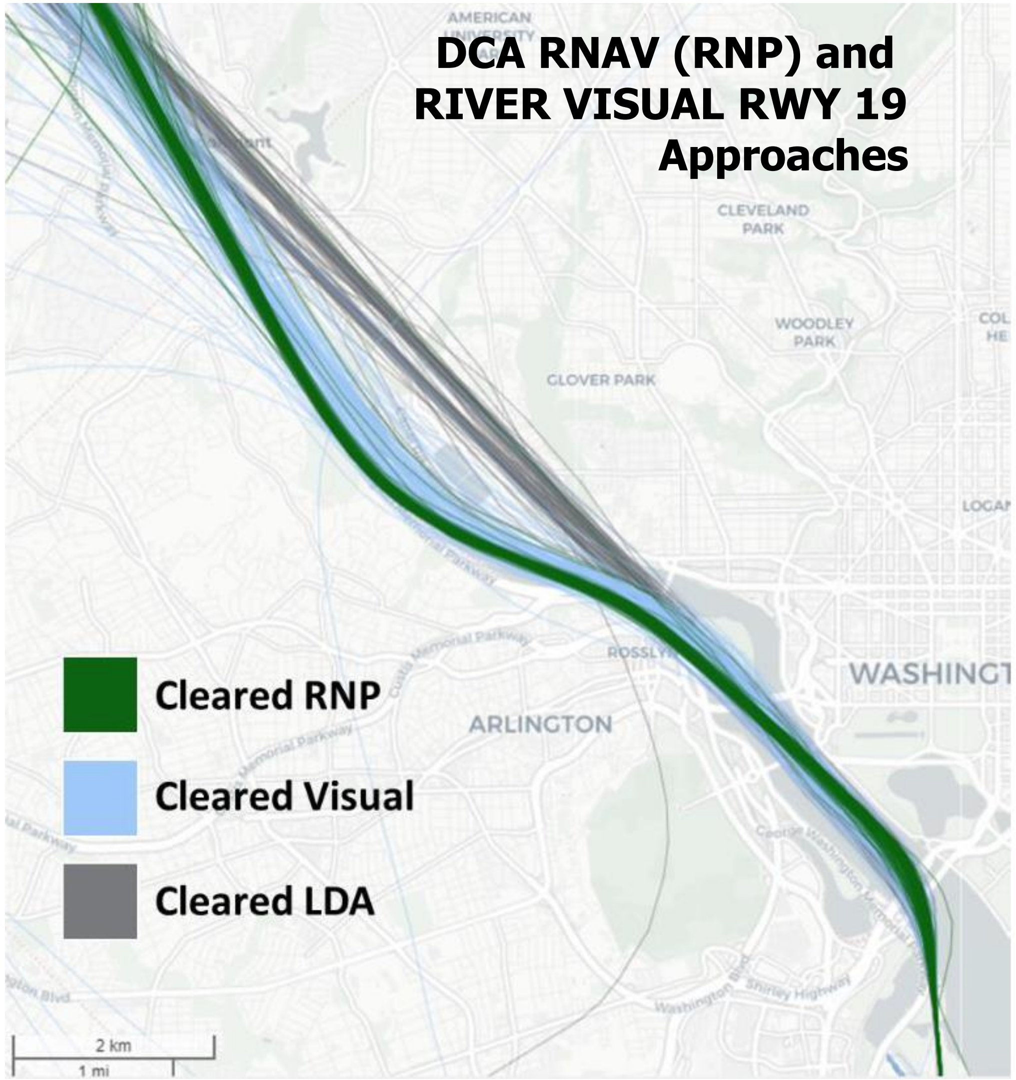


Source: R. John Hansman (MIT), "Procedure Design Concepts for Logan Airport Community Noise Reduction"

© 2019 The MITRE Corporation. All rights reserved.

