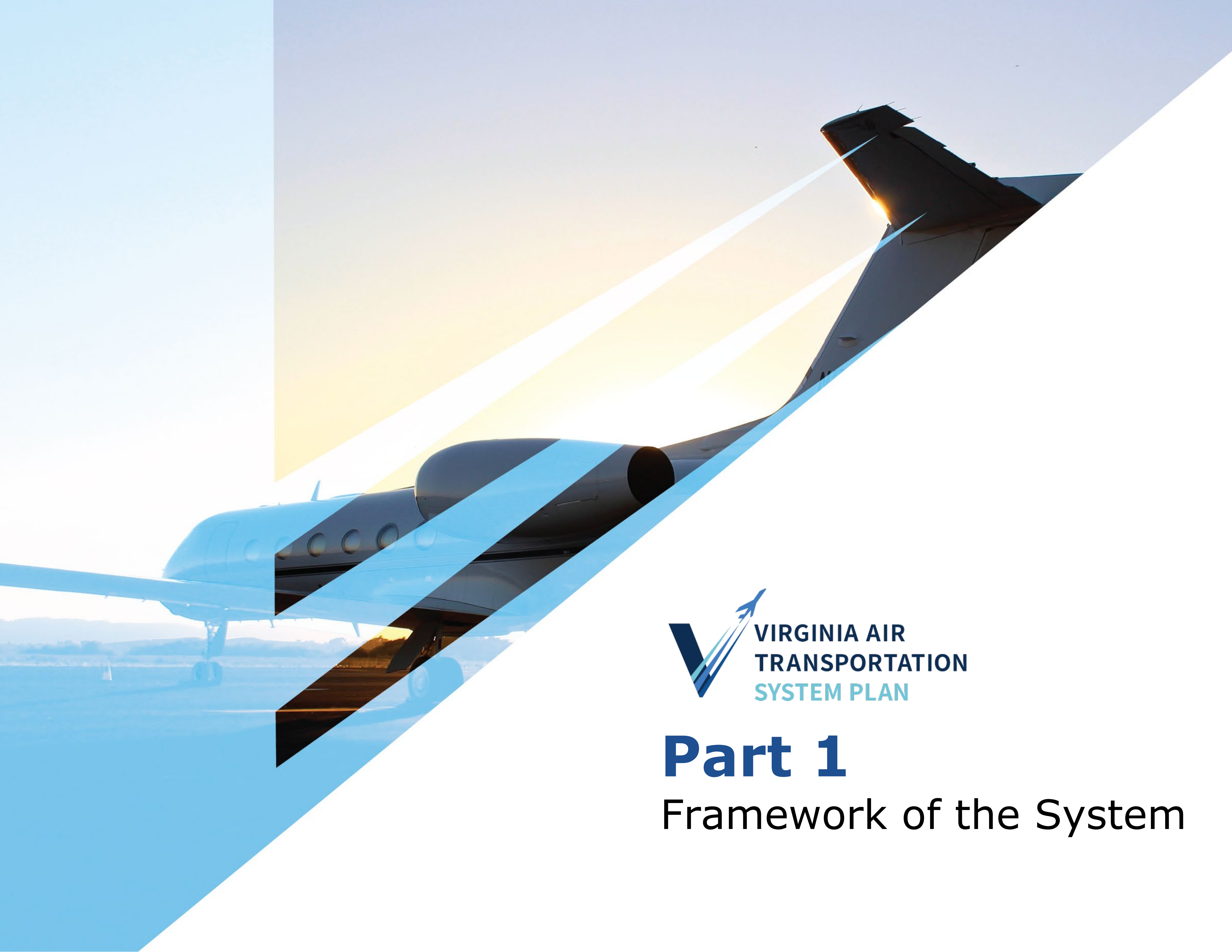

VIRGINIA AIR TRANSPORTATION SYSTEM PLAN

Part 1
Framework of the System

The preparation of this document was financed in part through a planning grant from the Federal Aviation Administration (FAA) as provided under Section 505 of the Airport and Airway Improvement Act as amended. The contents of this document do not necessarily reflect the official views of the FAA. Acceptance of this report by the FAA does not in any way constitute a commitment on the part of the United States to participate in any development depicted therein, nor does it indicate that the proposed development is environmentally acceptable in accordance with applicable public laws.

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Technical Report Summary

Virginia is served by a robust system of sixty-six (66) public-use airports, relied on by businesses, residents, and visitors every day. This Virginia Air Transportation System Plan (VATSP) is an update of the previous system plan, published in 2016. The purpose of the VATSP is to develop a modern system plan that will serve as a blueprint for airport development in the Commonwealth for the next 20 years. This update considers existing system data and evaluates changes since the publication of the 2016 VATSP.

This system plan explores the role and value of Virginia's airports in providing access for all users to the larger air transportation network. Additionally, this plan serves as a resource for federal, state, and local stakeholders to maintain and develop the system for continued use.

In order to effectively present the findings of this update, the technical report is divided into three parts (shown below), with the first part outlining the framework of the system, the second providing the analysis, and the third summarizing the recommendations and findings.

Part 1 – Framework of the System

- Chapter 1: Introduction – Virginia Aviation System
- Chapter 2: Purpose of the VATSP
- Chapter 3: Airport Roles
- Chapter 4: Issues Affecting Virginia Airports

Part 2 – System Analysis

- Chapter 5: Activity Forecasts
- Chapter 6: Inventory
- Chapter 7: Alternatives Analysis

Part 3 – Recommendations and Findings

- Chapter 8: Recommended Aviation System
- Chapter 9: Costs and Funding
- Chapter 10: Implementation Plan

Source: DOAV.

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Chapter 1: Introduction – Virginia Aviation System

A state aviation system plan has many objectives that can vary depending upon the interests and desires of the state entity who is conducting the study. The ultimate intent is to examine the system of public-use airports. For the Commonwealth of Virginia, the objective of this document is to provide an update of the previous Virginia Air Transportation System Plan (VATSP), which was completed in 2016. This Plan applies current system data and reviews and evaluates the system for changes since the previous VATSP's publication. A thorough evaluation of system developments and the implementation of the recommendations from the previous plan are included in this effort.

This chapter provides background information on system planning as well as components that guided and led to the development of this VATSP. These are summarized in the following sections:

- Overview of System Planning
- Virginia Aviation System History
- VATSP Public Engagement
- Comparative Analysis

Overview of System Planning

A state aviation system plan is a high-level assessment of the airports that comprise a state aviation system. This assessment is typically tailored to the needs of the study sponsor, but usually includes an evaluation of the performance of the aviation system, future system needs, and the needs of the system airports to properly serve their aviation users. Performance evaluations often consist of measuring the levels of service that the aviation system provides residents and businesses of the state. Individual airports are usually assessed for the adequacy of their facilities, such as runway width and length, passenger terminal, or supporting infrastructure.

Source: DOAV.

The purpose of system planning is to facilitate coordination between local, state, and federal agencies in maintaining and promoting a safe and efficient national aviation system. The development and maintenance of Virginia's aviation system is a collaborative effort between multiple entities and is led by the Virginia Department of Aviation (DOAV). DOAV uses the VATSP to cultivate an advanced aviation system that is safe, secure, and provides for economic development while also promoting aviation awareness and education.

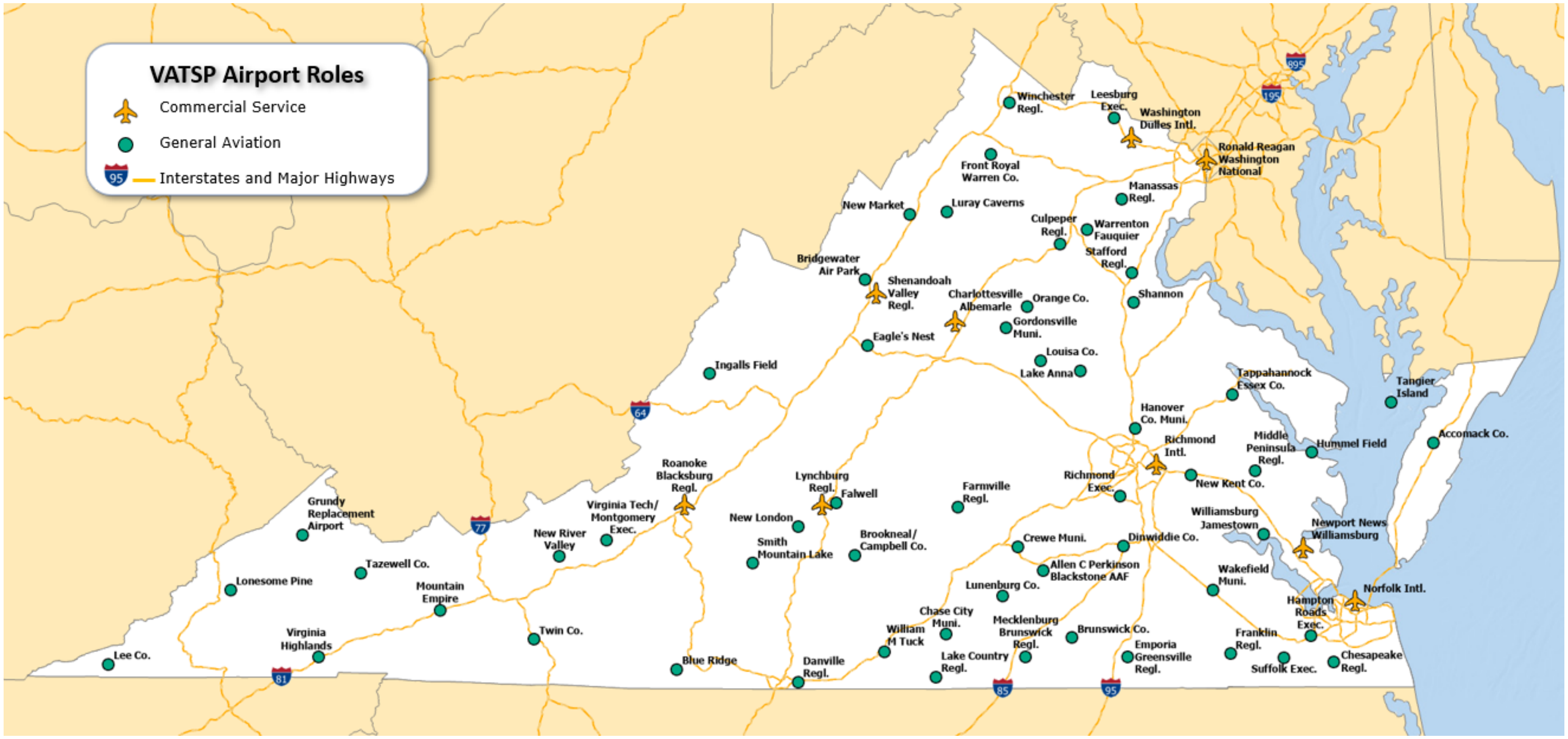
At the federal level, system plans are required by the Federal Aviation Administration (FAA) and must be evaluated periodically to receive funding through the Airport Improvement Program (AIP) for airports that are a part of the National Plan of Integrated Airport Systems (NPIAS). The FAA provides guidance to the states through the FAA Advisory Circular (AC) 150/5070-7 *The Airport System Planning Process* on how to conduct system plan evaluations or studies. This AC addresses core components of a system plan but also allows for customization by states based on individual needs.

At the state level, the VATSP provides guidance to DOAV for distribution of state funding to support individual airport development and growth.

At the local level, the VATSP targets stakeholders such as airport boards and authorities, municipalities, fixed-base operators, and members of the public who reference the Plan for guidance to achieve system goals and objectives. The VATSP also provides airport-specific operational forecasts and recommendations that help airport sponsors plan for improvements to meet user needs.

Virginia Aviation System History

Virginians strive to be the best and take pride in everything the state has to offer, so it comes as no surprise that the Commonwealth maintains one of the nation's most comprehensive and advanced statewide aviation systems. DOAV has a long history of aviation system planning, reaching back to the 1940s. DOAV is one of the most dedicated and consistent states in the U.S. when it comes to updating their aviation system plan, with the last update taking place in 2016. The VATSP examines the 66 public-use airports in the Virginia aviation system, which are displayed in **Figure 1-1**.



Source: Cignus, LLC.

