

Appendix A **ACRONYMS, ABBREVIATIONS AND GLOSSARY OF TERMS**

Table A-1 Acronyms

54T	RWJ Airpark, Baytown, TX
AAD	Average Annual Day
AAR	Airport Acceptance Rate
ACCRI	Aviation Climate Change Research Group
ACHP	Advisory Council on Historic Preservation
ACM	Adjacent Center Metering
ACS	American Community Survey
ADS-B	Automatic Dependent Surveillance-Broadcast
AFE	Above Field Elevation
AGL	Above Ground Level
APE	Area of Potential Effect
AR	Authorization Required
ARR	Arrival
ARTCC	Air Route Traffic Control Center
ASPM	Airport Specific Performance Metrics
ATALAB	Air Traffic Airspace Lab
ATC	Air Traffic Control
ATCT	Air Traffic Control Tower
ATM	Air Traffic Management
AXH	Houston-Southwest [Airport], Arcola, TX
BADA	Base of Aircraft Data
BLM	Bureau of Land Management
CAA	Clean Air Act of 1970
CAASD	Center for Advanced Aviation System Development
CAEP	Committee on Aviation and Environmental Protection
CATEX	Categorical Exclusion
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH ₄	Methane
CNS	Communications, Navigational, and Surveillance
CO	Carbon Monoxide
CTC	Cost To Carry
CXO	Lone Star Executive [Airport], Montgomery, TX
CY	Calendar Year
D&I	Design and Implementation
dB	Decibel
DEP	Departure
DNL	Day Night Average Sound Level
DoD	Department of Defense
DOT	Department of Transportation
DP	Instrument Departure Procedure
DWH	David Wayne Hooks Memorial [Airport], Houston, TX
EA	Environmental Assessment
EFD	Ellington Field, Houston, TX
EIS	Environmental Impact Statement

EJ	Environmental Justice
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act of 1973
ESRI	Environmental Systems Research Institute
ETMS	Enhanced Traffic Management System
EUROCONTROL	European Organization for the Safety of Air Navigation
EYQ	Weiser Air Park, Houston, TX
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FHWA	Federal Highway Administration
FICAN	Federal Interagency Committee on Aviation Noise
FICON	Federal Interagency Committee on Noise
FTA	Federal Transit Administration or Federal Transit Act
GA	General Aviation
GAO	General Accounting Office
GHG	Greenhouse Gases
GLS	Scholes International [Airport] at Galveston, Galveston, TX
GPS	Global Positioning System
HAATS	Houston Area Air Traffic System
HAS	Houston Airport System
HFC	Hydrofluorocarbon
HOU	William P. Hobby [Airport], Houston, TX
HPY	Baytown [Airport], Baytown, TX
I90	Houston Terminal Radar Approach Control (TRACON)
IAH	George Bush Intercontinental [Airport]/Houston, Houston, TX
ICAO	International Civil Aviation Organization
IFP	Instrument Flight Procedures
IFR	Instrumental Flight Rules
IMC	Instrument Meteorological Conditions
iTRAEC	Integrated Terminal Research, Analysis, and Evaluation Capabilities
IWS	West Houston [Airport], Houston, TX
L/R	Left/Right
LBX	Texas Gulf Coast Regional Airport, Angleton/Lake Jackson, TX
L _{eq}	Equivalent Sound Level
LOA	Letter of Agreement
LVJ	Pearland Regional [Airport], Houston, TX
LWCF	Land and Water Conservation Fund
MBTA	Migratory bird Treaty Act of 1918
MOU	Memorandum of Understanding
MSL	Mean Sea Level
MT CO _{2e}	Metric tons of Carbon Dioxide Equivalent
N ₂ O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAS	National Airspace System
NAT	National Analysis Team
NATCA	National Air Traffic Controllers Association
NAVAIDS	Navigation Aids
NEPA	National Environmental Policy Act of 1969
NextGen	Next Generation Air Transportation System

NFGT	National Forests and Grasslands in Texas
NHPA	National Historic Preservation Act of 1966
NIRS	Noise Integrated Routing Systems
NLR	Noise Level Reduction
NM	Nautical Mile
NMFS	National Marine Fisheries Service
NO ₂	Nitrogen Dioxide
NOP	National Offload Program
NPS	National Park Service
NRHP	National Register of Historic Places
NTML	National Traffic Management Log
O ₃	Ozone
OAPM	Optimization of the Airspace and Procedures in the Metroplex
ODP	Obstacle Departure Procedure
OPD	Optimized Profile Descent
OST	OAPM Study Team
PARTNER	Partnership for Air Transportation Noise & Emissions Reduction
Pb	Lead
PBN	Performance Based Navigation
PDARS	Performance Data Analysis and Reporting System
PM	Particulate Matter
PM ₁₀	PM with diameter less than 10 micrometers
PM _{2.5}	PM with diameter less than 2.5 micrometers
PSA	Primary Study Area
PTC	Presumed to Conform
RITA	Research and Innovative Technology Administration
RNAV	Area Navigation
RNP	Required Navigation Performance
RTCA	Radio Technical Commission for Aeronautics
SEL	Sound Exposure Level
SF ₆	Sulfur Hexafluoride
SGR	Sugar Land Regional [Airport], Houston, TX
SHPO	State Historic Preservation Officer
SID	Standard Instrument Departure
SIP	State Implementation Plan
SO ₂	Sulfur Dioxide
SOP	Standard Operating Procedure
SPL	Sound Pressure Level
SRM	Safety Risk Management
SSA	Supplemental Study Area
STAR	Standard Terminal Arrival Route
SUA	Special Use Airspace
SWAP	Severe Weather Avoidance Procedures
T00	Chambers County [Airport], Anahuac, TX
T41	La Porte Municipal [Airport], La Porte, TX
TAF	Terminal Area Forecasts
TARGETS	Terminal Area Route Generation, Evaluation, Traffic and Simulation
TBO	Trajectory Based Operations
TCEQ	Texas Commission on Environmental Quality
THC	Texas Historical Commission

THPO	Tribal Historic Preservation Officer
TIP	Transportation Improvement Project
TME	Houston Executive [Airport], Houston, TX
TNRIS	Texas Natural Resource Information System
TPWD	Texas Parks and Wildlife Department
TRACON	Terminal Radar Approach Control
USC	United States Code
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
WMA	Wildlife Management Area
ZFW	Fort Worth Air Route Traffic Control Center (ARTCC)
ZHU	Houston Air Route Traffic Control Center (ARTCC)
ZME	Memphis Air Route Traffic Control Center (ARTCC)