…but Precise, Repeatable Paths can be Beneficial

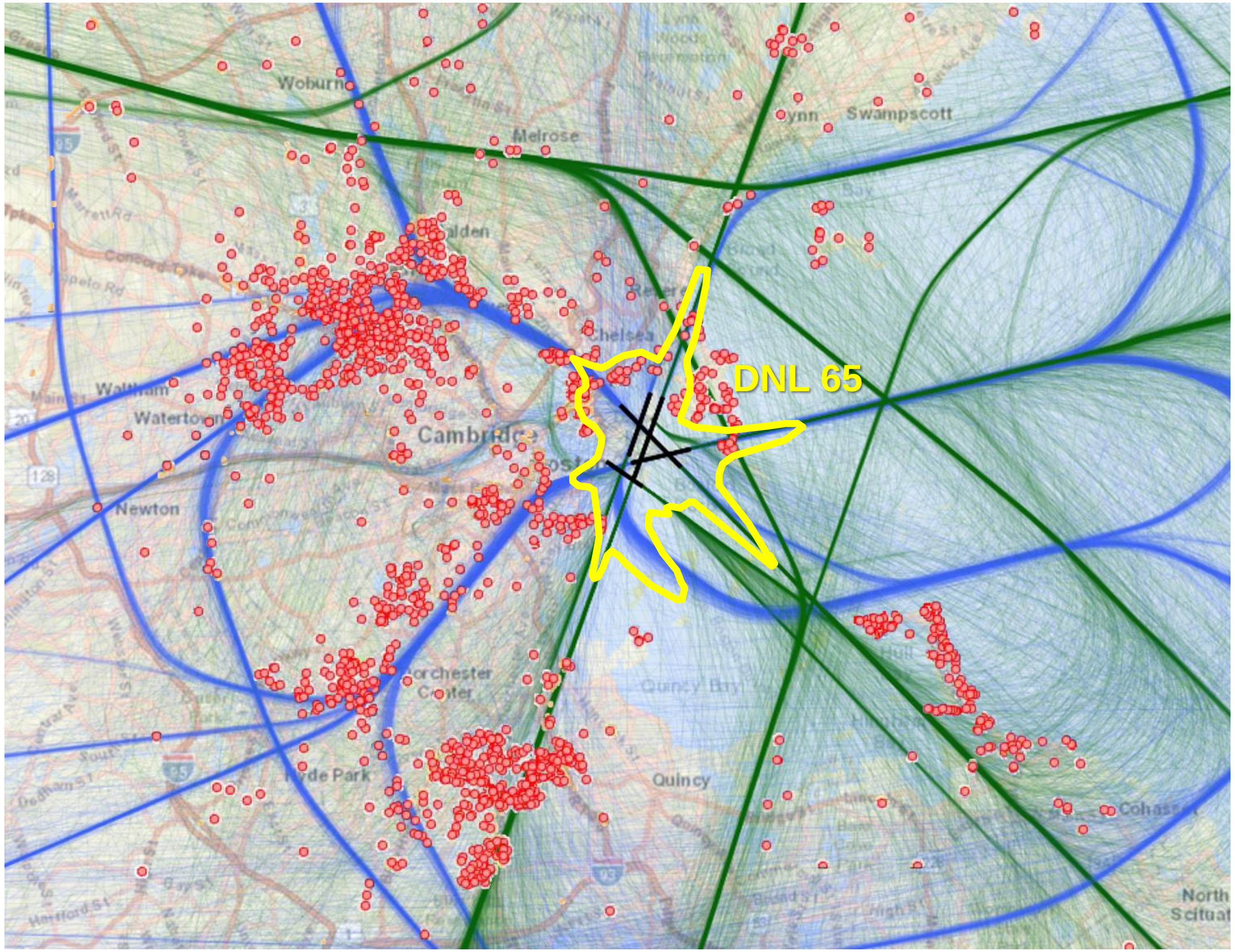




© 2019 The MITRE Corporation. All rights reserved.

MITRE

Current Noise Metrics may not Fully Reflect Community Perspectives



Departures

Arrivals

Source: Graphic compiled using complaint data from Massport complaint system and noise contours from the Boston-Logan International Airport 2015 Environmental Data Report.

Each red marker represents a unique complaint address

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Noise is Impacting the Ability to Implement NextGen…

Longer Implementation Timelines

Houston Metroplex only took **2.4 years to complete**

SoCal Metroplex took **4.7 years** due to scope of environmental review and litigation

Increased Costs

Houston Metroplex Environmental Assessment cost to FAA: **$880,000**

SoCal Metroplex Environmental Assessment cost to FAA: **$2.3 Million**

Operational Efficiencies not Realized

Procedures implemented at Phoenix saved **1,750 flying miles per day** but **had to be undone**

© 2019 The MITRE Corporation. All rights reserved.