Figure 1-1: Virginia Aviation System

VATSP Public Engagement

As a part of the project development, progress was shared with various stakeholders at key points and their resulting feedback was incorporated into the final technical report and executive summary. Each component of this engagement was critical to guiding and shaping the VATSP. These stakeholders and the varying roles they played are summarized in the following sections.

Virginia Aviation Board (VAB)

The VAB plays a critical role in the Virginia aviation system, with many responsibilities that impact its overall success. Because of this, DOAV knew that their involvement throughout the process was imperative.

Project updates were presented at VAB meetings throughout the VATSP's development. The VAB membership was solicited for comments and suggestions during each of these presentations. Feedback that would strengthen the final results was encouraged.

Responsibilities of the VAB

- Establishes financial assistance programs
- Allocates funds for capital improvement projects
- Sets policies to guide the funding programs and to promote and develop safe aviation practices and operations
- Hears airport sponsor and citizen concerns on matters pertaining to aviation and acts as a liaison to DOAV

Complete duties and responsibilities of the VAB can be found in *Code of Virginia* §5.1-2.1 et seq.

Virginia Airport Operator's Council (VAOC) Conferences

Presentations were made at two VAOC Conferences as well as one of the VAOC Spring Workshops. The goal of these presentations was to inform members of the Plan's progress, to initiate conversations with attendees about the Commonwealth's system as a whole, and to discuss what they hoped to gain from the Plan's results.

Study Advisory Group (SAG)

DOAV worked with the president of the VAOC to select members of a SAG, whose goal was to serve in an advisory capacity at key milestones throughout the project. These members included DOAV representatives, VAB members, and airport managers from air carrier and general aviation airports in Virginia. Six meetings were held throughout the process, at which the SAG members offered comments and improvements on the VATSP's development.

Study Advisory Group Members

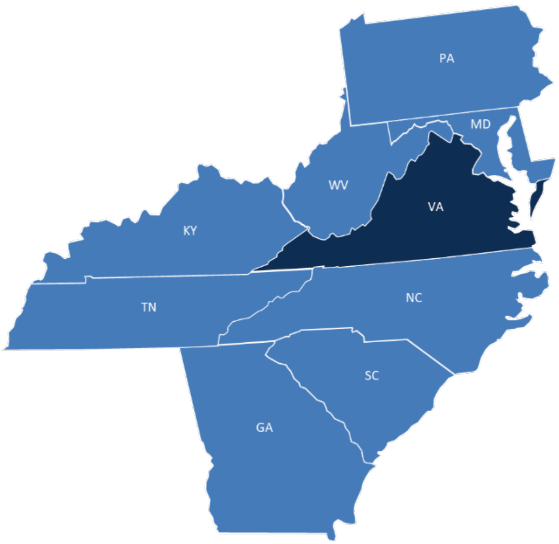
- **DOAV**
  - Greg Campbell
  - Rusty Harrington
- **VAB Members**
  - Dak Hardwick
  - Vicki Cox
- **Air Carrier Airports**
  - Charles Braden (ORF)
  - Perry Miller (RIC)
  - Andrew Ndolo (MWAA)
- **GA Airports**
  - Jason Davis (MTV)
  - Scott Coffman (JYO)
  - Keith Holt (BCB)
  - Debbie Kendall (GVE)
  - Chris Schrantz (CPK)
  - Donnie Rose (LNP)

VATSP Photo Contest

In order to showcase Virginia's aviation system, a photo contest was held encouraging members of the public to submit photos of Virginia's airports, aviation facilities, aircraft, and users. The number of photos submitted was vast, and many have been included in this report.

Comparative Analysis

As a part of a key task to kick off the VATSP, a comparison was conducted that evaluated peer State agencies and their most recent airport system plans. The peer group was comprised of Virginia's border states: Maryland, Pennsylvania, West Virginia,[1] Kentucky, Tennessee, and North Carolina, as well as, South Carolina, and Georgia.



The overall goal in the comparative analysis was to understand how each state agency utilizes their airport system plan and to identify new practices, approaches, perspectives, and innovative efforts being applied in the ongoing, daily stewardship of planning for and supporting an aviation system. Additional goals for the comparative analysis included evaluating Virginia's position compared to its peers and enhancing DOAV's effectiveness to support its aviation system. In addition to assessing the airport system planning effort, other aviation-related elements were evaluated and discussed with each state agency. Over approximately two weeks, interviews were conducted with the head of each peer state's aviation/aeronautics agency along with key planning staff, to discuss the following elements:

- The most recent system plan
  - Goals and objectives
  - Performance measures
  - Airport classifications
  - System gaps including deficiencies and funding
- Funding levels and trends
- Economic development
- Aviation policy
- Recovery from COVID-19

The text in **Appendix A** describes in detail the overall findings from the effort. Each state agency discussion provided information that served as key input to DOAV's system planning effort and its overall approach to implementing airport project funding.

While the review and interview process provided many considerations, there are six key takeaways that provide an overview on best practices in peer states and provided guidance to DOAV on next steps. These key takeaways are summarized to the right.

One overriding observation is that state agencies have little direct control over the aviation system, except for states that own and operate an airport. DOAV does not own any of the airports in the state, which is a constraint on policy, funding, and decision making. However, state agencies serve a vital role in guiding, influencing, and funding their airport facilities' infrastructure growth and development. The eight peer state agencies are strong partners to both the airports within their system and the FAA.

Key Takeaways

- All states have goals. Those states who link them to performance metrics and airport classifications should be examined more closely for effectiveness in achieving an integrated system.
- All of the peer states had performance measures (PMs) that measured accessibility, but only four had a full set of PMs that actually provided a foundation that could guide the state's management of its airport system.
- All states recognized the importance of meaningful airport classifications, but only a few states used classifications to guide an airport's development.
- While Virginia could seek more funding sources, the stability of Virginia's funding sources allows for a predictable partner for airports and the FAA.
- There was no discernible advantage or disadvantage to being a block grant state.
- Some states understand and encourage the link between aviation and economic development. These states should be studied for return on investment.

[1] West Virginia has not completed a State Aviation System Plan.

Chapter 2: Purpose of the VATSP

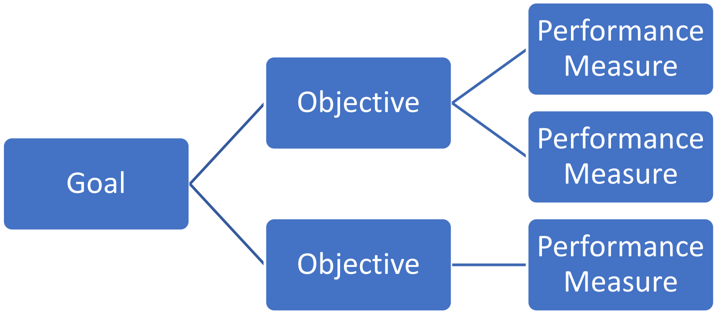
It is important at the onset of the planning process to define the overarching purpose of the Plan and design it to accomplish this purpose. This chapter defines the Virginia Air Transportation System Plan's (VATSP) purpose and explains how the Virginia Department of Aviation (DOAV) developed goals, objectives, and performance measures to ensure that it was achieved. Specifics on the importance and development of goals, objectives, and performance measures, as well as the resulting targets, are included in the following sections:

- Development of Goals, Objectives, and Performance Measures
- Goal 1: Assist DOAV in developing and maintaining a safe aviation system
- Goal 2: Provide DOAV with a blueprint for airport development based on the airport's role
- Goal 3: Assist DOAV in developing an accessible aviation system
- Goal 4: Assist DOAV in leveraging the economic development from system airports
- Goal 5: Assist DOAV in its continued use of technology to support the aviation system
- Goal 6: Promote environmental stewardship and sustainability in the aviation system

Development of Goals, Objectives, and Performance Measures

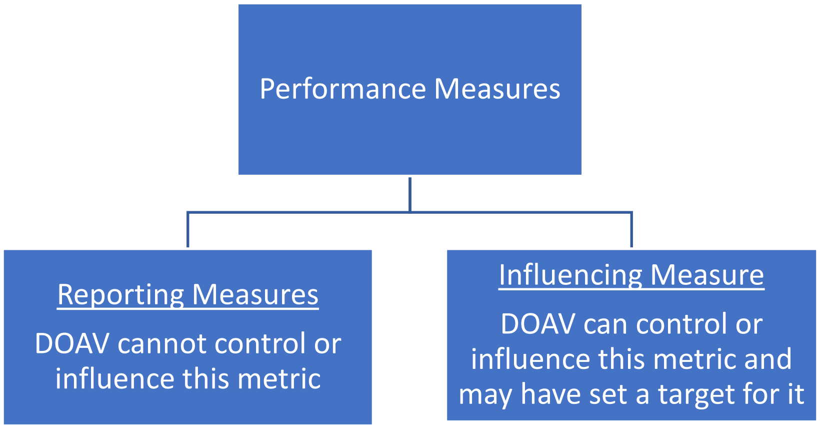
As previously stated, the purpose of the VATSP is to develop a modern system plan that will serve as a blueprint for airport development in the Commonwealth for the next 20 years. To accomplish this, DOAV aimed to develop a set of goals, objectives, and performance measures that guided certain elements of the system plan. This process began by clearly defining the meaning and intent of the terms goals, objectives, and performance measures.

- Goals – These are broad targets or aims that DOAV wanted the system plan to achieve. An example could be that a goal of the VATSP is to evaluate the safety of the Virginia aviation system.
- Objectives – Objectives are more detailed and quantifiable than goals. They define specific areas where progress is desired to achieve the goal and may include timeframes for accomplishment of objectives. Because goals tend to be broad in nature, multiple objectives are sometimes needed to support the achievement of each goal. An example of an objective that could partially address the goal of evaluating the safety of the Virginia aviation system could be achieving Runway Safety Area (RSA) compliance at Virginia's system airports within the next five years.
- Performance Measures – Performance measures (PM) quantitatively assess a particular objective. Each objective needs one or more PMs that are used to determine if the objective has been achieved or not. These PMs can evaluate specific aspects of each airport, or the collective performance of the aviation system, depending upon the objective. Continuing our example, the PM for the objective of evaluating the RSAs of Virginia's airports could assess the adequacy of each airport's RSA dimensions and tabulate which airports do or do not meet the Federal Aviation Administration (FAA) RSA design standard. For the system, a PM reporting the percentage of system airports meeting their FAA design standard could be tracked by DOAV.



Source: Mead & Hunt, Inc.

An important aspect of PMs is detailed in Airport Cooperative Research Program (ACRP) Research Report 223, *Performance Measures for State Aviation Agencies*. In brief, PMs are categorized as one of two types – reporting and influencing. A reporting measure is one that DOAV cannot control or influence, while an influencing measure is one that DOAV does exercise control over its outcome.



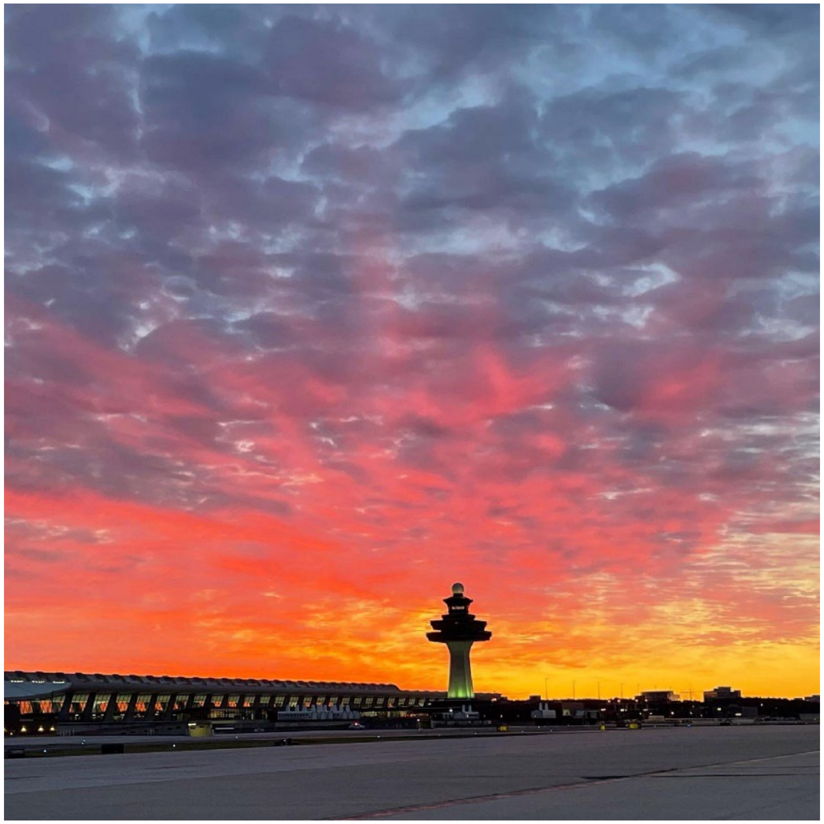
Source: Mead & Hunt, ACRP Report 223.