Table A-2 Glossary of Terms

A-Weighted Sound Level	A quantity, in decibels, read from a standard sound-level meter with A-weighting circuitry. The A-weighting scale discriminates against the lower frequencies below 1000 hertz according to a relationship approximating the auditory sensitivity of the human ear. The A-weighted sound level is approximately related to the relative “noisiness” or “annoyance” of many common sounds.
Acoustics	The science of sound, including the generation, transmission, and effects of sound waves, both audible and inaudible.
Air Carrier	An entity holding a Certificate of Public Convenience and Necessity issued by the Department of Transportation (DOT) to conduct scheduled air services over specified routes and a limited amount of non-scheduled operations.
Air Pollutant	Any substance in air that could, in high enough concentration, harm man, other animals, vegetation, or material. Pollutants may include almost any natural or artificial composition of airborne matter capable of being airborne. They may be in gases, particulates, or in combinations thereof. Generally, they fall into two main groups: (1) those emitted directly from identifiable sources and (2) those produced in the air by interaction between two or more primary pollutants, or by reaction with normal atmospheric constituents, with or without photo-activation.
Air Route Traffic Control Center (ARTCC, Center)	An FAA facility established to provide air traffic control service to aircraft operating on an Instrument Flight Rules (IFR) flight plan within controlled airspace and principally during the en-route phase of flight. When equipment capabilities and controller workload permit, certain advisory/assistance services may be provided to Visual Flight Rules (VFR).
Air Taxi	An air carrier certificated in accordance with Federal Aviation Regulations (FAR) Part 135 and authorized to provide, on demand, public transportation of persons and property by aircraft. Generally operates small aircraft “for hire” for specific trips.
Air Traffic Control (ATC)	A service operated by appropriate authority to promote the safe, orderly, and expeditious flow of air traffic.
Aircraft Surveillance Systems	Systems set up to enable the ATC system to know the location of an aircraft and where it is heading. Aircraft positions are displayed for controllers as they actively monitor the traffic to

	ensure that aircraft do not violate separation criteria
Airport Traffic Control Tower (ATCT)	A facility that uses air/ground communications, visual signaling, and other devices to provide ATC services to aircraft operating in the vicinity of an airport. Authorizes aircraft to land or take-off at the airport controlled by the tower regardless of flight plan or weather conditions.
Airspace	Navigable area used by aircraft for purposes of flight.
Airway	An area of Class E airspace established in the form of a corridor, the centerline of which is defined by radio navigational aids. The network of airways serving aircraft operations up to but not including 18,000 feet MSL are referred to as "Victor" airways. The network of airways serving aircraft operations at or above 18,000 feet MSL are referred to as "Jet" airways.
Altitude	Height above a reference point, usually expressed in feet. Reference points are typically sea level, the ground, or airfield elevation in which case Mean Sea Level (MSL), AGL or AFE further describes the altitude, respectively.
Ambient Noise Level	The level of noise that is all-encompassing within a given environment for which a single source cannot be determined. It is usually a composite of sounds from many and varied sources near to and far from the receiver.
Area Navigation (RNAV)	A method of air navigation that permits aircraft to operate on any desired course within a network of station-referenced navigation aids (NAVAIDs), rather than navigating directly to and from the NAVAIDs.
Arithmetic Averaged Sound Pressure Level	The arithmetic sum of a series of sound pressure levels divided by the number of levels included in the sum.
Arrival Stream	A sequence of aircraft that are following similar arrival procedures. This can conserve flight distance, reduce congestion, and allow instrument flight plans into airports with limited NAVAIDs.
Attainment Area	An area in which the Federal or state standards for ambient air quality are being achieved.
Based Aircraft	Active aircraft that are stationed at an airport on a permanent basis.
Block	Census blocks are small areas bounded on all sides by visible features such as streets, roads, streams, and railroad tracks, and by invisible boundaries such as city, town, township, and county limits; property lines; and short, imaginary extensions of streets and roads. Blocks are numbered uniquely within each census tract or block numbering area (BNA). A three-digit number identifies a block, sometimes with a single alphabetical suffix. The U.S. Bureau of Census designates census blocks.
Centroid	A point representing the geographic center of a US Bureau of Census' census block.
Climb	The act or instance of increasing altitude.
Conformity	A determination that a project conforms with a State Implementation Plan (SIP) whose purpose is to eliminate or reduce the severity and number of violations of the National Ambient Air Quality Standards; and does not impede the scheduled attainment of such standards.
Constructive Use	When the proximity impacts (e.g., noise) of a proposed project adjacent to, or near, a Section 4(f) property result in substantial impairment of the property
Controlled Airspace	Airspace of defined dimensions within which air traffic control service is provided to IFR flights and to VFR flights in accordance with the airspace classification.
Corner-Post Configuration	Corner-post Configuration refers to an arrangement of air traffic pathways in a terminal area that brings incoming flights over fixes at four general corners of the terminal area, while outbound

	flights depart between the corners, thus minimizing conflicts between arriving and departing air traffic.
Criteria Pollutants	The 1970 amendments to the Clean Air Act required EPA to set National Ambient Air Quality Standards for certain pollutants known to be hazardous to human health. EPA has identified and set standards to protect human health and welfare for six pollutants: ozone, carbon monoxide, total suspended particulates, sulfur dioxide, lead, and nitrogen oxide. The term, "criteria pollutants" derives from the requirement that EPA must describe the characteristics and potential health and welfare effects of these pollutants. It is on the basis of these criteria that standards are set or revised.
Day-Night Average Sound Level (DNL)	A measure of the annual average noise environment over a 24-hour day. It is the 24-hour, logarithmic- (or energy-) average, A-weighted sound pressure level with a 10-decibel penalty applied to the nighttime event levels that occur between 10 p.m. and 7 a.m.
De minimis Levels	De minimis is defined as lacking significance or importance, or so minor as to be disregarded. De minimis levels are minimum air pollutant levels and vary according to the type of pollutant and severity of the non-attainment area. Unless state minimums are lower than Federal, these levels are consistent for all conformity determinations. The calculation of total project emissions is made and compared to these de minimis cutoffs. If the emissions for a pollutant are above de minimis, the project requires a conformity determination. All emissions from the project must be analyzed and found to conform, not only those above the de minimis levels.
Decibel (dB)	Commonly used to define the level produced by a sound source. The decibel scale is logarithmic (e.g., when the scale goes up by ten, the perceived level is twice as loud)
Departure	The act of an aircraft taking off from an airport.
Departure Procedure (DP)	A preplanned IFR ATC departure procedure printed for pilot use in graphic and/or textual form. DPs provide transition from the terminal to the appropriate en route structure. SIDs are a type of DP.
Descent	The process of decreasing altitude.
Design and Implementation Team	Air traffic controllers and airspace procedures specialists from the Houston TRACON facility and Houston ARTCC, with additional participation by Fort Worth ARTCC personnel and OAPM Program Office personnel.
Distance Measuring Equipment (DME)	Equipment installed on an aircraft that provides the distance of the aircraft in relation to a navigation aid as well as ground speed. DME transmitters are often co-located with a Very High Frequency Omni-directional Radio Range Station (VOR), known in this case as a VOR-DME.
Downwind Leg	A flight path parallel to the landing runway in the direction opposite to the landing. The downwind leg normally extends between the crosswind leg and the base leg.
Emissions	Pollution discharged into the atmosphere from stationary sources such as smokestacks, surface areas of commercial or industrial facilities, residential chimneys, and from mobile sources such as motor vehicles, locomotives, or aircraft exhausts.
En Route Airspace	A general term to describe the airspace controlled by an ARTCC.
Energy-Averaged Sound Pressure Level	The logarithmic sum of the sound power of a series of sound pressure levels divided by the number of levels included in the sum.
Enplanement	The total number of revenue passengers boarding aircraft, including originating, stopover, and transfer passengers, in scheduled and non-scheduled services.
Environmental Assessment	An EA is a concise document used to describe the environmental impacts of a proposed