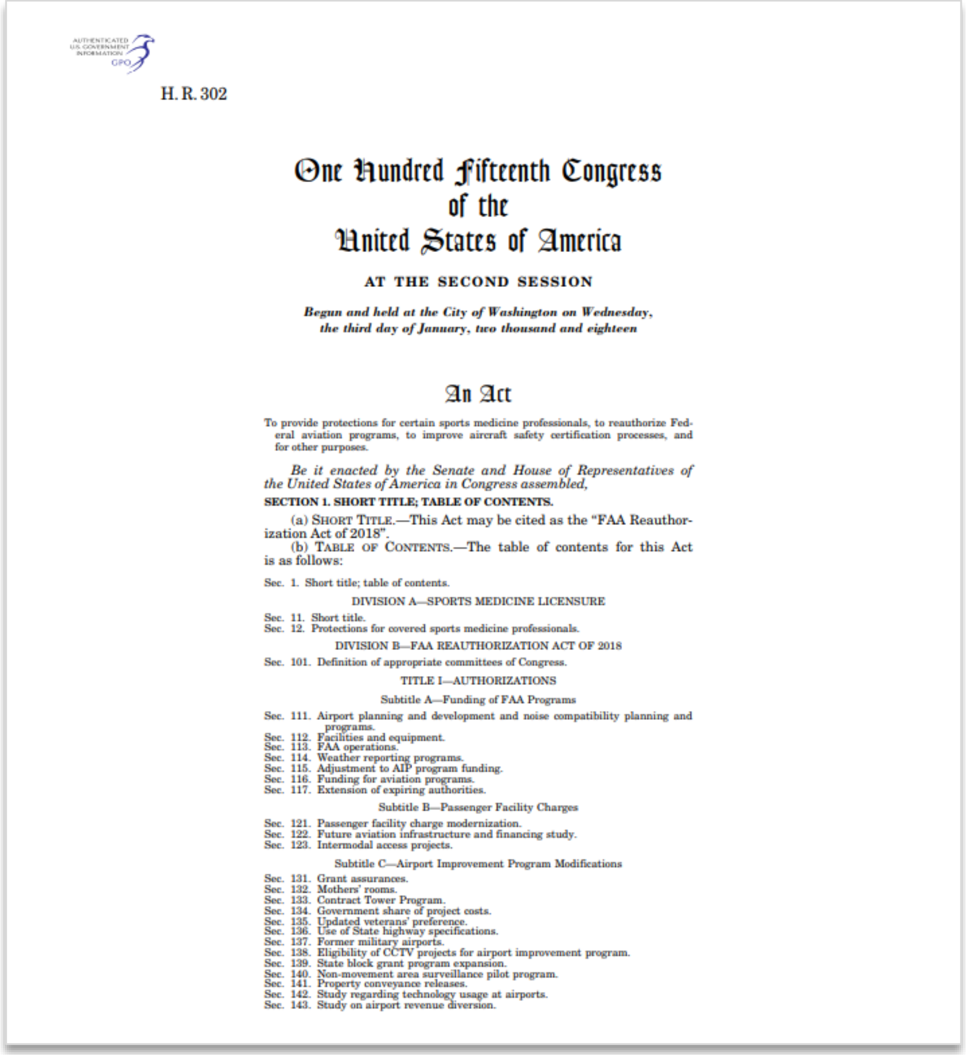
MITRE

…and Congress is Getting Involved

- Dispersal Procedures — Sec. 175
- Reduced Speed Takeoffs — Sec. 179
- Supersonic Transport — Sec. 181

- Alternative Noise Metrics — Sec. 173, Sec. 188
- Aircraft Noise Exposure — Sec. 187
- Stage 3 Study — Sec. 186

- Enhanced Community Engagement — Sec. 176
- Regional Ombudsmen — Sec. 180



AUTHENTICATED U.S. GOVERNMENT INFORMATION GPO

H. R. 302

One Hundred Fifteenth Congress
of the
United States of America

AT THE SECOND SESSION

Begun and held at the City of Washington on Wednesday, the third day of January, two thousand and eighteen

An Act

To provide protections for certain sports medicine professionals, to reauthorize Federal aviation programs, to improve aircraft safety certification processes, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE.—This Act may be cited as the "FAA Reauthorization Act of 2018".

(b) TABLE OF CONTENTS.—The table of contents for this Act is as follows:

Sec. 1. Short title; table of contents.