Returning to the RSA example previously used, the percentage of system airports that meet their FAA design standard would be an influencing measure, since DOAV has the ability to fund RSA improvement projects at airports. An example of a reporting measure would be the number of aircraft accidents in Virginia, since DOAV has no direct control over aircraft accidents.

Simply measuring performance without knowing what is or is not acceptable performance is not useful. To properly evaluate certain objectives and PMs, there needs to be a target against which the actual measurement can be compared. If the PM surpasses this target, then the associated objective is met.

Establishing a target for a PM should be based on the goals of DOAV. It can be as simple as translating desired compliance into a corresponding target. For example, a PM may be established that says 100 percent of system airports will have a current airport layout plan (ALP) on file. If 50 out of Virginia's 66 system airports have a current ALP on file, DOAV could report having 75.8 percent compliance with this goal. This would be the report for the PM across the whole system.

The target can be further refined to account for different types of airports within the system. If the 16 airports in the example above do not have a current ALP because they are privately owned, general aviation airports that have no obligation to maintain an ALP, then the target can be refined to state that of those system airports obligated to maintain an ALP, 100 percent are required to have a current ALP on file. This would then allow the PM to be shown as 100 percent since the 50 required airports comply.



Source: Kristen Long.

For other PMs, the choice of a target can be more complex. For example, DOAV has various options for establishing one or more targets for tracking instrument approach procedures (IAP). The simplest option is to set a target for the total number of IAPs in the state. Setting a target for total number of IAPs can be appropriate if DOAV has a goal of rightsizing the facilities under its jurisdiction, as the target may be below or above the existing number of IAPs.

If DOAV establishes a goal of improving access to its airports, a possible means of accomplishing this is setting a target for the average number of IAPs per airport that is higher than the current measure, knowing that raising this average will improve the ability to use airports during periods of poor weather.

These considerations were important when contemplating the appropriate goals, objectives, and PMs for the VATSP. In general, DOAV was looking for PMs that it can influence, since the feedback from such PMs can help DOAV improve the job it is doing. There are three questions that were kept in mind when developing the goals, objectives, and PMs for the VATSP:

- How does this help DOAV do its job?
- Is this something DOAV can influence?
- If DOAV cannot influence it, is it information that DOAV needs?

The following goals, objectives, and PMs for the VATSP were developed using the preceding definitions and concepts.

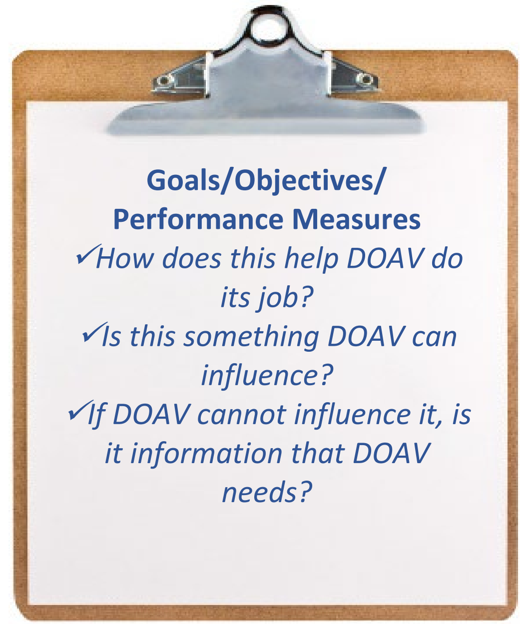
The process of developing the four goals for the VATSP started with the mission of the DOAV:

- Develop, promote, and advance aviation in Virginia for the benefit of all; and
- Partner with airports to improve airport facilities, provide safe air transportation, cultivate new technologies, inspire the next generation, and foster economic development in the Commonwealth.

After evaluating DOAV's mission and how it relates to the VATSP's purpose, the following higher-level targets were established as a starting point:

- Develop an airport classification system that guides airport development over the next 20 years;
- Estimate the costs of recommended system level capital improvement projects for Virginia's airports;
- Assist DOAV in developing guidance for airport funding priorities;
- Evaluate the Navigational Aids (NAVAIDs) in Virginia, and their anticipated maintenance and replacement cost;
- Review technology trends, such as Uncrewed Aerial Vehicles (UAV)/Urban Air Mobility (UAM) and remote air traffic control towers and evaluate how they might impact Virginia's airports; and
- Produce materials for communicating the value, importance, and needs of Virginia's system airports.

The development of goals, objectives, and PMs was a continuous process with input from numerous sources. A review of the 2016 VATSP provided an initial framework for discussion of goals for the VATSP.



Source: Mead & Hunt, Inc.

DOAV conducted a review of the aviation system plans of peer states to get ideas of the goals, objectives, and PMs used by other states. The findings from that review, summarized in **Chapter 1**, were considerations in the formulation of the goals, objectives, and PMs for the VATSP.

Through discussions with DOAV staff, the goals and objectives were further refined before sharing them with the Study Advisory Group, who provided valuable input that further revised the goals for the project. Throughout the Plan's development the goals, objectives, and PMs underwent review and revision, to reflect the emerging findings of the Plan.

This continuous process produced the following goals, objectives, and PMs.

Goal 1: Assist DOAV in developing and maintaining a safe aviation system

One element of DOAV's mission is to provide safe air transportation, so DOAV wanted to ensure that safety be incorporated into the goals of the VATSP. After evaluating the components that ensure a safe aviation system, including adherence to FAA standards, state licensing standards, and the DOAV Airport Program Manual, the following objectives and PMs were developed.

Objective 1.1 Assess system airports for adherence to FAA standards on critical safety areas.

Measure the percentage of system airports:

- *that adhere to FAA runway safety area (RSA) standards on primary runways.*
- *that control their runway protection zones (RPZ) on the primary runway.*
- *that control their object free areas (OFA) on their primary runway.*
- *with second runways that have justification (capacity or crosswind need) for that runway.*

Objective 1.2 Assess system airports for minimum facilities as defined by Virginia State Airport Licensing Standards.

Measure the percentage of system airports that meet the following minimum requirements for a standard airport license:

- an effective runway length of at least 2,000 feet for each direction of operation.
- minimum runway width of 50 feet.
- minimum runway safety area length equal to the length of the runway plus 100 feet at each end of the runway.
- minimum runway safety area width of 120 feet centered on the runway centerline.
- minimum unobstructed approach surface of 15:1 horizontal to vertical slope at each end of the runway.
- approach surface that is centered along the runway centerline and that begins at the threshold at a width of 250 feet; expands uniformly for a distance of 2,250 feet to a width of 700 feet; and continues at the width of 700 feet for a distance of 2,750 feet.
- minimum unobstructed runway object free area length equal to the length of the runway.
- minimum unobstructed runway object free area width of 250 feet centered on the runway centerline.
- displaced threshold, if an approach surface to either physical end of the runway is obstructed, and the obstacle cannot be removed, that shall be located down the runway at the point where the obstruction clearance plane intersects the runway centerline.

Source: Heather Ream.

Measure the percentage of system airports that meet the following minimum requirements for a standard Day/Visual Flight Rules (VFR) airport license:

- an effective runway length of at least 2,000 feet for each direction of operation.
- minimum runway width of 50 feet.
- minimum runway safety area length equal to the length of the runway plus 100 feet at each end of the runway.
- minimum runway safety area width of 120 feet centered on the runway centerline.
- minimum unobstructed approach surface of 15:1 horizontal to vertical slope at each end of the runway.
- approach surface that is centered along the runway centerline and that begins at the threshold at a width of 120 feet; expands uniformly for a distance of 500 feet to a width of 300 feet; and continues at the width of 300 feet for a distance of 2,500 feet.

Objective 1.3 Assess system airports for minimum facilities as defined by Basic Airport Unit measures in the DOAV Airport Program Manual.

Measure the percentage of system airports that have the following Basic Airport Unit elements:

- runway
- airport lighting system
- visual navigational aids
- stub taxiway
- aircraft parking apron
- terminal facility
- automobile parking
- airport access road
- fuel facility
- a terminal that provides adequate shelter from inclement weather, electric lighting, accessible public phone, and restroom facilities

Source: DOAV.

Goal 2: Provide DOAV with a blueprint for airport development based on the airport's role

A major component of a system plan, which will be covered in greater detail in **Chapter 3,** is the development and assignment of airport roles. These roles are used to classify airports based on how they contribute to the aviation system, and DOAV wanted a way to guide future development based on these assigned roles.

Objective 2.1 Assess the facilities, equipment, and services at each system airport based on assigned airport role.

Measure the percentage of system airports that have the following adequate facilities, equipment, and services as determined by that airport's role:

- runway length
- runway strength
- taxiway system, classified as "Stub," "Partial parallel," and "Full parallel" where Full parallel is any taxiway that provides access to both runway ends without the need for back taxi
- primary runway instrumentation (instrument approach type, approach lighting system, visual glide slope instruments, and runway lighting)
- automated weather reporting
- visual guidance (rotating beacon, windcone, segmented circle)
- terminal facilities
- fueling systems
- snow removal equipment
- pavement maintenance
- airport parking (non-revenue producing or affiliated)
- utilities (electric, water, sewer, internet)
- hangar space
- airport parking (revenue producing or exclusive)
- snow removal service
- fuel delivery (hours of availability, self-service, single-point fueling, over-wing fueling, credit card reader, call-out service)
- ground transportation available

Objective 2.2 Evaluate each system airport's runway parameters.

Assess the primary runway length at each system airport based on airport role.

Assess the primary runway width at each system airport based on airport role.

Source: DOAV.

Goal 3: Assist DOAV in developing an accessible aviation system

For an aviation system to be sustainable, it is critical that access is obtainable and feasible for as much of the population as possible. For this reason, developing an accessible aviation system was high on DOAV's list of priorities. This goal incorporates measures that look at not only airport coverage across the Commonwealth, but access to various services provided by the system as well.

Objective 3.1 Assess the coverage of Virginia system airports based on GIS drive-time analysis.

Measure the percentage of Virginia's population within a

- *45-minute drive time of any commercial service system airport, or neighboring state commercial service airports.*
- *30-minute drive time of any system airport.*
- *30-minute drive time of each category of airport role.*

Objective 3.2 Assess the coverage of services provided by Virginia system airports based on GIS drive-time analysis.

Measure the percentage of Virginia's population within a 30-minute drive time of any system airport that:

- *provides any fuel.*
- *provides jet fuel.*
- *has based flight training.*
- *has a 4,000-foot or longer runway.*
- *has a 5,000-foot or longer runway.*
- *has a 5,500-foot or longer runway.*
- *has a 6,000-foot or longer runway.*
- *has an instrument approach.*
- *has an instrument approach with vertical guidance.*
- *has on-site weather reporting.*
- *has an air traffic control tower.*
- *has a based air ambulance operator.*
- *can serve an air ambulance operator (4,500-foot runway, approach with vertical guidance, 24-hour jet fuel, and on-site weather reporting).*
- *serves business aircraft needs (5,500-foot runway, approach with vertical guidance, and on-site weather reporting).*

Source: DOAV.

Goal 4: Assist DOAV in leveraging the economic development from system airports

DOAV is focused on how airports can support economic development across the Commonwealth and felt that there were two key objectives when measuring this: through the facilitation of economic development efforts through system airports, and by tracking how well engaged each airport is in their local community.

Objective 4.1 Facilitate economic development efforts through system airports.