(EA)	Federal action.
Environmental Noise	Unwanted sound from various outdoor sources that produce noise (e.g., aircraft, cars, trucks, buses, railways, industrial plants, construction activities)
Equipage	Communication, navigation and surveillance equipment installed on an aircraft
Equivalent Sound Level (L_{eq})	The level of a constant sound, which, in the given situation and time period, has the same average sound energy, as does a time-varying sound. Specifically, equivalent sound level is the energy-averaged sound pressure level of the individual A-weighted sound pressure levels occurring during the time interval.
Federal Aviation Administration (FAA)	The Federal Aviation Administration (FAA) is the agency of the United States Department of Transportation with primary responsibility for civil aviation. Among its major functions are the regulation of civil aviation to promote safety, fulfill the requirements of national defense and development, and operate a common system of air traffic control and navigation for both civil and military aircraft.
Federal Infrastructure Projects Dashboard	Part of an inter-agency initiative, spearheaded by the Office of Management and Budget, to institutionalize best practices to reduce the amount of time required to make permitting and review decisions and improve environmental and community outcomes
Fix	A geographical position determined by reference to one or more radio NAVAIDS, celestial plotting, or by some other means such as satellite navigation.
Flight Data Information	Specific information used by ATC for an individual flight, including information such as aircraft identification, destination, type, route, and altitude.
Flight Track	The path an aircraft describes over the ground.
Flow	Describes the direction in which aircraft take-off and land at a particular airport. Aircraft generally take-off and land into the wind. However, other factors (e.g., nearby airports, construction) can also affect flow.
Flyways	Migration routes for avian species
Frequency (acoustic)	The number of oscillations per second completed by a vibrating object.
General Aviation (GA)	All civil aviation except scheduled passenger, air taxi and cargo airlines.
Global Positioning System (GPS)	A satellite-based radio positioning and navigation system operated by the U.S. Department of Defense. The system provides highly accurate position and velocity information, and precise time, on a continuous global basis to an unlimited number of properly equipped users.
Hand-Off	An action taken to transfer the radar identification of an aircraft from one controller to another.
Heading	A compass bearing indicating the direction of travel.
Hertz (Hz)	The unit used to designate frequency; specifically, the number of cycles per second.
Household	A household includes all the persons who occupy a housing unit. The occupants may be a single family, one person living alone, two or more families living together, or any other group of related or unrelated persons who share living arrangements.
Housing Unit	A housing unit is a house, apartment, a mobile home or trailer, a group of rooms or a single room occupied as separate living quarters or, if vacant, intended for occupancy as separate living quarters.
Houston OAPM Airports	These are the airports that are the subject of the Proposed Action.
Hydrocarbons (HC)	Chemical compounds that consist entirely of carbon and hydrogen.

Instrument Approach Procedure	A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a land or to a point from which a landing may be made visually. It is prescribed and approved for a specific airport by a competent authority
Instrument Departure Procedure	A preplanned instrument flight rule (IFR) departure procedure published for pilot use, in graphic or textual format, that provides obstruction clearance from the terminal area to the appropriate en route structure. There are two types of DP, Obstacle Departure Procedure (ODP), printed either textually or graphically, and, Standard Instrument Departure (SID), which is always printed graphically
Instrument Flight Rules (IFR)	Rules governing the procedures for conducting instrument flight in aircraft. Also a term used by pilots and controllers to indicate type of flight plan.
Instrument Meteorological Conditions (IMC)	Weather conditions expressed in terms of visibility, distance from clouds, and cloud ceilings during which all aircraft are required to operate using Instrument Flight Rules (IFR).
Integrated Noise Model (INM)	A computer program developed, updated and maintained by the Federal Aviation Administration to evaluate aircraft noise impacts in the vicinity of airports.
In-Trail Spacing	The distance between two aircraft on an identical route; one aircraft is following another.
Invasive Species	Invasive species are organisms (usually transported by humans) that successfully establish themselves in, and then overcome, otherwise intact, pre-existing native ecosystems.
Knots	Speed measured in nautical miles per hour.
Level-off	The process by which an aircraft that is climbing or descending transitions to a constant altitude. This can be done once the aircraft reaches its cruise altitude in the en route environment, or as a series of steps taken as the aircraft transition to/from the en route environment to guarantee adequate separation from other aircraft.
Loudness	The attribute of an auditory sensation in terms of which sounds may be ordered on a scale extending from soft to loud. Loudness depends primarily upon the sound pressure of the source, but it also depends upon the frequency and waveform of the source.
Low-Income	A person whose median household income is at or below the Department of Health and Human Services poverty guidelines
Mean Sea Level (MSL)	The height of the surface of the sea for all stages of the tide, used as a reference for elevations or altitude of aircraft flight. Also called sea level datum.
Metroplex	A geographic area containing several airports serving major metropolitan areas and a diversity of aviation stakeholders
National Airspace System (NAS)	The common network of air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; rules, regulations and procedures, technical information, and manpower and material.
National Ambient Air Quality Standards (NAAQS)	Standards for criteria pollutants established by United States Environmental Protection Agency that apply to outdoor air.
Nautical Mile (NM)	A measure of distance equal to 1 minute of arc on the earth's surface (approximately 6,076 ft. or approximately 1.15 statute miles).
Navigation Aids (NAVAIDs)	Any visual or electronic device airborne or on the surface that provides point to point guidance information or position data to aircraft in-flight.
Next Generation Air	A program shifting aircraft procedures from fixed, ground-based radio navigation transmitting