DIVISION A—SPORTS MEDICINE LICENSURE

Sec. 11. Short title.
Sec. 12. Protections for covered sports medicine professionals.

DIVISION B—FAA REAUTHORIZATION ACT OF 2018

Sec. 101. Definition of appropriate committees of Congress.

TITLE I—AUTHORIZATIONS

Subtitle A—Funding of FAA Programs

Sec. 111. Airport planning and development and noise compatibility planning and programs.
Sec. 112. Facilities and equipment.
Sec. 113. FAA operations.
Sec. 114. Weather reporting programs.
Sec. 115. Adjustment to AIP program funding.
Sec. 116. Funding for aviation programs.
Sec. 117. Extension of expiring authorities.

Subtitle B—Passenger Facility Charges

Sec. 121. Passenger facility charge modernization.
Sec. 122. Future aviation infrastructure and financing study.
Sec. 123. Intermodal access projects.

Subtitle C—Airport Improvement Program Modifications

Sec. 131. Grant assurances.
Sec. 132. Mothers' rooms.
Sec. 133. Contract Tower Program.
Sec. 134. Government share of project costs.
Sec. 135. Updated veterans' preference.
Sec. 136. Use of State highway specifications.
Sec. 137. Former military airports.
Sec. 138. Eligibility of CCTV projects for airport improvement program.
Sec. 139. State block grant program expansion.
Sec. 140. Non-movement area surveillance pilot program.
Sec. 141. Property conveyance releases.
Sec. 142. Study regarding technology usage at airports.
Sec. 143. Study on airport revenue diversion.

Image Source: http://congress.gov

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Addressing the Aircraft Noise Challenge Requires Efforts in Multiple Areas

Reducing Noise

Airframe modifications

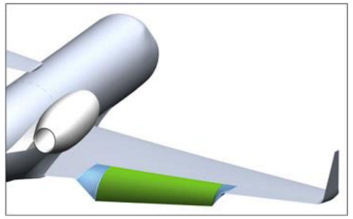


Image Source: Flexsys Inc.

Quieter engines

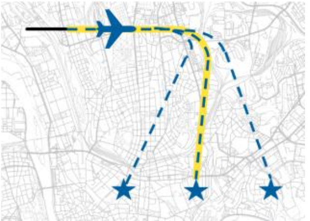
Image Source: Pratt & Whitney

New aircraft designs

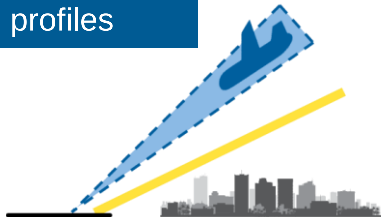
Image Source: NASA, MIT, Aurora Flight Sciences

Managing Noise

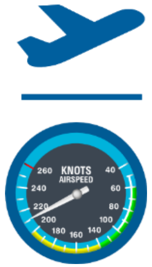
Dispersion



Modified vertical profiles



Speed restricted departures



Involving the Public

Image Source: FAA

Image Source: Queens Chronicle, 19 April 2018

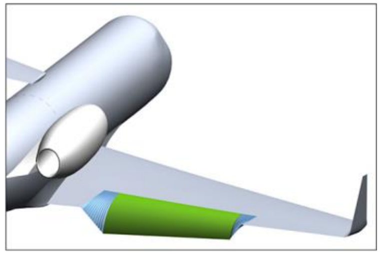
© 2019 The MITRE Corporation. All rights reserved.

Reducing Noise

Airframe Modifications

Noise-reducing vortex generators
Image Source: Condor

Slat cove fillers
Image Source: Boeing



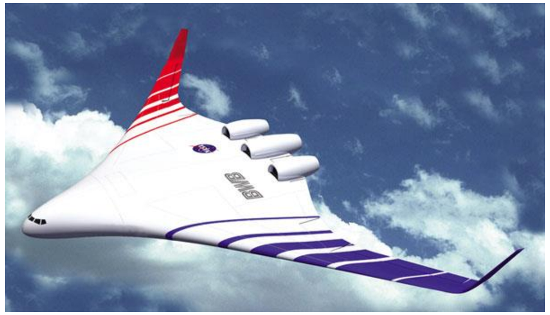
Adaptive trailing edges
Image Source: Flexsys Inc.