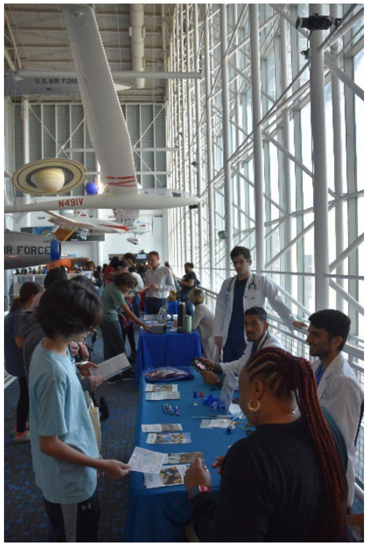
Measure the percentage of airports that:

- *show economic development areas on their ALP.*
- *are aware of development areas in their region.*
- *have site ready locations on their property.*

Objective 4.2 Evaluate the community engagement of system airports.

Measure the percentage of airports that:

- *have staff volunteering/serving with tourism boards or the Chamber of Commerce.*
- *have an internship or job shadowing program.*
- *communicate periodically with local officials or economic development representatives.*
- *host Chamber of Commerce, economic development, or other officials for Airport Days or similar events.*
- *host air shows, flights for veterans, career days, or similar events.*



Source: DOAV.

Goal 5: Assist DOAV in its continued use of technology to support the aviation system

The advancement of technology is not slowing down, and DOAV wanted measures that would assist in developing their system to include these advancing technologies, with specific focus on uncrewed air mobility and advanced air mobility.

Objective 5.1 Guide the development of the aviation system to facilitate the development of UAM/advanced air mobility (AAM).

Measure the population coverage provided by proposed AAM operations.

Measure the percentage of airports that:

- *anticipate electric vertical takeoff and landing (eVTOL) operations taking place on their airport during the planning period.*
- *are making plans for electric aircraft operations at their airport during the planning period.*
- *track aircraft operations and the method used.*

Goal 6: Promote environmental stewardship and sustainability in the aviation system

A growing concern across the aviation industry is the environmental impact that airports have, and how these facilities and users can encourage sustainability. DOAV felt that this was a critical topic and developed measures that track and encourage more sustainable and environmentally friendly practices at airports across the state.

Objective 6.1 Encourage the use of best environmental practices at system airports.

Measure the percentage of airports that use LED lighting for:

- *runway lighting.*
- *taxiway lighting.*
- *apron lighting.*
- *auto parking lighting.*
- *terminal lighting.*

Measure the percentage of airports that:

- *make use of native plants for landscaping.*
- *make use of water recycling.*
- *are recycling construction materials.*

Objective 6.2 Encourage the use of best sustainable practices at system airports.

Measure the percentage of airports that:

- *have solar farms.*
- *use geothermal energy.*
- *already have or are making provisions for electric charging stations for automobiles at their airport.*
- *already have or are making provisions for electric charging stations for aircraft at their airport.*

Source: DOAV.

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Chapter 3: Airport Roles

Airports serve many roles, and there are many means of classifying the roles played by airports. This chapter examines the different systems used to classify Virginia's airports and explains the reasons behind the Virginia Department of Aviation's (DOAV) decision to revise its airport role classification method for use in the Virginia Air Transportation System Plan (VATSP). It also describes the classification method DOAV selected for the VATSP and the resulting roles for each system airport.

Before laying out the process of assigning Virginia's system airports to their respective roles and process results, it is useful to examine how these airports are classified in various other system plans. There are two national system classifications that this chapter will examine to provide context. Both are found in the Federal Aviation Administration's (FAA) National Plan of Integrated Airport Systems (NPIAS). Each one is detailed below in terms of how it stratifies airports into groups, the purpose behind that stratification, and how Virginia's airports fit into those two systems of classification. This chapter covers the following sections, which showcase the reasoning, development, and resulting roles for Virginia's airports:

- NPIAS
- Virginia Airport Roles
- Facility, Equipment, and Service Targets
- Minimum Facilities of the VATSP

Virginia's NPIAS Airports

Virginia's system airports include 47 airports that are part of the NPIAS, with the Grundy Replacement Airport under consideration as a new addition to the NPIAS.

National Plan of Integrated Airport Systems

The NPIAS is the FAA's nationwide airport system plan. It is updated and sent to Congress every two years with the intent of identifying airports that are significant to the national air transportation system. The most recent NPIAS at the time of this system analysis, the *National Plan of Integrated Airport Systems (NPIAS) 2023–2027*, was published on September 30, 2022, and includes 3,287 existing and eight proposed airports that are eligible for federal funding through the FAA's Airport Improvement Program (AIP).

In order to be included in the NPIAS, existing general aviation airports must meet a number of criteria. In general, an airport must:

- Be operated by a sponsor eligible to receive federal funds and meet obligations.
- Be used by 10 or more operational and airworthy aircraft based on the airport. The aircraft tail numbers must be provided and validated against the FAA Aircraft Registry.
- Be located at least 30 miles from the nearest NPIAS airport. The 30-mile calculation must consider all existing NPIAS airports within a 30-mile radius, even if it is in an adjacent state.
- Be demonstrating an identifiable role in the national system (such as a basic, local, regional, or national).
- Be included in a state or territory aviation system plan with a role similar to the federal role and recommended by the airport's state or territory aviation authority to be a part of the NPIAS.
- Have a review by the FAA that finds no significant airfield design standard deficiencies, compliance violations, or wetland or wildlife issues.

Virginia's system of airports consists of 66 public-use airports, of which 47 are included in the NPIAS. Future chapters will analyze whether these NPIAS airports adequately serve the needs of Virginia. Included in Virginia's aviation system is a replacement airport for Grundy Municipal Airport that closed temporarily in October 2019. DOAV is working toward reopening Grundy's airport with enhanced facilities. This enhanced airport is referred to as the Grundy Replacement Airport in this report. DOAV has included the Grundy Replacement Airport in the Virginia system since this is one of the criteria for considering the airport for inclusion in the NPIAS. The classification of these 47 airports in the NPIAS provide some insight as to the composition of the Virginia aviation system.

The NPIAS classifies airports using two systems, one aimed at airports with commercial airline service and the other aimed at general aviation airports. The NPIAS refers to the first as an airport's category, and the second as the airport's role. These two classification systems and how they apply to Virginia's airports are explained in more detail in the following sections.

NPIAS Airport Categories

The NPIAS recognizes four categories of airports. They are:

- **Primary** – Any commercial service airport that enplanes more than 10,000 passengers annually.
- **Commercial Service** – Any publicly owned airport that has scheduled passenger service and at least 2,500 annual enplanements.
- **Reliever** – An airport designated by the Secretary of Transportation as relieving congestion at a commercial service airport and to provide more general aviation access to the overall community. As stated in the NPIAS, the FAA recognizes that a significant number of airports with reliever designation no longer meet the reliever status since the airports they are relieving are no longer considered congested. However, because the term is defined by statute in 49 U.S.C. § 47102, the FAA continues to track this category of airport.
- **General Aviation** - A public-use airport that is located in a state and that, as determined by the Secretary, does not have scheduled service, or has scheduled service with less than 2,500 passenger boardings each year.

Source: DOAV.

The primary airports are further classified into one of four hub designations based on their proportion of annual enplaned passengers.

- **Large Hub** – A primary airport that enplanes 1 percent or more of total U.S. passenger enplanements.
- **Medium Hub** – A primary airport that enplanes between 0.25 percent and 1 percent of total U.S. passenger enplanements.
- **Small Hub** – A primary airport that enplanes between 0.05 percent and 0.25 percent of total U.S. passenger enplanements.
- **Nonhub** – A primary airport that enplanes less than 0.05 percent of total U.S. passenger enplanements but more than 10,000 enplanements.

By designating these hub airports as primary airports, the NPIAS categorizes the other airports (Reliever, General Aviation, and Commercial Service) as nonprimary by default.

NPIAS Airport Roles

The NPIAS categories offer significant differentiation among the primary airports but lump most nonprimary airports into either the Reliever or General Aviation category. The FAA recognized this shortfall and created NPIAS airport roles that provide greater differentiation among the general aviation airports. The five NPIAS airport roles are:

- **National Airports** – These airports are typically found near major business centers and support the national aviation system by providing communities access to national and international markets. National airports offer alternatives to primary airports, resulting in very high levels of aviation activity with many jets and multiengine propeller aircraft. On average, National Airports are home to about 200 total based aircraft, of which nearly 40 are typically jets.
- **Regional Airports** – These airports are usually found in metropolitan areas serving large populations. They support regional economies by connecting communities to regional and national markets. Regional airports have high levels of activity with some jets and multiengine propeller aircraft. Total based aircraft at Regional Airports average 86 aircraft, of which three are jets.
- **Local Airports** – These airports provide access to markets within a state or immediate region. The predominant aviation activity at Local Airports is conducted by piston aircraft in support of business and personal needs. These airports typically accommodate flight training, emergency services, and charter flights. Local airports host an average of 32 based aircraft, all generally propeller driven.

- **Basic Airports** – These airports link the community to the national aviation system. Basic Airports support general aviation activities, such as emergency response, air ambulance service, flight training, and personal flying. Propeller-driven aircraft are the predominant aircraft at these airports, with an average of nine based aircraft per Basic Airport.
- **Unclassified** – Airports that are in the NPIAS but do not meet any of the criteria for the roles listed above.

The FAA introduced these airport roles in 2012 with its publication of the *General Aviation Airports: A National Asset* report. The FAA has subsequently included its airport role assessments and updates in the publication of its NPIAS report.

Table 3-1 shows the number of Virginia system airports in each NPIAS category and role as of 2023 and compares it to the data from the 2016 VATSP. The only change in NPIAS categories since the 2016 VATSP is that one general aviation airport has been moved out of the NPIAS. That airport is Grundy Municipal Airport, which was temporarily closed in October 2019. DOAV plans to reopen the airport, referred to as Grundy Replacement Airport (GDY) in this report, but it is not yet included in the NPIAS. Also note that although the table shows some minor changes amongst the roles overall, only 13 airports changed their NPIAS role since the 2016 VATSP. **Table 3-2** lists the 13 airports that changed their NPIAS role since 2016.

Table 3-1: Virginia Airports by NPIAS Categories and Roles

NPIAS Categories	Number of Airports	
	2023	2016
Primary Airports		
Large Hub	2	2
Medium Hub	1	0
Small Hub	1	2
Nonhub	5	5
Total	9	9
Nonprimary Airports by Category		
Commercial Service	0	0
Reliever	6	6
General Aviation	32	33
Total	38	39
Nonprimary Airports by Role		
National	2	1
Regional	11	12
Local	15	17
Basic	8	7
Unclassified	2	2
Not included in NPIAS	19	18
Total	**66**	**66**

Note: Total number of airports is calculated by combining the number of primary, nonprimary, and those airports not included in the NPIAS.
Source: NPIAS 2023-2027 and 2016 VATSP.

Table 3-2: Virginia Airport NPIAS Role Changes Since 2016

ID	Airport Name	NPIAS Role	
		2023	2016
JYO	Leesburg Executive	National	Regional
DAN	Danville Regional	Regional	Local
LUA	Luray Caverns	Local	Basic
SFQ	Suffolk Executive	Local	Regional
HLX	Twin County	Local	Basic
FKN	Franklin Regional	Basic	Local
MKJ	Mountain Empire	Basic	Local
EMV	Emporia-Greensville Regional	Basic	Other
FVX	Farmville Regional	Basic	Local
LNP	Lonesome Pine	Basic	Local
0VG	Lee County	Unclassified	Basic
0V4	Brookneal/Campbell County	Unclassified	Other
GDY	Grundy Replacement Airport	Not in NPIAS	Basic

Source: NPIAS 2023-2027 and 2016 VATSP.

There are multiple conditions that an airport can meet to determine its NPIAS role. If an airport does not meet any of the numerous conditions listed for a NPIAS role, then the airport falls into the Unclassified role.