Transportation System	facilities and radar to satellite, or GPS, navigation and onboard surveillance
Noise	Any sound that is undesirable because it interferes with speech and hearing, or is intense enough to damage hearing, or is otherwise annoying.
Noise Abatement Procedure	A measure taken to reduce the off-airport impacts of aircraft noise through changes in airport layout or aircraft operations. Noise abatement procedures are generally developed by airport operators in cooperation with the FAA, aircraft operators, pilots, and other aviation interests, to address noise concerns raised by residents and local community officials.
Noise Exposure	The cumulative acoustic stimulation reaching the ear of a person over a specified period of time (e.g., a work shift, a day, a working life, or a lifetime).
Noise Integrated Routing System (NIRS)	A computer program developed, updated, and maintained by the FAA to evaluate aircraft noise impact for air traffic actions involving multiple airports over broad geographic areas.
Non-Attainment Area	Areas with levels that exceed one or more of the NAAQS for the criteria pollutants designated in the Clean Air Act.
Operation	Landing or take-off of an aircraft.
Over-flights	Aircraft whose flights originate or terminate outside the controlling facility's area that transit the airspace without landing.
Performance-Based Navigation (PBN)	Specifies that aircraft Required Navigation Performance (RNP) and Area Navigation (RNAV) systems performance requirements be defined in terms of accuracy, integrity, availability, continuity and functionality required for the proposed operations in the context of a particular airspace, when supported by the appropriate navigation infrastructure.
Piston Aircraft	Propeller-driven aircraft powered by an internal combustion engine.
Power Settings	Amount of engine power used by the pilot.
Procedural Deconfliction	Defined altitude or lateral restrictions as part of a procedure to keep aircraft from conflicting with other aircraft on different procedures.
Q-route	'Q' is the designator assigned to published RNAV routes used by the United States
Quadrant	A quarter part of a circle, centered on a NAVAID oriented clockwise from magnetic north.
Radar (primary)	A device which, by measuring the time interval between transmission and reception of radio pulses, and correlating the angular orientation of the radiated antenna beam, or beams in azimuth and/or elevation, provides information on range, azimuth, and /or elevation of objects in the path of the transmitted pulses. Also known as "Primary Radar".
Radar (secondary)	A radar system in which the object to be detected is fitted with cooperative equipment in the form of a radio receiver/transmitter (transponder). Radar pulses transmitted from the searching transmitter/receiver (interrogator) site are received in the cooperative equipment and used to trigger a distinctive transmission from the transponder. This reply transmission, rather than a reflected signal, is then received back at the interrogator site for processing and display at an ATC facility. Also known as a "Radar Beacon".
Radial	A magnetic bearing extending from a VOR/VORTAC/TACAN navigation facility.
Required Navigation Performance (RNP)	A type of performance-based navigation (PBN) that allows an aircraft to fly a specific path between two 3-dimensionally defined points in space. RNP differs from Area Navigation (RNAV) systems in that there is a requirement for on-board performance monitoring and alerting

	specification.
Satellite Navigation	See Global Positioning System (GPS).
Section 4(f)	A property that may be protected under special provisions of the U.S. Department of Transportation Act, 49 USC 303(c).
Sector	A defined volume of airspace, including both lateral and vertical limits, in which an air traffic controller is responsible for the safe movement of air traffic. A TRACON's or ARTCC's airspace is comprised of multiple sectors.
Separation	Required FAA minimum spacing between aircraft.
Sequencing	A process used to merge air traffic into an orderly flow.
Sound Exposure Level (SEL)	A time-integrated metric (i.e., continuously summed over a time period) that quantifies the total energy in the A-weighted sound level measured during a transient noise event. The time period for this measurement is generally taken to be that between the moments when the A-weighted sound level is 10 dB below the maximum.
Sound Pressure Level	A measure, in decibels, of the magnitude of the sound. Specifically, the sound pressure level of a sound that is 10 times the logarithm to the base 10 of the ratio of the squared pressure of this sound to the squared reference pressure. The reference pressure is usually taken to be 20 micropascals. See also Energy-Averaged Sound Pressure Level.
Source (acoustic)	The object that generates the sound.
Standard Instrument Approach Procedure (SIAP)	A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a land or to a point from which a landing may be made visually. It is prescribed and approved for a specific airport by a competent authority
Standard Instrument Departure Procedure (SID)	A preplanned instrument flight rule (IFR) departure procedure published for pilot use, in graphic or textual format, that provides obstruction clearance from the terminal area to the appropriate en route structure.
Standard Terminal Arrival (STAR)	A preplanned instrument flight rule (IFR) air traffic control arrival procedure published for pilot use in graphic and/or textual form. STAR's provide transition from the en route structure to an outer fix or an instrument approach fix/arrival waypoint in the terminal area.
Statute Mile (SM)	A measure of distance equal to 5,280 feet.
Sulfur Dioxide (SO ₂)	Sulfur dioxide typically results from combustion processes, refining of petroleum, and other industrial processes.
T-Route	T-routes are available for use by RNAV equipped aircraft from 1,200 feet above the surface (or in some instances higher) up to but not including 18,000 ft. mean sea level (MSL).
Tactical Separation	The separation of aircraft by air traffic control instruction versus procedural deconfliction.
Terminal Area	A general term used to describe airspace in which approach control service or airport traffic control service is provided.
Terminal Radar Approach Control (TRACON)	An FAA ATC facility that uses radar and two-way radio communication to provide separation of air traffic within a specified geographic area in the vicinity of one or more large airports.
Threshold of Significance	A threshold of significance is a quantitative or qualitative standard, or set of criteria, pursuant to which the significance of a given environmental effect may be determined. These standards or criteria are established by the lead government agency performing a NEPA review, in this case the FAA.

Time Above (TA or TALA)	The TA noise metric provides the duration in minutes for which aircraft-related noise exceeded a specified A-weighted sound level. If not stated otherwise, TA pertains to a 24-hour day. (e.g., A TA65 [or TALA65] of 17 minutes means that 65 dB was exceeded for a total of 17 minutes of the course of a 24-hour day.)
Topography	The configuration of a surface including its relief and the position of its natural and man-made features.
Turboprop Aircraft	An aircraft whose main propulsive force is provided by a propeller driven by a gas turbine. Additional propulsive force may be provided by gas discharged from the turbine exhaust.
Uncontrolled Airspace	Class G airspace (uncontrolled) is that portion of airspace that has not been designated as (controlled) Class A, Class B, Class C, Class D, or Class E airspace
Vector	Heading instructions issued by ATC to provide navigational guidance by radar.
Victor Airway	An airspace area established in the form of a corridor, the centerline of which is defined by radio navigational aids.
Very High Frequency Omni-directional Radio Range Station (VOR)	A ground-based electronic navigation aid transmitting very high frequency navigation signals, 360° in azimuth, oriented from magnetic North. Distance Measuring Equipment (DME) may be installed. Used as a basis for navigation in the National Airspace System.
Very High Frequency Omni-directional Range with Tactical Air Navigation (VORTAC)	A navigation aid providing VOR azimuth, TACAN azimuth, and TACAN distance measuring equipment (DME) at one site. The most common form of radio navigation currently in use.
Visual Flight Rules (VFR)	Rules that govern the procedures for conducting flight under visual conditions. The term 'VFR' is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, it is used by pilots and controllers to indicate type of flight plan.
Visual Meteorological Conditions (VMC)	Weather conditions expressed in terms of visibility, distance from cloud, and ceiling, equal to or better than specified minima.
Volatile Organic Compound (VOC)	Any organic compound that participates in atmospheric photochemical reactions except those designated by EPA as having negligible photochemical reactivity.