Quieter Engines

Image Source: Pratt & Whitney

Ultra-high bypass geared turbofan engine

New Aircraft Designs



Blended Wing Body
Image Source: NASA

"Double Bubble" D8 Series

Image Source: NASA, MIT, Aurora Flight Sciences

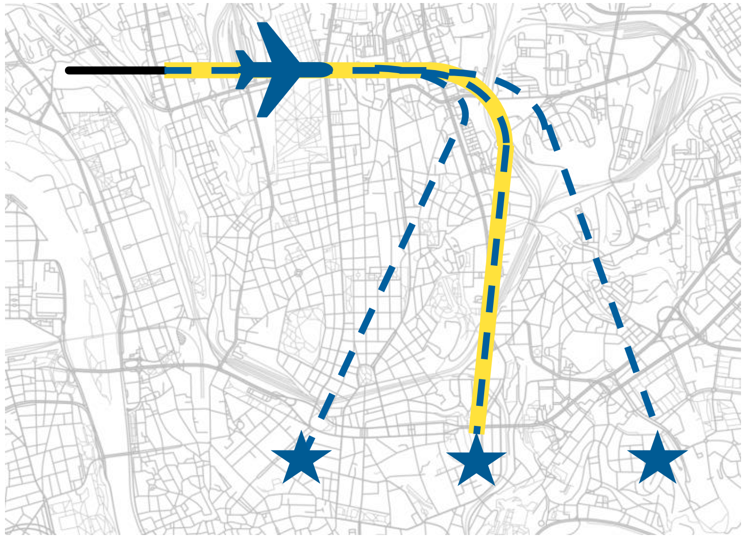
New aircraft designs offer the greatest opportunity for a step change in noise reduction but also take longer to reach maturity

© 2019 The MITRE Corporation. All rights reserved.

MITRE

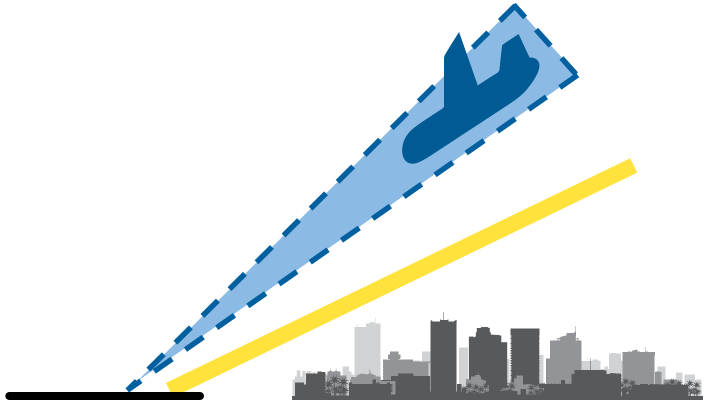
Managing Noise

Dispersion



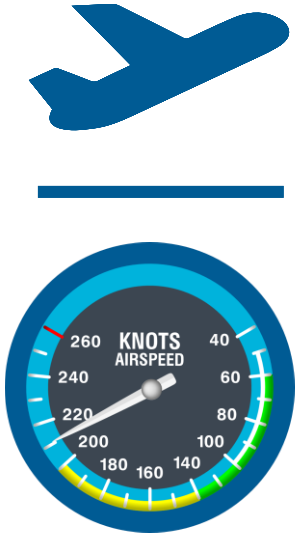
Dispersed Flow
Concentrated Flow

Modified vertical profiles



Modified Profile
Existing Profile

Speed restricted departures



The above introduce inefficiencies or operational tradeoffs that must be balanced against relatively modest noise reductions

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Involving the Public

FAA's Role

Give meaningful consideration to community concerns

Work collaboratively with airport and aircraft operators

Inform and involve the public

Aircraft and Airport Operators Role

Act as advocates for the proposed initiatives

Partner with FAA on engagements with roundtables, elected officials, stakeholders and the public

Provide relevant historical information, input on specific community concerns, and feedback on proposed initiatives

© 2019 The MITRE Corporation. All rights reserved.