Because of the multiple provisions for each NPIAS role, identifying the NPIAS role for each airport involves a significant amount of data collection followed by analysis of several conditions. DOAV sought an airport role classification system that was easier to follow and implement, as will be shown later. The NPIAS role process resulted in the NPIAS role assignments for each airport shown in **Table 3-3.** Virginia system airports not included in the NPIAS are listed in **Table 3-4.**

Table 3-3: NPIAS Airport Role and Category Classifications for Virginia's System Airports

ID	Airport Name	NPIAS Role	NPIAS Category
CHO	Charlottesville-Albemarle	Commercial Service	Primary
LYH	Lynchburg Regional/Preston Glenn Field	Commercial Service	Primary
PHF	Newport News-Williamsburg	Commercial Service	Primary
ORF	Norfolk International	Commercial Service	Primary
RIC	Richmond International	Commercial Service	Primary
ROA	Roanoke-Blacksburg Regional/Woodrum Field	Commercial Service	Primary
SHD	Shenandoah Valley Regional	Commercial Service	Primary
DCA	Ronald Reagan Washington National	Commercial Service	Primary
IAD	Washington Dulles International	Commercial Service	Primary
JYO	Leesburg Executive	National	Reliever
HEF	Manassas Regional/Harry P Davis Field	National	Reliever
MTV	Blue Ridge	Regional	General Aviation
CPK	Chesapeake Regional	Regional	General Aviation
CJR	Culpeper Regional	Regional	General Aviation
DAN	Danville Regional	Regional	General Aviation
PVG	Hampton Roads Executive	Regional	Reliever
OFP	Hanover County Municipal	Regional	General Aviation
FCI	Richmond Executive-Chesterfield County	Regional	Reliever
VJI	Virginia Highlands	Regional	General Aviation
BCB	Virginia Tech/Montgomery Executive	Regional	General Aviation
HWY	Warrenton-Fauquier	Regional	Reliever
OKV	Winchester Regional	Regional	General Aviation
MFV	Accomack County	Local	General Aviation
PTB	Dinwiddie County	Local	General Aviation

An Example of NPIAS Role Criteria

Airports in the National role must meet at least one of the following three sets of conditions:

- Condition 1
  - 5,000 or more instrument operations;
  - 11 or more based jets; and
  - 20 or more international flights or 500 or more interstate departures.
- Condition 2
  - 10,000 or more enplanements; and
  - at least 1 enplanement by a large, certificated air carrier.
- Condition 3
  - 500 million pounds or more of landed cargo weight (including weight of the aircraft).

Table 3-3: NPIAS Airport Role and Category Classifications for Virginia's System Airports (continued)

ID	Airport Name	NPIAS Role	NPIAS Category
FRR	Front Royal-Warren County	Local	General Aviation
LKU	Louisa County/Freeman Field	Local	General Aviation
LUA	Luray Caverns	Local	General Aviation
AVC	Mecklenburg-Brunswick Regional	Local	General Aviation
FYJ	Middle Peninsula Regional	Local	General Aviation
W96	New Kent County	Local	General Aviation
PSK	New River Valley	Local	General Aviation
OMH	Orange County	Local	General Aviation
RMN	Stafford Regional	Local	Reliever
SFQ	Suffolk Executive	Local	General Aviation
XSA	Tappahannock-Essex County	Local	General Aviation
HLX	Twin County	Local	General Aviation
W78	William M Tuck	Local	General Aviation
EMV	Emporia-Greensville Regional	Basic	General Aviation
FVX	Farmville Regional	Basic	General Aviation
FKN	Franklin Regional	Basic	General Aviation
HSP	Ingalls Field	Basic	General Aviation
LNP	Lonesome Pine	Basic	General Aviation
MKJ	Mountain Empire	Basic	General Aviation
TGI	Tangier Island	Basic	General Aviation
JFZ	Tazewell County	Basic	General Aviation
0V4	Brookneal/Campbell County	Unclassified	General Aviation
0VG	Lee County	Unclassified	General Aviation

Source: FAA NPIAS 2023-2027.

Source: Alan White.

Source: Alan White.

Table 3-4: Virginia System Airports Not Included in the NPIAS

ID	Airport Name	NPIAS Role	NPIAS Category
BKT	Allen C Perkinson Blackstone AAF	Not in NPIAS	Not in NPIAS
VBW	Bridgewater Air Park	Not in NPIAS	Not in NPIAS
LVL	Brunswick County	Not in NPIAS	Not in NPIAS
CXE	Chase City Municipal	Not in NPIAS	Not in NPIAS
W81	Crewe Municipal	Not in NPIAS	Not in NPIAS
W13	Eagle's Nest	Not in NPIAS	Not in NPIAS
W24	Falwell	Not in NPIAS	Not in NPIAS
GVE	Gordonsville Municipal	Not in NPIAS	Not in NPIAS
GDY	Grundy Replacement Airport	Not in NPIAS	Not in NPIAS
W75	Hummel Field	Not in NPIAS	Not in NPIAS
7W4	Lake Anna	Not in NPIAS	Not in NPIAS
W63	Lake Country Regional	Not in NPIAS	Not in NPIAS
W31	Lunenburg County	Not in NPIAS	Not in NPIAS
W90	New London	Not in NPIAS	Not in NPIAS
8W2	New Market	Not in NPIAS	Not in NPIAS
EZF	Shannon	Not in NPIAS	Not in NPIAS
W91	Smith Mountain Lake	Not in NPIAS	Not in NPIAS
AKQ	Wakefield Municipal	Not in NPIAS	Not in NPIAS
JGG	Williamsburg-Jamestown	Not in NPIAS	Not in NPIAS

Source: FAA NPIAS 2023-2027.

Source: DOAV.

Source: Nancy Lewis.

Virginia Airport Roles

DOAV desired an airport role methodology that is easier to implement and is transparent to stakeholders of the aviation system. To achieve that, the Plan looked at the reasons behind the method used in determining Virginia's airport roles in the 2016 VATSP.

Virginia's last system plan had four primary aims for its airport classification system. They were:

- Airport function – The airport role was intended to capture the way the airport functioned.
- Primary economic role – The airport role also sought to categorize airports by the level of economic activity that the airport generated.
- Optimal Airport Reference Code – The airport role was intended to help determine each airport's optimal airport reference code, a measure that determines airport geometry and layout to accommodate its most demanding aircraft.
- Funding category eligibility – The airport role was to be used to assist with distribution of state capital funding dollars.

Virginia realized that it was time to reassess its airport role methodology due to recent changes related to the four aims. For example, the FAA ceased to apply funding priority to Reliever Airports (as identified by the FAA in the NPIAS), which then questioned the applicability of using the Reliever role. DOAV sought to establish an airport role methodology that was tailored to the needs of Virginia. The updated aims of the new role methodology are to:

- Help guide DOAV in its funding decisions
- Better characterize airport function
- Provide a roadmap for development.

Peer Review of Roles

DOAV investigated how other states conducted the role analysis for their aviation systems. This effort included review of the airport classification methodologies of nine peer states as noted in **Chapter 1** and **Appendix A**. These states classified their airports into roles, with states using between three to six role designations. Based on some broad generalizations, these nine states used one of three methodologies to assign roles. Those methodologies were:

- Strict Criteria Method – Using a group of criteria, such as runway length, city population, and other factors, airport roles are assigned based on meeting or exceeding specific thresholds for some or all the criteria. An example is assigning airport roles based on primary runway length. All airports that exceed a specified runway length, such as 5,000 feet, are assigned a role, while airports with runways between 4,000 and 5,000 feet are assigned to a different role, and so on.
- Decision Tree Method – The decision tree method makes use of a series of objectively evaluated questions to arrive at an airport's role.
- Points Method – This method selects a number of objective criteria that have points assigned to them. Each airport's points are totaled, and the airports are listed in order by point total. Airports are then grouped, either by an objective measure (e.g., top quartile), or by a subjective assessment (e.g., an analyst selecting a breakpoint between airport groups based on which airports seem to belong together or not) and roles assigned to the groups.

Source: Alan White.

The strict criteria method offers the primary advantage of simplicity, especially if only one criterion is evaluated. This makes it easy to explain to interested parties. It also results in a simple implementation that is straight forward to update. The roles of individual airports can be updated when changes occur at those facilities. The downside is that this method can fail to adequately distinguish between airports. For example, a strict criteria method that uses runway length will have a difficult time discriminating between airports with the same runway length where one caters to business jets, and the other to flight training. Of course, additional evaluation criteria can be added, but this complicates the analysis.

The decision tree method typically makes use of a flow chart that helps illustrate the logic used in assigning airport roles, which aids in explaining how the method works. Through the use of multiple criteria, many different combinations of airport characteristics can be evaluated, allowing this method to capture subtle differences between airports. A disadvantage of this method is that evaluating more than four or five criteria complicates the analysis significantly due to the increase in the number of possible combinations.

The points method is a good method for systems that have a large number of criteria for evaluation. Each criteria gets boiled down to a point value that can all be added together. Another advantage is that this method can evaluate any criteria that can have a point value assigned to it. Criteria can also be weighted by adjusting the range of points assigned to each criterion. An argument for avoiding this method is that it can be challenging to explain to stakeholders since it is difficult to visualize how the combination of points results in a particular role. Another downside is that assigning points to criteria is a subjective assessment. Finally, the main disadvantage of this method is that it is impossible to update individual airports. This is because this method assigns roles based on an airport's point total relative to all other airports in the system. Therefore, the only way to evaluate and update an airport with this methodology is by evaluating and updating all airports in the system so that a new relative ranking of all airports by points can be established. **Table 3-5** summarizes the pros and cons of the three methods.

Table 3-5: Airport Role Determination Methodologies

Method	Used by:	Pros	Cons
Strict Criteria	TN, PA, MD, NY	• Easily presented to stakeholders, decision-makers, and the public • Straight forward and easy to implement	• Lacks flexibility and customization • Overly simple, not as well suited for complex systems
Decision Tree	VA, SC, KY	• Easily presented to stakeholders, decision-makers, and the public • Uses few criteria but yields detailed results • Easy to customize	• Becomes more difficult to implement as number of criteria increase
Point System	GA, NC	• Captures nuances of complex systems • Very customizable • Easy to incorporate a large number of criteria	• Difficult to present to stakeholders, decision-makers, and the public • Point value assigned to criteria is subjective • Impossible to update individual airport since roles are based on relative scores (i.e., all airports must be updated, not just one)

Source: The Meehan Aviation Group.

Role Development Process

In selecting one of these approaches to assign airport roles, it was important to DOAV that the process:

- **Provided transparency** – The method needed to make it clear to stakeholders how an airport's role is determined.
- **Made it easy to apply in practice** – The method should make use of a limited number of easily evaluated objective criteria.
- **Emphasized funding** – The method needed to put the focus on funding by including criteria related to grants and financial sustainability.

Based on these elements, a decision tree approach was used to assign airport roles. The decision tree approach is simple to explain to stakeholders and, as will be shown later in the chapter, can be done by anyone with basic information about an airport, making the method very transparent. The decision tree approach can also be tailored to focus on specific criteria so that the roles adequately capture those measures. As will be shown later, the decision tree method DOAV developed focused on a key funding aspect of Virginia's airports.

As part of the effort to emphasize funding in the airport role methodology, DOAV looked at the airport roles used in the 2016 VATSP and recommended changes. As shown in **Figure 3-1**, the three previous airport roles of Reliever Airport, General Aviation Regional Airport, and General Aviation Community Airport were condensed into two airport roles that were reevaluated and renamed Regional Business Airport and Community Business Airport.

These changes were made for two reasons. The first is that the Reliever Airport designation no longer received preferential funding considerations from the FAA, so there was no longer a valid reason for distinguishing it from other airport roles. Consolidating the airport roles simplified the system. The second reason related to the change in airport role names. This was done to better describe the function that these airports serve in the Virginia aviation system.

Figure 3-1: Comparison of Previous Airport Roles to New Airport Roles

Definition of Roles

With these changes, the descriptions of the airport roles were established as follows.

- **Commercial Service Airport** – Commercial Service Airports provide scheduled airline service for surrounding communities. Destinations are both domestic and, in some cases, international. Airports with established commercial service are included in this category. Commercial Service airports are eligible for air carrier entitlement and air carrier/reliever discretionary funding from the Commonwealth Aviation Fund.
- **Regional Business Airport** – Regional Business Airports serve a large segment of aviation, catering to higher performance aircraft, or filling significant demand for aviation services. Most aviation services and facilities needed by general aviation activity are found at these airports. Regional Business Airports are eligible for general aviation discretionary funding from the Commonwealth Aviation Fund. It is important to note that current Reliever Airports are eligible for Air Carrier/Reliever funding.
- **Community Business Airport** – Community Business Airports provide general aviation facilities and services to a smaller market segment than Regional Business Airports. The services at Community Business Airports may include fuel sales, aircraft rental, and pilot training. General Aviation Community airports are eligible for general aviation discretionary funding from the Commonwealth Aviation Fund.
- **Local Service Airport** – Local Service Airports generally have a lower level of operational activity than other general aviation airports. All Local Service Airports are non-NPIAS airports. Local Service Airports provide limited facilities and often have constraints on expansion capability. Commonwealth funding for Local Service Airports is limited to safety and preservation projects. Local Service airports are eligible for general aviation discretionary funding from the Commonwealth Aviation Fund. Like all airports, these airports must meet 5.1-7 of the Code of Virginia and 24VAC 5-20-140 licensing requirements.