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Appendix C LIST OF PREPARERS

As required by Federal Aviation Administration (FAA) Order 1050.1E, the names and qualifications of the principal persons contributing information to this Environmental Assessment (EA) are identified in this section. The FAA employed the efforts of an interdisciplinary team of scientists, technicians, and experts in various fields to accomplish this study, as required by Section 1502.6 of Council on Environmental Quality (CEQ) regulations. Specialists involved in this EA included FAA and support contractor staff in such fields as air traffic control, airspace planning, noise assessment and abatement, DOT Section 4(f) resources, avian and bat species, and other disciplines. While an interdisciplinary approach has been used to develop the EA, all decisions made with regard to the content and scope of the EA are those of the FAA.

Table C-1 Federal Aviation Administration List of Preparers

Name and Job Title	Education	Years of Experience	Area of Expertise Relating to Project	Project Responsibilities
Roger McGrath, Environmental Protection Specialist	M.G.A. State and Local Government B.A. Political Science	42	Management, Administration, Aviation, Environmental and Airspace Planning, Design, and Development	FAA Project Manager for the Houston OAPM Environmental Process
Gregory L. Hines, Environmental Protection Specialist	M.A. Management M.A. Human Resources Development B.S. Bioenvironmental Engineering Technology	22	Project Management, Administration, and Environmental Planning and Compliance	Document Review and Assistant to FAA Project Manager for the Houston OAPM Environmental Process
Mark Phipps, Houston OAPM Design and Implementation Team Co-Lead	High School Diploma	38	Air Traffic Control, Pilot, Airspace Manager Denver Airport, RNAV Project Manager, OAPM Project Manager	FAA Project Manager, Responsible for coordinating all resources and delivering the product according to the timelines as promised to the DOT.
Keith Brown, Houston OAPM Design and Implementation Team Co-Lead	B.A. Professional Aeronautics A.A.S Logistics Management	25	Airport Air Traffic Control, En Route Air Traffic Control, NATCA LMR and Leadership Training	Represent NATCA in collaborative labor- management leadership of project

Table C-2 Harris Miller Miller & Hanson Inc. List of Preparers

Name and Job Title	Education	Years of Experience	Area of Expertise Relating to Project	Project Responsibilities
David Crandall, Environmental Assessment Contractor Technical Lead	B.S. Aeronautical Engineering	14	Aircraft noise related projects ranging from EA/EIS preparation, 14 CFR part 150 studies, and airport noise monitoring system analysis.	Environmental Assessment Contractor Technical lead Noise Impact Analysis
Robert Miller, Senior Vice President	B.A. Mathematics	45	5 years in the US Air Force. Managed 14 CFR Part 150 Programs at air carrier, general aviation, and joint use facilities, and has conducted assessments of Naval and Marine Corps Air Stations under the Navy's Air Installation Compatible Use Zone (AICUZ) program.	Document Review and Quality Control
Vinayak Khera, Vice President	M.S. Environmental Engineering B.S. Aircraft Engineering (minor in Aviation Business Administration)	15	Participated and led a wide variety of aviation studies covering issues related to airspace and airport modeling, environmental planning, staffing requirements, airline financial management, international airline management, air cargo, and economics of airline service.	Project Manager Purpose and Need
Robert Behr, Senior Consultant	M.S. Aeronautical Engineering B.S. Aeronautical Engineering	38	25 years in the US Air Force. Data acquisition and analysis of environmental noise and vibration data for airports and helicopters. Extensive field measurements of noise and vibration with a variety of metrics and instrumentation.	Noise Impact Analysis Alternatives
Kurt Hellauer, Principal Consultant	B.A. Government	25	National Environmental Policy Act (NEPA) program management, environmental impact analysis, and land-use planning. Background in aircraft operations modeling, airspace analysis, airport operations, and land use planning. FAA Commercial Pilot Certificate.	Purpose & Need, Alternatives, DOT Section 4(f) Properties, Historic & Cultural Resources, Outreach
Jesse Lambert, Senior Consultant	M.A. International Commerce and Policy B.A. Political Science	5	Provided on-site support to Next Generation Air Transportation System. Expertise includes interagency coordination, sustainable energy policy, and intermodal transportation planning.	Technical Writer and Document Development
Kirk Harris, Consultant	M.B.A. Entrepreneurship B.S. Aviation Management	5	Airline dispatcher and operations specialist. Program Management Support to the FAA/Joint Planning and Development office, and leading industry experts of the Aircraft Working Group/Equipage Standing Committee and the Global Harmonization Working	Administrative File Manager, Project Researcher and Document Development

Name and Job Title	Education	Years of Experience	Area of Expertise Relating to Project	Project Responsibilities
			Group.	
Sean Doyle, Consultant	B.S. Physics B.S. Astronomy	7	Part 150 and Part 161 studies, Environmental Impact Studies, and other studies related to State and local requirements. Expert user of the Federal Aviation Administration's airport noise models, the Integrated Noise Model, and the Area Equivalent Method. SQL Database manager and query designer for aircraft radar data evaluation and analysis.	Noise Impact Analysis
Michael Hamilton, Senior Geographic Information Specialist	B.S. Geographic Information Systems & Cartography A.S. Survey and Highway Engineering Technology	28	Use of graphics applications (GIS and CAD) for noise contour creation, overlay, manipulation, environmental noise impacts, Census data analysis including environmental justice and population impacts, noise sensitive mapping, land use mapping and analysis, noise barrier and noise mitigation mapping.	Geographic Information Spatial Analysis and Graphics
Philip DeVita, Director, Air Quality	M.S. Environmental Studies B.S. Meteorology	20	Air quality permitting and modeling, wind turbine and solar evaluation, air emissions characterization, and meteorological monitoring.	Air Quality, Natural Resources and climate change analysis
Stephen Barrett, Director of Clean Energy	M.A. Environmental Science and Policy B.A. International Relations	15	Environmental and regulatory consulting and project management. Planning and permitting expert in natural resource issue areas for energy and transportation projects.	Wildlife related analysis
Diana Wasiuk, Director of Airport and Airspace Management	M.B.A Aviation B.A. Aviation Business Administration	13	Project Management, Airfield and Airspace operations	Outreach

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Appendix D NATIONAL AIRSPACE SYSTEM GUIDEBOOK

D.1 Governing U.S. Airspace

The *Federal Aviation Act of 1958* delegates various responsibilities to the FAA including control over the use of the nation's navigable airspace and regulation of civil and military operations in that airspace in the interests of safety and efficiency.¹ Within the U.S. National Airspace System (NAS), the FAA manages aircraft takeoffs, landings and the flow of aircraft between airports through an infrastructure of air traffic control and navigation facilities, people (e.g., air traffic controllers, maintenance personnel), and technology (e.g., radar, communications equipment).