New Entrants Bring Additional Noise Challenges

UAS and UAM will introduce aircraft noise where it does not exist today

High operational tempo

Image Source: Amazon

Flights closer to the ground

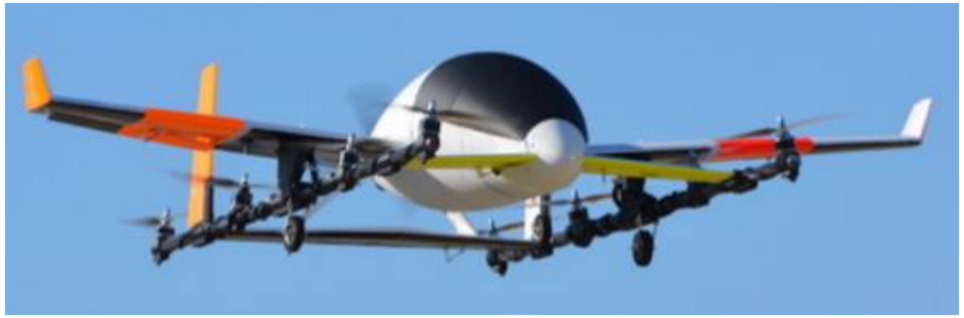


Image Source: Aurora

Flights in high population centers

Image Source: Volocopter

Image Source: Lockheed Martin

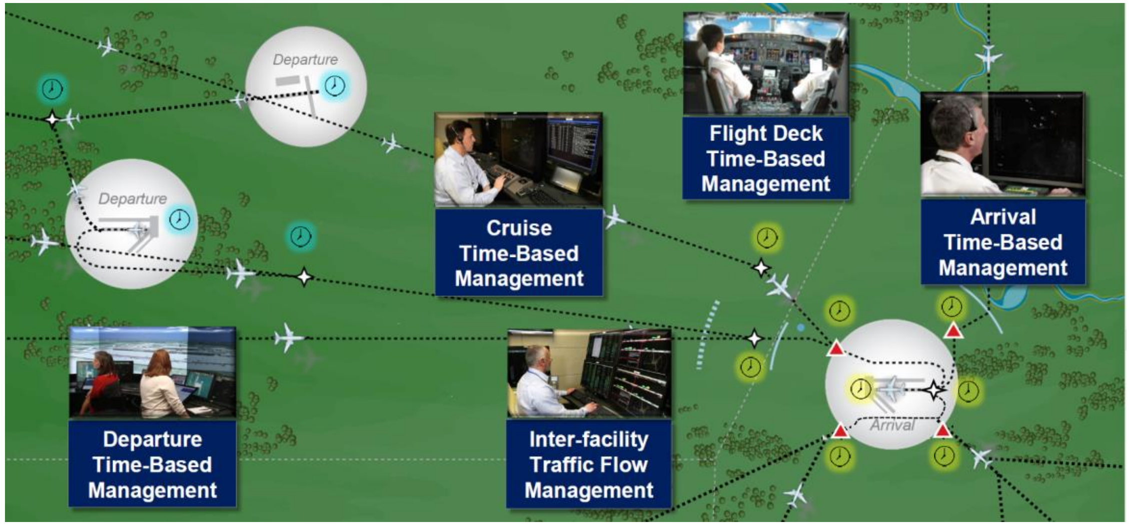
Supersonic transports could make a comeback

© 2019 The MITRE Corporation. All rights reserved.

Future NextGen Capabilities May Offer New Challenges but also Opportunities

Near-term

NextGen operations will require continued noise management and public involvement