Working with these airport roles, a process of developing a decision tree method of assigning airport roles was carried out. Multiple approaches were created using different sets of criteria, and DOAV then reviewed the resulting airport role outputs. Through this process, DOAV arrived at a decision tree method that used the following criteria:

- Commercial airline service
- NPIAS status and ownership
- Runway length
- Fuel available (jet fuel, avgas, or no fuel)
- Average based aircraft

These criteria were selected because they are objective and easily evaluated. Each is explained in more detail in the following section, along with icons to assist the reader in identifying their implementation in the airport role flow charts depicted later in this chapter.

Commercial Airline Service – The airports with scheduled commercial airline service have different funding rules than the general aviation airports, so it was important to break the commercial service airports into their own role. This was accomplished by identifying those airports with scheduled commercial airline service.

NPIAS status and ownership – For the general aviation airports, funding was a critical qualifier in airport role assessment. The role analysis first looked at the key aspect of AIP funding eligibility by assessing whether the airport was part of the NPIAS, and, therefore, eligible for AIP grants. Those airports that are not part of the NPIAS were further evaluated based on whether their owner is a public or private entity. Looking at airport closures in the past, the vast majority have been privately owned airports, which indicates that publicly owned airports are statistically more likely to continue operating as airports as compared to privately owned airports. DOAV wants aviation funding it provides to have the longest impact possible, so directing those resources to airports with long-term prospects is important. For this reason, airports that are not in the NPIAS that are publicly owned are regarded as having a higher potential for development and funding than those non-NPIAS airports that are privately owned.

Runway length – The length of an airport's primary runway is an indicator of what types of aircraft are likely to use the airport, which addresses how an airport functions. Longer runways can accommodate higher performance aircraft, which typically means aircraft powered by turbine engines – either turboprops or jet aircraft. Shorter runways—identified as those under 3,500 feet in length for this analysis—are generally used by less demanding aircraft that are typically powered by piston engines. The role analysis broke Virginia's airports into groups consisting of those with primary runways that are 5,000 feet or longer, those with runways between 3,500 feet and 5,000 feet, and those with runways less than 3,500 feet.

Fuel available – The types of fuel available at an airport can also indicate to a degree how that airport functions in the system. There are two forms of aircraft fuel predominately available at Virginia's airports – jet fuel and aviation gasoline (avgas). Jet fuel is used in aircraft with turbine engines – both turboprops and jet engines. Avgas is used in piston-powered aircraft. The role analysis assesses what fuel type is available at each airport, either jet fuel, avgas, or no fuel available. With two exceptions, every system airport in Virginia that has jet fuel available also has avgas. The two exceptions are Bridgewater Air Park (VBW) and Ronald Reagan Washington National Airport (DCA), both of which have jet fuel but no avgas.

Average based aircraft – The number of aircraft based at the airport serves as an indicator of the level of activity occurring at the airport. To mitigate large swings in based aircraft, for example from the startup of a new flight school, a three-year average is used so that large changes to based aircraft only have an impact if they are lasting changes.

The VATSP makes use of the following criteria for assigning general aviation airport roles:

- NPIAS status and ownership
- Runway length
- Fuel available
- Average based aircraft

Even though there are only a handful of evaluation criteria, there are more than 140 combinations of these items for general aviation airports, allowing the analysis to assess and differentiate among the system airports.

The role assignment process proceeds by logically assigning roles to airports with certain combinations of criteria. To facilitate this process, a flow chart was developed with decision points for each of the evaluation criteria to make it easy to determine which combinations of criteria were assigned to each airport role.

This flow chart is broken into three figures (**Figures 3-2** through **3-4**) corresponding to the three groups of general aviation airports under the NPIAS status and ownership criteria (NPIAS airports, non-NPIAS publicly owned airports, and non-NPIAS privately owned airports). **Figure 3-2** shows Flow Chart A, which is used for all airports that are part of the NPIAS. For those airports that are not part of the NPIAS, Flow Chart B (**Figure 3-3**) and Flow Chart C (**Figure 3-4**) are used, with public sponsor airports using Flow Chart B, and privately owned airports using Flow Chart C. The following hypothetical example illustrates how these charts were used to assign roles to each system airport.

Virginia Skies Airport is a privately owned airport that is in the NPIAS with the following parameters:

- No commercial airline service
- 4,500-foot runway
- Avgas available
- An average of 40 based aircraft over past three years

Starting with Flow Chart A, the first decision point is whether the airport has commercial airline service. Virginia Skies Airport does not, so the flow chart process proceeds to the next decision point, which is the NPIAS status of the airport. Since Virginia Skies Airport is in the NPIAS (private or public ownership of the airport is irrelevant when the airport is in the NPIAS), the flow chart proceeds to the runway length decision point. Virginia Skies Airport's 4,500-foot-long runway places it on the "Runway ≥ 3,500 feet" path, taking the flow chart to the next decision point, which involves fuel. Virginia Skies Airport does not have jet fuel, but does have avgas, so the flow chart follows the bottom "Avgas or No Fuel Available" path to where it is evaluated as a Community Business Airport. Under those conditions, there was no need to evaluate the average number of based aircraft at the airport over the past three years.

Source: DOAV.