The U.S. NAS is one of the most complex aviation networks in the world and when the FAA proposes changes to its design and operation, four principles must be preserved:

1. Maintain or improve system safety
2. Increase system flexibility, predictability, and access
3. Improve efficiency and reduce delays
4. Support evolution of emerging technologies

Inside the FAA, the Air Traffic Organization (ATO) is responsible for the safe and efficient use of navigable airspace. ATO is also charged with compliance with the National Environmental Protection Act (NEPA) and other laws and regulations that could be impacted by the (re)design of and air traffic management procedures and the airspace management structure in the NAS.

D.2 Air Traffic Control Fundamentals

As a public service, the FAA provides the network of infrastructure, people, and technology that is used to monitor, guide, and direct aircraft along routes within the NAS. This service is known collectively as Air Traffic Control (ATC). The ATO is responsible for managing day-to-day ATC operations, including the maintenance of safe separation distances between aircraft, and the efficient flow of air traffic with as little delay as possible while maintaining safety standards.

Aircraft operate under two distinct categories of flight rules: Visual Flight Rules (VFR) and Instrument Flight Rules (IFR).² These flight rules generally correspond to two categories of weather conditions: Visual Meteorological Conditions (VMC) and Instrument Meteorological Conditions (IMC). VMC generally exist during fair to good weather, when good visibility conditions exist. IMC occur during periods when visibility falls to less than 3 statute miles or the ceiling³ drops to lower than 1,000 feet. Correspondingly, under VFR a pilot is responsible to "see and avoid" to maintain safe

¹ Title 49, U.S.C., Section 40101(d)4

² Title 14, Code of Federal Regulations (CFR), Part 91

³ Ceiling: the distance from the ground to the bottom layer of clouds, defined as the point where the clouds cover more than 50 percent of the sky

separation from other aircraft and obstacles. IFR procedures are designed for use when separation from other aircraft and terrain is maintained by cockpit instrument reference or radar. Pilots must follow IFR during IMC. Regardless of weather conditions, however, the majority of commercial air traffic operates under IFR.

Based on factors such as aircraft type and weather, among others, air traffic controllers apply various rules to maintain defined minimum distances (e.g., separation) between aircraft⁴:

- Vertical Separation: Separation between aircraft operating at different altitudes
- Longitudinal Separation: Separation between aircraft operating along the same flight route, referring to the distance between a lead and a following aircraft; also referred to as “in-trail” separation
- Lateral Separation: Separation between aircraft operating along two separate but proximate flight routes

Standard instrument procedures define routes along which aircraft operate. For aircraft operating under IFR, air traffic controllers maintain separation by monitoring and directing pilots of aircraft following standard instrument procedures. Controllers monitor the aircraft routes, altitudes, and airspeeds using various sensors (e.g., radar and satellites). Effectively, this system of procedures defines the routes along which IFR aircraft operate. Procedures are intended to provide predictable, efficient flight routes to move aircraft through the airspace in an orderly manner, minimizing the need for communication between the controller and pilot. “Conventional” standard instrument procedures rely on verbal instructions from controllers to the pilot, in conjunction with instrument guidance transmitted from ground-based navigational aids (NAVAIDs). The aircraft flies above the NAVAIDS along a point-to-point route while the aircraft cockpit instruments receive instructions via data communication with the NAVAIDs below.

More recently, FAA modernization has begun to employ innovative technologies to enhance routes defined by standard instrument procedures. Area Navigation (RNAV) is one such technology, which enables RNAV-equipped aircraft to fly more precise and efficient routes. RNAV procedures are based on instrument guidance transmitted from a network of ground-based NAVAIDS operating in concert, as well as space-based navigational aids that use Global Positioning System (GPS) technology. A comparison of “conventional” and RNAV standard instrument procedures is illustrated in Figure D-1.