Longer-term

Options to more effectively distribute noise may be possible

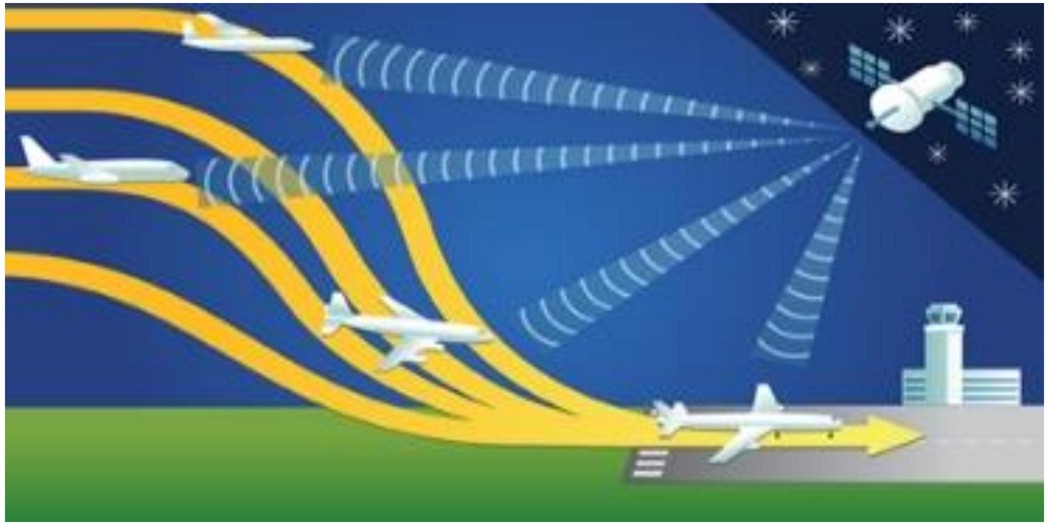


Image Source: FAA

© 2019 The MITRE Corporation. All rights reserved.

Summary

© 2019 The MITRE Corporation. All rights reserved.

Summary

- **NextGen is a suite of critical improvements to modernize the NAS**
- **NextGen provides a range of benefits to pilots, controllers, and the traveling public**
  - Access
  - Capacity
  - Environment
  - Efficiency
  - Flexibility
  - Predictability
  - Safety
- **Some NextGen capabilities increase navigational accuracy, predictability, and repeatability, which may result in flight path concentration**

© 2019 The MITRE Corporation. All rights reserved.

Open Discussion

© 2019 The MITRE Corporation. All rights reserved.

Supplemental Information

© 2019 The MITRE Corporation. All rights reserved.

MITRE

Resources

(1 of 2)

Below are the links for all the videos in this document:

- **Slide 41: https://www.faa.gov/nextgen/faqs/#q5**
- **Slide 43: https://www.faa.gov/nextgen/how_nextgen_works/**
- **Slide 50: https://www.faa.gov/tv/?mediaId=1793**
- **Slide 51: https://www.faa.gov/tv/?mediaId=1520**
- **Slide 52: https://www.faa.gov/tv/?mediaId=1526**
- **Slide 54: https://www.faa.gov/tv/?mediaId=1714**
- **Slide 56: https://www.faa.gov/tv/?mediaId=1528**
- **Slide 62: https://www.faa.gov/tv/?mediaId=1689**
- **Slide 63: https://www.faa.gov/about/office_org/headquarters_offices/ang/offices/tc/library/storyboard/detailedwebpages/asdex.html**
- **Slide 81: https://www.faa.gov/nextgen/how_nextgen_works/new_technology/pbn/**
- **Slide 84: https://www.faa.gov/tv/?mediaId=1426**
- **Slide 91: https://www.faa.gov/tv/?mediaId=1437**

© 2019 The MITRE Corporation. All rights reserved.

Resources

(2 of 2)

- **Additional FAA Videos: https://www.faa.gov/tv/**
- **NextGen Website: https://www.faa.gov/nextgen/**
- **NextGen Performance Snapshots Website: https://www.faa.gov/nextgen/snapshots/**
- **NextGen Community Involvement: https://www.faa.gov/nextgen/nextgen_near_you/community_involvement/**

© 2019 The MITRE Corporation. All rights reserved.

Eleven NextGen Portfolios

Performance-Based Navigation (PBN) defines the performance requirements for routes and procedures that enable aircraft to navigate with greater precision and accuracy.

Enhancement of aircraft separation assurance to provide air traffic controllers with tools and procedures to separate aircraft with different kinds of navigation equipment and wake performance capabilities.

Improvements in Time Based Flow Management capability its trajectory modeler, an expansion of its departure capabilities to additional locations, and enhancements to its departure capabilities.

Coordinates flight and flow decision-making by flight planners and Federal Aviation Administration (FAA) traffic managers to improve overall efficiency.

Provide flight planners, air traffic controllers and traffic managers, and flight crews with consistent and complete information related to the National Airspace System (NAS) operational changes.

Procedural changes, improved aircraft capabilities, and improved precision approach guidance.