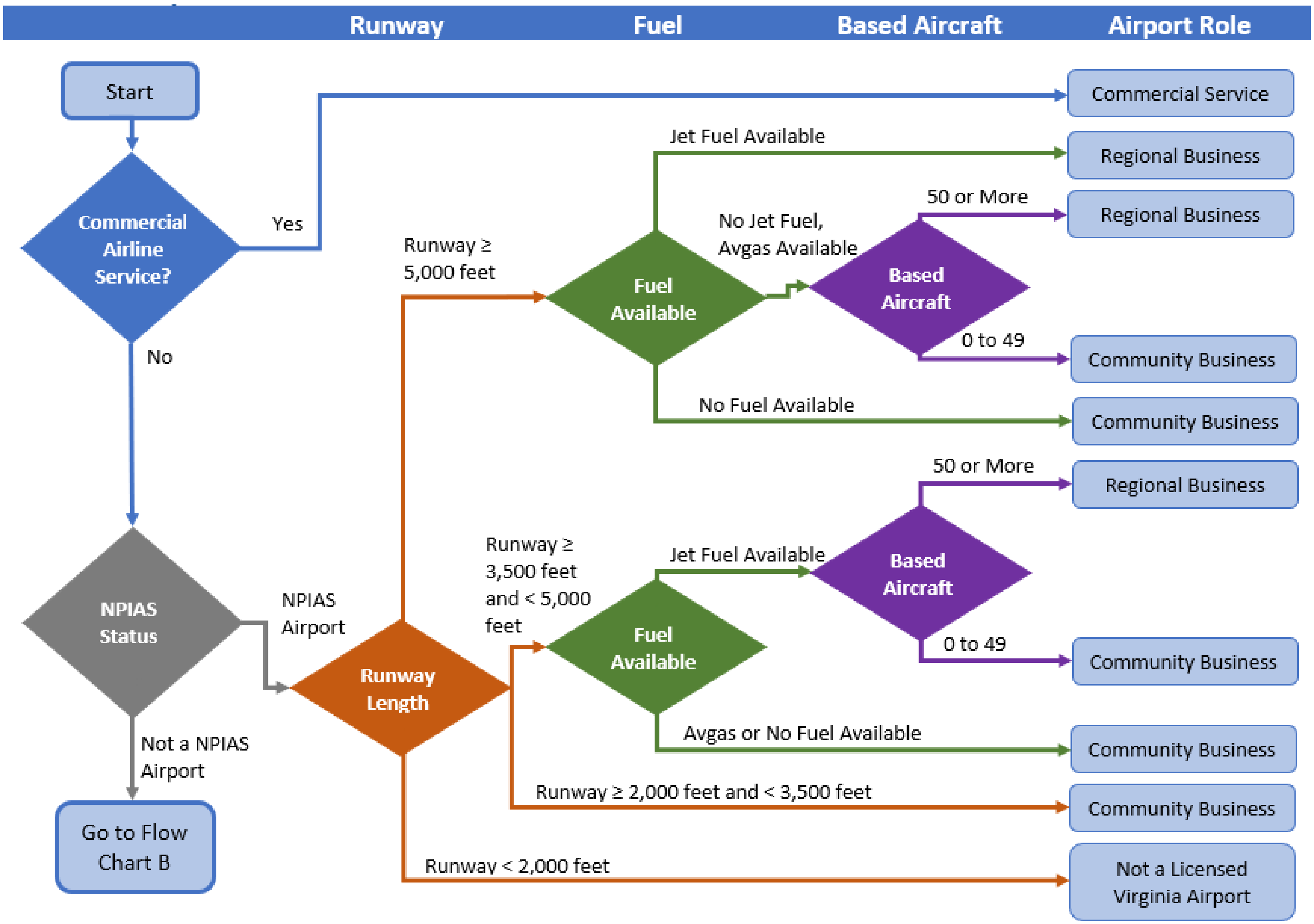


Figure 3-2: Flow Chart A – NPIAS Airports

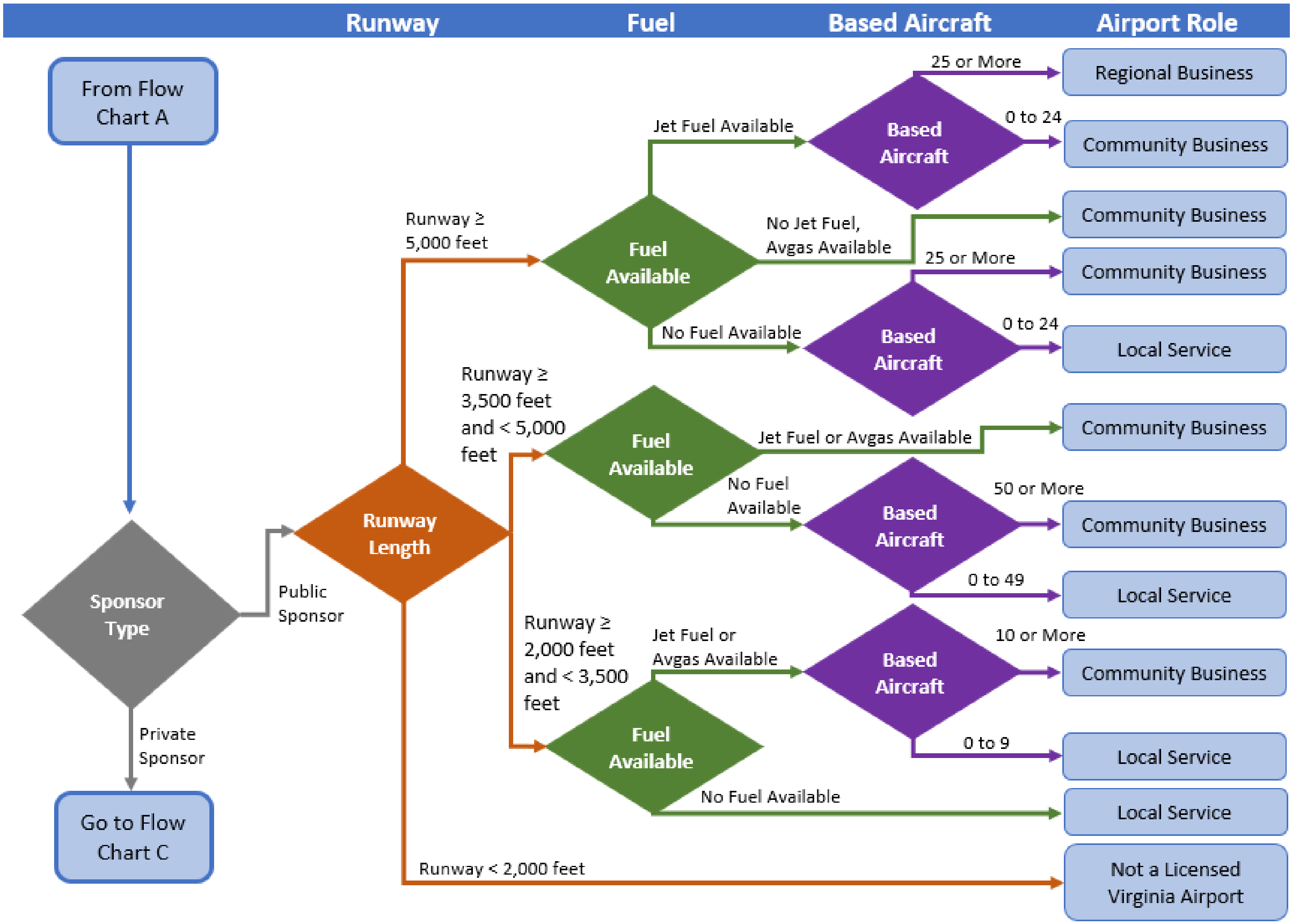


Figure 3-3: Flow Chart B – Non-NPIAS Publicly Owned Airports

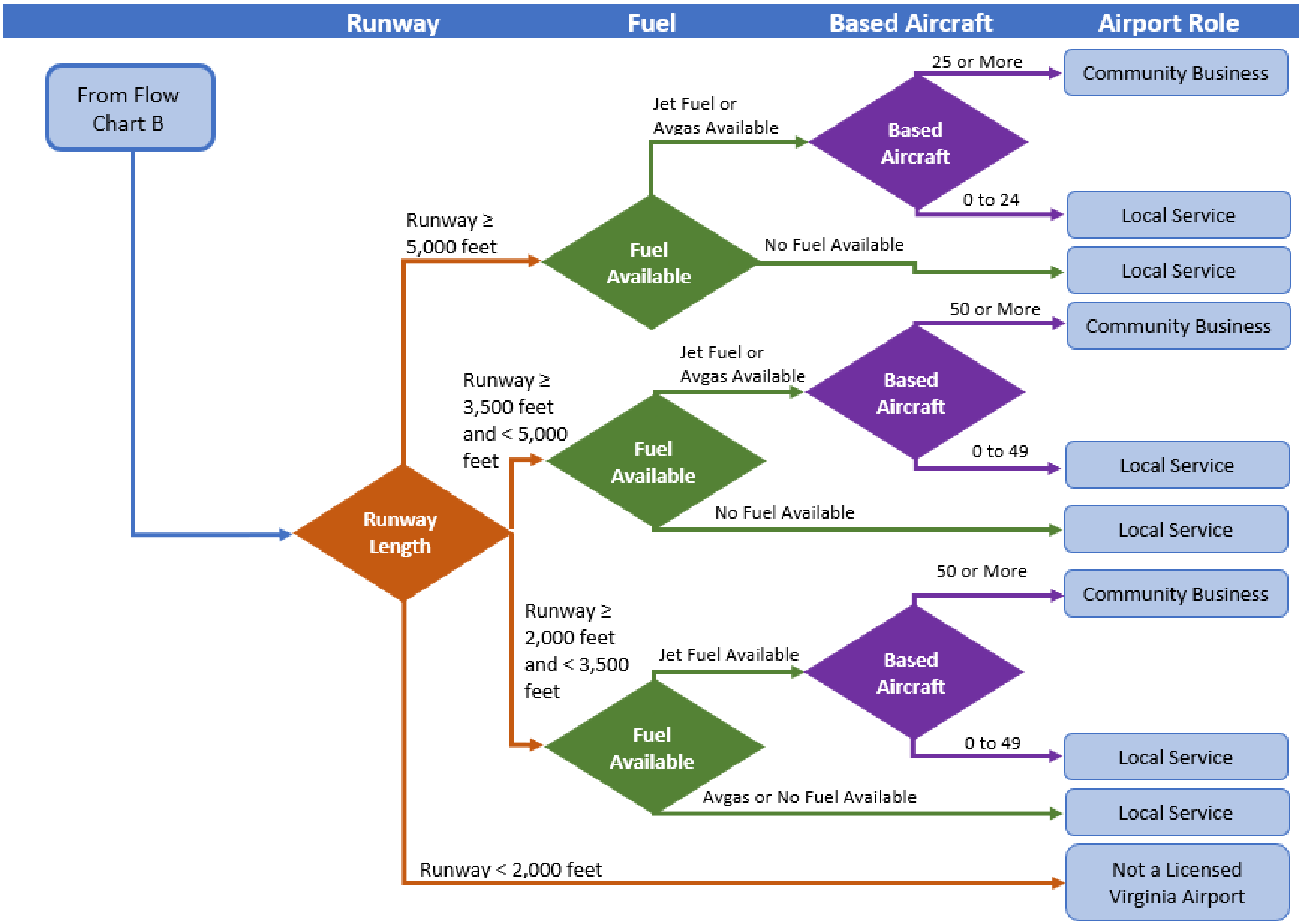


Figure 3-4: Flow Chart C – Non-NPIAS Privately Owned Airports

Results

Looking at Flow Chart A (**Figure 3-2**), it is apparent that if Virginia Skies Airport had jet fuel available, its role analysis would require an evaluation of its average based aircraft to determine if it is classified as a Community Business or Regional Business Airport. With an average of 40 based aircraft over the past three years, the analysis follows the "0 to 49" path, making it a Community Business Airport. It is worth noting that if in this case Virginia Skies Airport had an average of 50 or more based aircraft, it would fall into the Regional Business Airport role. When this decision tree approach is applied to Virginia's system airports, it classifies the 66 airports as shown in **Table 3-6**. **Table 3-7** shows each airport's role assignment along with the data from each airport that was used to determine its existing role. **Figure 3-5** depicts a map with each airport's role indicated.

Table 3-6: VATSP Roles

Airport Role	Number of Airports
Commercial Service	9
Regional Business	26
Community Business	20
Local Service	11
Total	66

Source: Mead & Hunt, Inc.

Table 3-7: Airport Role Classifications for Virginia's System Airports

ID	Airport Name	NPIAS Status	Ownership	Runway Length	Fuel Available	Average Based Aircraft	Airport Role
CHO	Charlottesville-Albemarle	NPIAS	Public	6,801	Jet fuel	62	Commercial Service
LYH	Lynchburg Regional/Preston Glenn Field	NPIAS	Public	7,100	Jet fuel	89	Commercial Service
PHF	Newport News-Williamsburg	NPIAS	Public	8,003	Jet fuel	136	Commercial Service
ORF	Norfolk International	NPIAS	Public	9,001	Jet fuel	86	Commercial Service
RIC	Richmond International	NPIAS	Public	9,003	Jet fuel	62	Commercial Service
ROA	Roanoke-Blacksburg Regional/Woodrum Field	NPIAS	Public	6,800	Jet fuel	97	Commercial Service
DCA	Ronald Reagan Washington National	NPIAS	Public	7,169	Jet fuel	1	Commercial Service
SHD	Shenandoah Valley Regional	NPIAS	Public	6,002	Jet fuel	85	Commercial Service
IAD	Washington Dulles International	NPIAS	Public	11,500	Jet fuel	63	Commercial Service
MFV	Accomack County	NPIAS	Public	5,000	Jet fuel	22	Regional Business
MTV	Blue Ridge	NPIAS	Public	5,002	Jet fuel	39	Regional Business
CPK	Chesapeake Regional	NPIAS	Public	5,500	Jet fuel	127	Regional Business

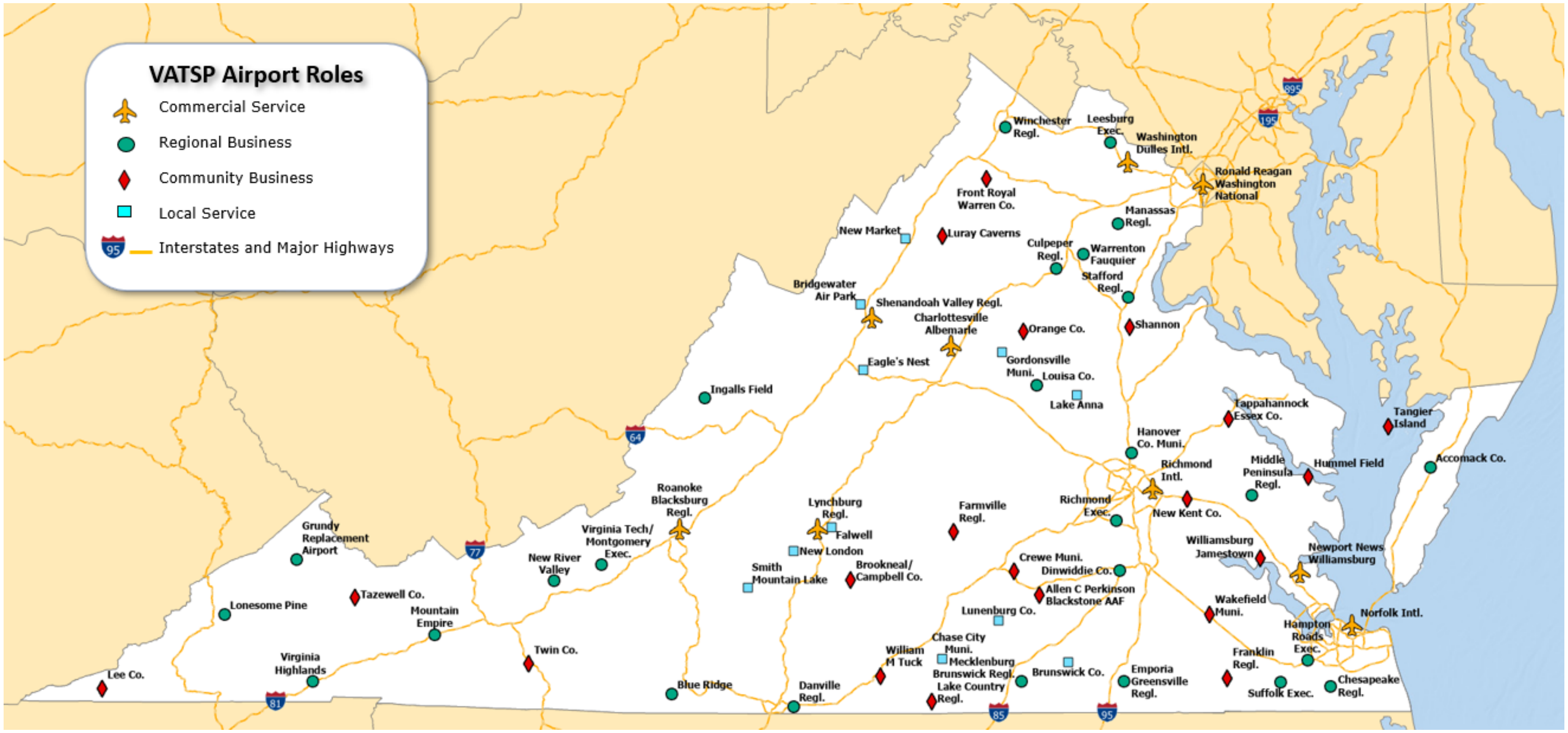
Table 3-7: Airport Role Classifications for Virginia's System Airports (continued)