⁴ FAA Order 7110.65T, Air Traffic Control

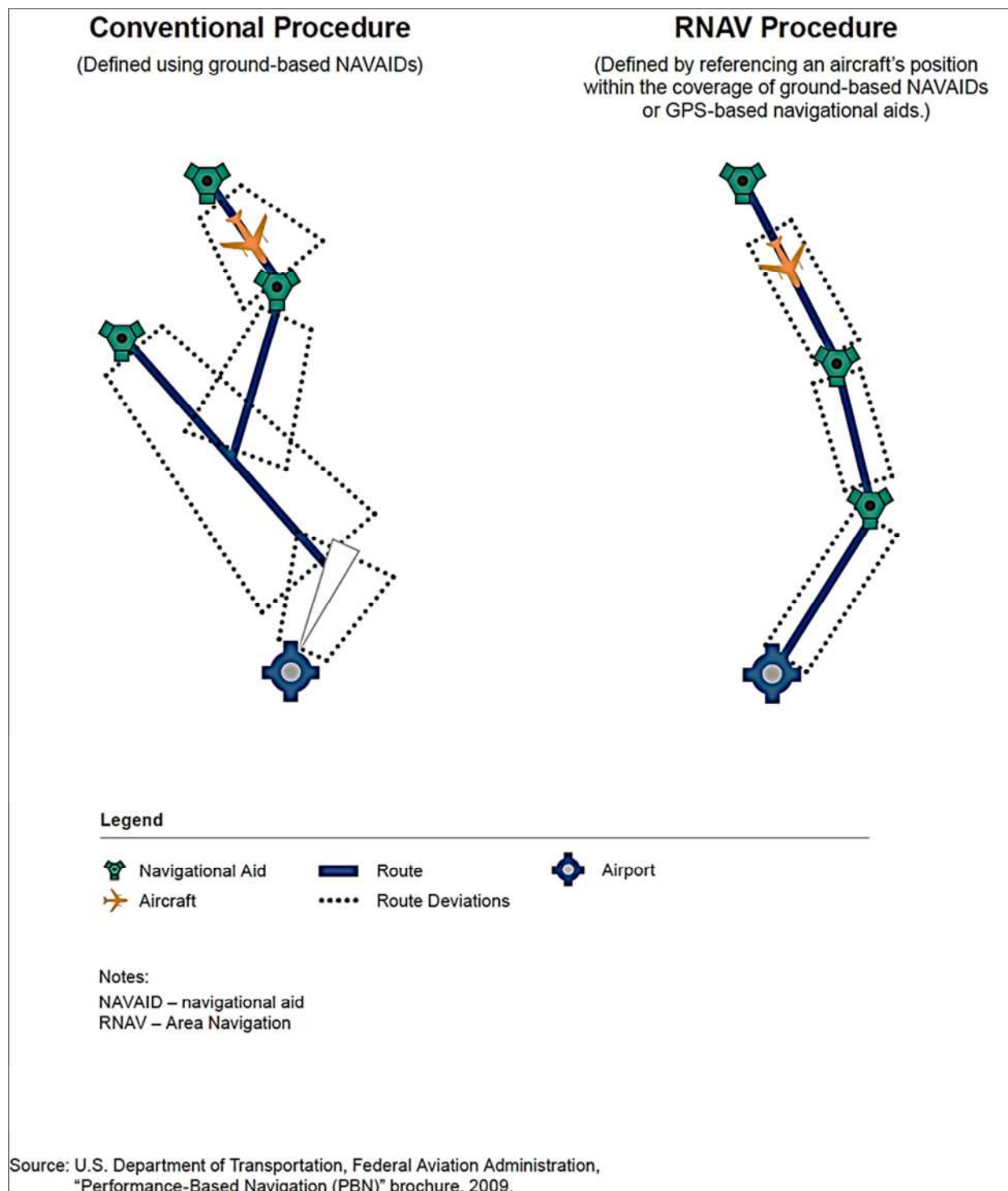


Figure D-1 Comparison of Conventional and RNAV Procedures

In certain locations where standard instrument procedures do not exist, or in congested terminal airspace, controllers must maintain safety within the airspace by using one or a

combination of management tools and coordination techniques, shown in Table D-1. Use of these tools and coordination techniques increases air traffic controller and pilot workload and can impact flight time, distance, and predictability.

Table D-1 Management Tools and Coordination Techniques

	Description	Flight Impact	Workload Impact
Hold Pattern or Ground Hold	Assigning an aircraft to a holding pattern in the air or holding an aircraft on the ground before departure	Can delay aircraft that are holding on the ground or increase flight time of aircraft holding during flight	Increases controller and pilot communication requirements
Level-off	Leveling the altitude of an aircraft during its ascent or descent	Can decrease fuel efficiency	Increases controller and pilot communication requirements
Reroute	Rerouting aircraft to manage congestion	Can increase flight time and distance, and decrease flight route predictability	Increases controller and pilot communication requirements
Speed Control	Reducing or increasing aircraft speed	Can increase flight time if speed is reduced or decrease flight plan predictability	Increases controller and pilot communication requirements
Vectoring	Issuing compass directions to modify the route of an aircraft	Can increase flight time and distance, and decrease flight route predictability	Increases controller and pilot communication requirements

As an aircraft moves from origin to destination, ATC personnel function as a team, managing the safe “flow” of aircraft and transferring control from one ATC facility to the next. Overall, managing departure flow is less complicated because aircraft can often be held on the ground to maintain aircraft separation if conflicts are anticipated. Managing arrival flow, however, tends to be more complicated because arriving aircraft are already airborne and thus require more complicated management to maintain a safe airspace environment.

D.2.1 Phases of Flight

Control of a typical commercial aircraft flight begins with a controller in an **Air Traffic Control Tower (ATCT)** issuing departure clearance instruction to the pilot. ATCTs control departing and arriving flights that are normally within a few miles of the airport as well as aircraft on the ground at the airport. ATCTs normally use visual contact to track arriving and departing aircraft and those on the ground.

Once the aircraft leaves the vicinity of the airport, a **Terminal Radar Approach Control (TRACON)** facility normally assumes responsibility for guiding the flight. Controllers in a TRACON use short-range radar to identify and track aircraft out to an approximate distance of 50 miles from the airport. Airspace assigned to a TRACON is divided into sectors⁵. A controller, or team of controllers, manages the safe, orderly and expeditious flow of air traffic within the sector. As aircraft move through the TRACON-controlled airspace, management responsibility is transferred and the aircraft is “handed off” from a controller in the previous sector to the controller in the new sector. Inside the

⁵ Sector: a portion of positively controlled airspace having defined geographic and altitude boundaries

TRACON, or “terminal,” airspace, FAA typically requires separation of three nautical miles (NM) lateral or 1,000 feet vertical between aircraft.⁶

As the aircraft moves further from the airport and climbs to higher cruising altitudes, control is passed to an **Air Route Traffic Control Center (ARTCC)**, a much larger airspace than a TRACON. Controllers in an ARTCC, or “Center”, use long-range radar to identify and track aircraft. Within ARTCC, or “en-route”, airspace, FAA typically requires a larger lateral separation of five NM.⁷ In remote areas without proximity to an ATCT or TRACON, the Center also assumes responsibilities that would be otherwise designated to airport and terminal area controllers.

As the aircraft proceeds towards its destination, control is typically transferred to succeeding Centers along the flight route and then back to a TRACON and ATCT as the aircraft approaches its destination airport. This tower to tower process is illustrated in Figure D-2.

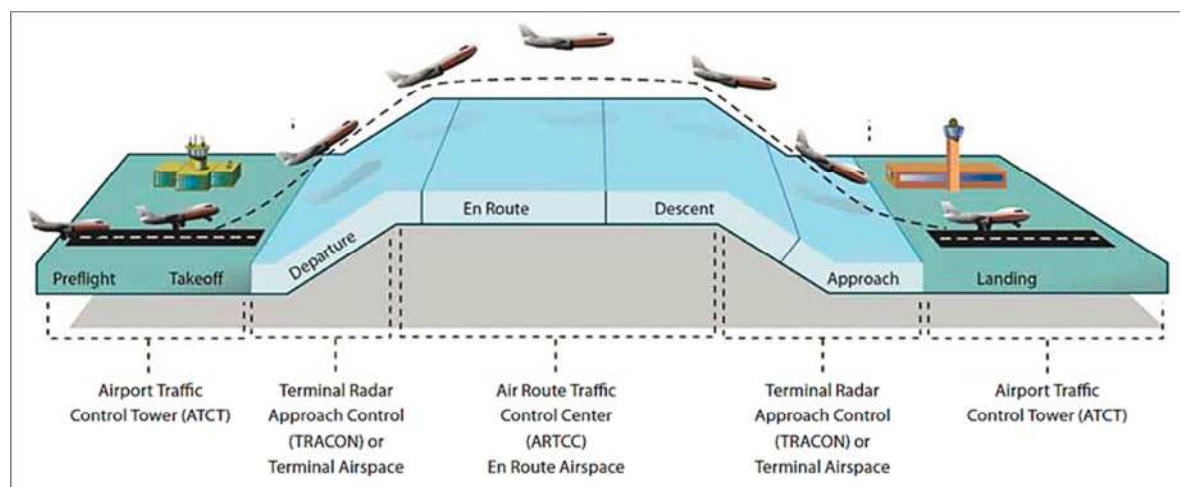


Figure D-2 Phases of Flight

D.3 Next Generation Air Transportation System

The Next Generation Air Transportation System (NextGen) is the Federal Aviation Administration’s (FAA) plan to modernize the National Airspace System (NAS) through 2025.⁸ Through NextGen, the FAA is addressing the impact of air traffic growth by increasing NAS capacity and efficiency while simultaneously improving safety, reducing environmental impacts, and increasing user access to the NAS. To achieve its NextGen goals, the FAA is implementing new Performance-Based Navigation (PBN) routes and procedures that leverage emerging technologies and aircraft navigation capabilities.