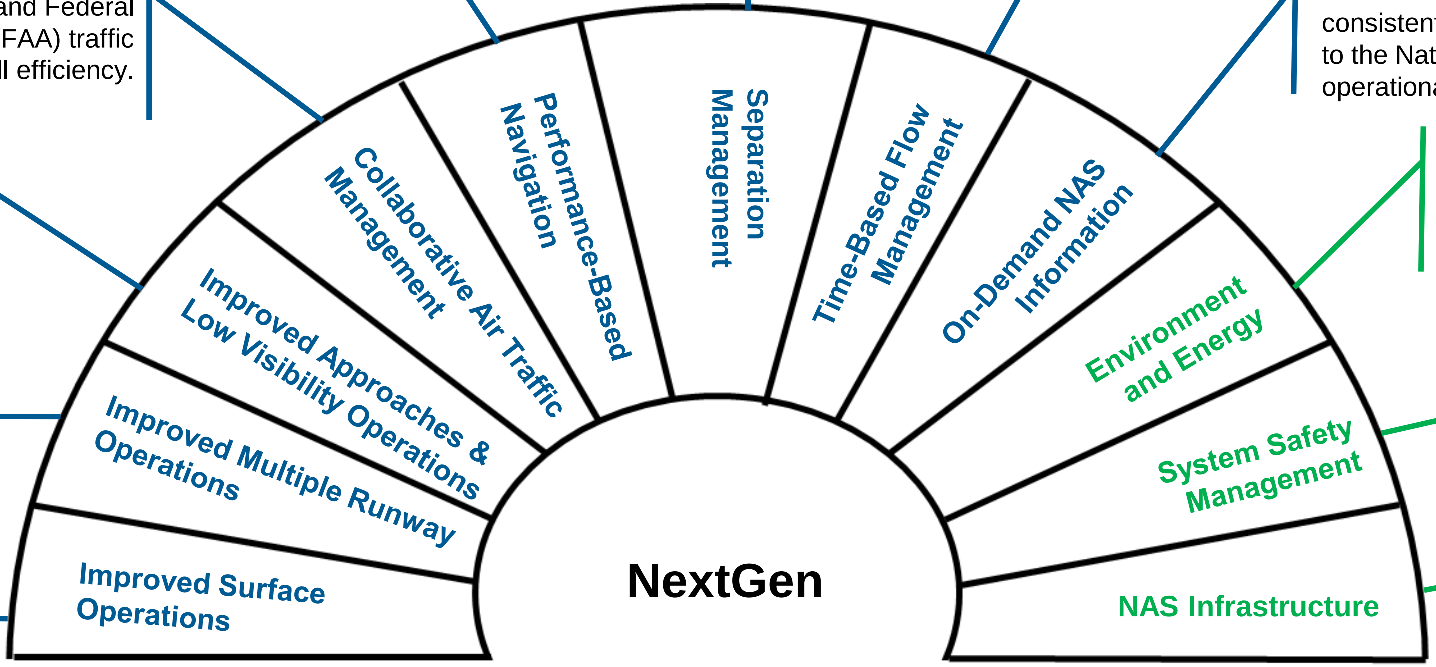
Overcome the environmental constraints that are facing aviation from noise, air quality, climate, energy and water quality concerns.

Simultaneous approaches during reduced visibility, decrease the required separations between aircraft on dependent approaches, alleviate the effects of wake turbulence.

Data acquisition, storage, analysis and modeling capabilities to meet the safety analysis needs of NextGen designers, implementers and practitioners, portfolio contains Aviation Safety Information Analysis and Sharing (ASIAS) data base.

New traffic management capabilities for pilots and controllers using shared surface movement data.

Weather capabilities, Terminal Radar Approach Control (TRACON) engineering, navigation systems, information management, procedures, standards, airspace.



Implementation Portfolios / Supporting Activity Portfolios

© 2019 The MITRE Corporation. All rights reserved.

MITRE

MITRE

MITRE's mission-driven teams are dedicated to solving problems for a safer world. Through our federally funded R&D centers and public-private partnerships, we work across government to tackle challenges to the safety, stability, and well-being of our nation.

Learn more www.mitre.org

© 2019 The MITRE Corporation. All rights reserved.

NOTICE

This is the copyright work of The MITRE Corporation, and was produced for the U. S. Government under Contract Number DTFAWA-10-C-00080, and is subject to Federal Aviation Administration Acquisition Management System Clause 3.5-13, Rights In Data-General, Alt. III and Alt. IV (Oct. 1996). No other use other than that granted to the U. S. Government, or to those acting on behalf of the U. S. Government, under that Clause is authorized without the express written permission of The MITRE Corporation. For further information, please contact The MITRE Corporation, Contracts Management Office, 7515 Colshire Drive, McLean, VA 22102-7539, (703) 983-6000.

© 2019 The MITRE Corporation. All Rights Reserved.