⁶ Aeronautical Information Manual, Change 1, August 3, 2006, Chapter 4.

⁷ Ibid.

⁸ FAA Fact Sheet – NextGen Goal: Performance-Based Navigation

D.3.1 Performance-Based Navigation (PBN)

PBN is a framework for defining performance requirements in “navigation specifications.” PBN framework can be applied to an air traffic route, instrument procedure, or defined airspace. PBN provides a basis for the design and implementation of automated navigation along flight paths, as well as for airspace design and obstacle clearance. The two main components of PBN framework are Area Navigation (RNAV) and Required Navigation Performance (RNP). Once the required performance level is established, the aircraft’s own capability determines whether it can safely achieve the specified performance and qualify for the operation.

Several NextGen solutions are dependent on RNAV and RNP implementation as enabling technology in the NAS, including:

- Trajectory-Based Operations (TBO)
- Closely Spaced Arrivals/Departures at High-Density Airports
- Flexible Terminals and Airports
- Optimized Profile Descent (OPD)

These advances in aircraft capabilities and air traffic system operations support the transition to performance-based operations, enabled by RNAV and RNP.⁹

D.3.1.1 Area Navigation (RNAV)

RNAV enables aircraft to fly on any desired flight path within the coverage of ground- and/or spaced-based navigation aids. Without it, aircraft have to navigate from one NAVAID to another, often flying significant distances outside of a direct path to their destination. RNAV procedures are typically used to provide terminal-area arrival procedures and instrument departure procedures.¹⁰ While RNAV paths are typically limited to straight lines, they represent an improvement over conventional, ground-based navigation in the sense that they allow an aircraft to fly a direct, straight route. RNAV is less precise than RNP, currently does not offer curved paths, and does not provide an onboard monitoring and alerting capability.

An RNAV approach is the simplest type of PBN procedure, offers precision-like landing approach procedures without the need for traditional ground radio-navigation infrastructure and also providing a back-up system for existing ground-based navigation procedures.

D.3.1.2 Required Navigation Performance (RNP)

RNP is a method of aircraft navigation that utilizes modern flight computers, GPS and innovative new procedures to precisely fly predetermined paths programmed into aircraft computers. Accurate navigation performance is ensured through the ability of

⁹ FAA Fact Sheet – NextGen Goal: Performance-Based Navigation

¹⁰ FAA Fact Sheet – NextGen Goal: Performance-Based Navigation

the aircraft's Flight Management System (FMS) to monitor the performance it achieves and inform the crew if the requirement is not met during an operation. This onboard monitoring and alerting capability enhances the pilot's situational awareness and can enable reduced obstacle clearance or closer route spacing without ATC intervention. RNP is increasingly used for airport arrival and departure procedures that reduce flight distances and reduce thrust settings, with fuel cost savings. RNP also can facilitate noise and emissions reductions, benefiting airport neighbors and the environment. The accuracy and all-weather capability of RNP creates flight safety benefits as well.¹¹

RNP – Authorization Required, the highest-performing type of PBN procedure, offers the most benefit to users by allowing for predetermined, precise, curved flight paths that reduce flight distances, conserve fuel, and preserve the environment.

D.3.1.3 Optimized Profile Descent (OPD)

The precision, accuracy and reliability of PBN flight paths (especially RNP) gives ATC the ability to sequence air traffic predictably so that an advanced arrival procedure, called an Optimized Profile Descent (OPD), can be accommodated without interrupting conventional operations. An OPD is a procedure in which the aircraft's FMS facilitates a continuous descent from the top of descent to touchdown, without level-off segments. The FMS chooses the optimum point to begin an aircraft's descent to landing and then selects the lowest possible thrust setting (often flight idle) to keep the aircraft on a desired descent profile, adjusting for wind, temperature, and other flight variables throughout the descent. This reduces CO₂ emissions and fuel burn.

D.4 Efficiency of the National Airspace System

As indicated in Section 2, the use of air traffic management tools, such as vectoring and holding, can impact flight time and distance, resulting in delay and reduced efficiency in the NAS. Efficiency is gauged using various metrics that assess the productive use of ATC resources in comparison to system capacity – defined as the “throughput” of operations using a specific resource, like a runway or a section of airspace, over time.

A runway can accommodate a defined number of aircraft operations, which is considered the capacity of the runway.¹² One measure of runway capacity is *runway throughput*, which is the expected number of operations (arrivals and/or departures) that a runway can accommodate in one hour while maintaining safe operating standards. The combined capacity of multiple runways at an airport can be defined by *airfield throughput*. Airfield throughput factors in the operating dependencies between multiple runways to maintain safe operating standards.

At an airport served by more than one runway, runway operating configurations are established to define optimal combinations of two or more runway ends to accommodate arriving and departing aircraft under differing conditions, such as

¹¹ FAA Fact Sheet – NextGen Goal: Performance-Based Navigation

¹² An aircraft “operation” is defined by the FAA as one takeoff or one landing by an aircraft.

weather, prevailing winds, traffic type (i.e., predominately arrivals or departures), and amount of traffic. Although a runway has two “ends,” typically only one end of a runway would accommodate departing and/or arriving aircraft, ensuring that all aircraft using that runway are operating in the same direction, or “flow”. Furthermore, to ensure safe operating standards, the use of one runway end for an operation may be dependent on how another runway end is being used. It is possible for ATC to change the runway operating configuration throughout the day to adjust to changing weather, wind, and traffic conditions. Therefore, both the *runway throughput* as well as the *airfield throughput* can vary as the runway operating configuration varies.

Similar to a runway or an airfield, an area of airspace managed by an ATC facility has a defined capacity, which can be measured in terms of *airspace throughput* – the number of aircraft that can operate through the airspace in a safe manner, based on route design and management structure. Airspace throughput can quantify how efficiently the airspace is operating.

In addition to runway/airfield and airspace throughput, *sustained throughput* refers to the greatest number of aircraft operations per hour that can be accommodated for successive hours without eventually resulting in delays. During some hours, the runways or airspace can accommodate more operations than what is considered to be sustainable. Put differently, a higher level of operations that may be accommodated during some hours may not be sustainable during every hour of the day.

If the sustained throughput of one component of the NAS is not in balance with another, a component with a lower throughput could limit overall system capacity. For instance, if terminal airspace throughput is not equivalent to or greater than that of the runway, the terminal airspace would be considered a limitation on the ability to fully utilize the runway capacity. When persistent inefficiencies occur, redesign of the various ATC components may be necessary, in order to sustain or improve throughput levels of NAS resources.