ID	Airport Name	NPIAS Status	Ownership	Runway Length	Fuel Available	Average Based Aircraft	Airport Role
CJR	Culpeper Regional	NPIAS	Public	5,000	Jet fuel	163	Regional Business
DAN	Danville Regional	NPIAS	Public	5,900	Jet fuel	45	Regional Business
PTB	Dinwiddie County	NPIAS	Public	5,002	Jet fuel	57	Regional Business
EMV	Emporia-Greensville Regional	NPIAS	Public	5,010	Jet fuel	9	Regional Business
GDY	Grundy Replacement Airport	NPIAS	Public	5,100	Jet fuel	0	Regional Business
PVG	Hampton Roads Executive	NPIAS	Private	5,350	Jet fuel	159	Regional Business
OFP	Hanover County Municipal	NPIAS	Public	5,402	Jet fuel	108	Regional Business
HSP	Ingalls Field	NPIAS	Public	5,600	Jet fuel	4	Regional Business
JYO	Leesburg Executive	NPIAS	Public	5,500	Jet fuel	240	Regional Business
LNP	Lonesome Pine	NPIAS	Public	5,280	Jet fuel	31	Regional Business
LKU	Louisa County/Freeman Field	NPIAS	Public	4,300	Jet fuel	53	Regional Business
HEF	Manassas Regional/Harry P Davis Field	NPIAS	Public	6,200	Jet fuel	393	Regional Business
AVC	Mecklenburg-Brunswick Regional	NPIAS	Public	5,002	Jet fuel	33	Regional Business
FYJ	Middle Peninsula Regional	NPIAS	Public	5,000	Jet fuel	38	Regional Business
MKJ	Mountain Empire	NPIAS	Public	5,252	Jet fuel	18	Regional Business
PSK	New River Valley	NPIAS	Public	6,201	Jet fuel	37	Regional Business
FCI	Richmond Executive-Chesterfield County	NPIAS	Public	5,500	Jet fuel	116	Regional Business
RMN	Stafford Regional	NPIAS	Public	6,000	Jet fuel	63	Regional Business
SFQ	Suffolk Executive	NPIAS	Public	5,007	Jet fuel	68	Regional Business
VJI	Virginia Highlands	NPIAS	Public	5,500	Jet fuel	67	Regional Business
BCB	Virginia Tech/Montgomery Executive	NPIAS	Public	5,501	Jet fuel	46	Regional Business
HWY	Warrenton-Fauquier	NPIAS	Public	5,000	Jet fuel	139	Regional Business
OKV	Winchester Regional	NPIAS	Public	5,498	Jet fuel	104	Regional Business
BKT	Allen C Perkinson Blackstone AAF	Non-NPIAS	Public	5,333	Jet fuel	7	Community Business
0V4	Brookneal/Campbell County	NPIAS	Public	3,798	Avgas	3	Community Business
W81	Crewe Municipal	Non-NPIAS	Public	3,300	Avgas	15	Community Business
FVX	Farmville Regional	NPIAS	Public	4,400	Jet fuel	15	Community Business
FKN	Franklin Regional	NPIAS	Public	4,977	Jet fuel	16	Community Business
FRR	Front Royal-Warren County	NPIAS	Public	3,008	Avgas	53	Community Business
W75	Hummel Field	Non-NPIAS	Public	2,167	Avgas	29	Community Business

Table 3-7: Airport Role Classifications for Virginia's System Airports (continued)

ID	Airport Name	NPIAS Status	Ownership	Runway Length	Fuel Available	Average Based Aircraft	Airport Role
W63	Lake Country Regional	Non-NPIAS	Public	4,488	Avgas	6	Community Business
0VG	Lee County	NPIAS	Public	5,003	Avgas	8	Community Business
LUA	Luray Caverns	NPIAS	Public	3,126	Jet fuel	24	Community Business
W96	New Kent County	NPIAS	Public	3,602	Avgas	45	Community Business
OMH	Orange County	NPIAS	Public	3,200	Jet fuel	43	Community Business
EZF	Shannon	Non-NPIAS	Private	2,999	Jet fuel	97	Community Business
TGI	Tangier Island	NPIAS	Public	2,426	No fuel	0	Community Business
XSA	Tappahannock-Essex County	NPIAS	Public	4,300	Jet fuel	30	Community Business
JFZ	Tazewell County	NPIAS	Public	4,299	Jet fuel	14	Community Business
HLX	Twin County	NPIAS	Public	4,204	Jet fuel	21	Community Business
AKQ	Wakefield Municipal	Non-NPIAS	Public	4,337	Avgas	21	Community Business
W78	William M Tuck	NPIAS	Public	4,003	Avgas	21	Community Business
JGG	Williamsburg-Jamestown	Non-NPIAS	Private	3,204	Jet fuel	56	Community Business
VBW	Bridgewater Air Park	Non-NPIAS	Private	4,034	Jet fuel	43	Local Service
LVL	Brunswick County	Non-NPIAS	Public	3,020	No fuel	5	Local Service
CXE	Chase City Municipal	Non-NPIAS	Public	3,400	No fuel	3	Local Service
W13	Eagle's Nest	Non-NPIAS	Private	2,004	Avgas	38	Local Service
W24	Falwell	Non-NPIAS	Private	2,932	Avgas	16	Local Service
GVE	Gordonsville Municipal	Non-NPIAS	Public	2,300	No fuel	17	Local Service
7W4	Lake Anna	Non-NPIAS	Private	2,558	No fuel	2	Local Service
W31	Lunenburg County	Non-NPIAS	Public	3,000	Avgas	2	Local Service
W90	New London	Non-NPIAS	Private	3,164	No fuel	34	Local Service
8W2	New Market	Non-NPIAS	Private	2,920	Avgas	25	Local Service
W91	Smith Mountain Lake	Non-NPIAS	Private	3,058	Avgas	26	Local Service

Source: Mead & Hunt, Inc.



Source: Cignus, LLC.

Figure 3-6: Virginia's Existing Aviation system

Facility, Equipment, and Service Targets

Part of the reason DOAV establishes airport roles is so that each airport has a system-level plan for airport development. This is accomplished by assigning recommended facilities, equipment, and services (FE&S) for each airport role.

Lacking these recommended FE&S does not prevent an airport from functioning in its assigned role. Rather, these are recommended improvements that will optimize the airport's ability to function in that role and provide direction for future development. Additionally, not all recommended improvements are necessarily feasible, and coordination with local planning endeavors, especially an airport's master planning and airport layout planning efforts, is encouraged.

Similarly, airports may exceed these FE&S recommendations. These recommended targets should be considered minimum FE&S for each airport role, not specific targets that airports in that role must meet.

Another aspect to these FE&S is that they provide a means for DOAV to measure its progress toward some of its goals for the aviation system. Evaluating the percentage of airports that meet or exceed their FE&S recommendations can give DOAV an idea of how close they are to accomplishing their goal. Tracking this percentage over time allows DOAV to determine whether they are trending toward or away from their goal. **Table 3-8** lists each FE&S, along with the recommended targets by airport role. The analysis of how well Virginia's airports meet or exceed their recommended FE&S targets is found in **Chapter 8**.

Table 3-8: Recommended Facility, Equipment, and Service Targets for Virginia's System Airports by Airport Role

Performance Measure	Commercial Service	Regional Business	Community Business	Local Service
Primary Runway Length	6,000 feet	5,000 feet	3,500 feet	2,000 feet
Primary Runway Width	150 feet	75 feet	50 feet	50 feet
Primary Runway Strength	Dual Wheel = 60,000 lbs.	Single Wheel = 30,000 lbs.	Single Wheel = 12,500 lbs.	Preserve existing
Primary Runway Instrumentation (ALS, RW lights, VGSI)	MALSR, HIRLs, PAPI	REILS (or approach lights), MIRLs, PAPI	REILS (or approach lights), MIRLs, PAPI	Preserve existing
Taxiway System	Full parallel	Full parallel	Partial parallel	Stub
Automated Weather Reporting	ASOS or AWOS III on field, 24/7	ASOS or AWOS III on field, 24/7	ASOS or AWOS on field, 24/7	No target
Visual Guidance (rotating beacon, windcone, segmented circle)	Rotating beacon, lighted windcone/segmented circle at non-towered airports	Rotating beacon, lighted windcone	Rotating beacon, lighted windcone	Rotating beacon, windcone
IAP Minimums on Primary Runway (ceiling and visibility in feet and statute miles, respectively)	200 and 1/2	250 and 1	500 and 1	1,100 and 3
Remote Towers	Any airport without ATCT	Any airport without ATCT and 3 or more based jets	No target	No target
Terminal Facilities	Per Master Plan	Based on DOAV terminal building objectives to represent the total terminal space needed	Based on DOAV terminal building objectives to represent the total terminal space needed	1,236 sq. ft. of public use space

Table 3-8: Recommended Facility, Equipment, and Service Targets for Virginia's System Airports by Airport Role (continued)

Performance Measure	Commercial Service	Regional Business	Community Business	Local Service
Hangar Space	100% of based aircraft	100% of based aircraft	100% of based aircraft	Preserve existing
Fueling Available	Jet fuel and avgas	Jet fuel and avgas	Avgas	Preserve existing
Fuel Delivery	24/7 jet fuel and avgas with card reader	24/7 jet fuel and avgas with card reader	24/7 jet fuel and avgas with card reader	Preserve existing
Snow Removal Service	Airport staff	Airport staff	No target	No target
Snow Removal/Maintenance Equipment	Snow removal equipment, mower, tractor, vehicle attachments, front end loader, truck, debris sweeper, other maintenance equipment as needed	Snow removal equipment, mower, tractor, vehicle attachments, front end loader, truck, debris sweeper	Mower, tractor, vehicle attachments, front end loader, truck, debris sweeper	Preserve existing
Ground Transportation	On-site rental car	Rental car access	Rental car access	Preserve existing
Airport Parking (non-revenue)	1 space per every 2 airport/tenant employees (assumes 3 shifts)	1 space per airport/tenant employee + 1.5 spaces per based aircraft departure on average day in peak month	1 space per airport/tenant employee + 1.5 spaces per based aircraft departure on average day in peak month	1 space per airport/tenant employee + 1.5 spaces per based aircraft departure on average day in peak month
Airport Parking (revenue)	100 parking space per 100,000 enplanements	No target	No target	No target
Pavement Maintenance	PCI ≥ 70	PCI ≥ 70	PCI ≥ 70	PCI ≥ 70
Utilities	Electricity, water, sewer, communications	Electricity, water, sewer, communications	Electricity, water, sewer, communications	Electricity, communications

Source: Mead & Hunt, Inc.

Performance Measure Descriptions

Each of the performance measures identified in Table 3-8 is discussed below. It is important to remember that the targets for each FE&S are not requirements, but are minimum objectives intended for the airport to best serve its role. Each airport's master plan, as well as unique circumstances, will dictate what types of facilities are feasible and needed at an individual airport.

- **Primary Runway Length** – Aircraft with higher speeds and payloads generally need longer runways to take advantage of their full capabilities. As a result, airports with greater business potential generally need longer runways to accommodate more demanding aircraft and this is reflected in the runway length targets. Commercial Service Airports have a primary runway length target of 6,000 feet. Regional Business Airports, which can serve a mix of business jets, should strive for a primary runway of at least

5,000 feet. Community Business Airports, which tend to focus more on turboprops and piston aircraft, are recommended for 3,500-foot or longer primary runways. Local Service Airports should meet the Virginia airport licensing standard of at least a 2,000-foot runway.

Source: Heather Ream.

- **Primary Runway Width** – Airports that cater to larger aircraft generally need wider runways to accommodate the wider landing gear of larger aircraft. Therefore, Commercial Service Airports are recommended to have 150-foot-wide primary runways, while Regional Business Airports are recommended for 75-foot-wide runways. Community Business Airports and Local Service Airports have a runway width target of 50 feet so that they meet Virginia airport licensing standards.
- **Primary Runway Strength** – The strength of runway pavement, expressed in terms of the aircraft weight (based on landing gear configuration) that can be supported on a regular basis, can limit what types of aircraft operate at an airport. Operations by aircraft that exceed the weight bearing capacity of a runway may not immediately damage the runway pavement, but repeated operations will accelerate the deterioration of the pavement. To support the operations of heavier aircraft, Commercial Service Airports are recommended to maintain their primary runway strength at a minimum of 60,000 pounds for dual wheel aircraft. Regional Business Airports should have a primary runway with a minimum, single-wheel weight-bearing capacity of 30,000 pounds. Community Business Airports have a target of 12,500 pounds for single wheel aircraft, which is adequate for small- to medium-sized turboprop aircraft. Local Service Airports should maintain their existing runway strength.
- **Primary Runway Instrumentation** – This FS&E includes three runway-related items – runway approach lights, runway lights, and visual glide slope equipment.
  - Approach lighting systems (ALS) assist pilots in identifying the runway threshold environment, helping them transition to the landing phase of their flight by providing visual guidance and orientation to flight crews during the final approach phase of the flight. Approach lighting systems are a prerequisite for some types of instrument approach procedures and are a recommended FE&S target for Commercial Service Airports where the greatest utility can be obtained from an approach lighting system. Runway end identifier lights (REIL) are recommended for Regional Business Airports and Community Business Airports. REILs are an economical answer to aiding pilots in identifying the runway environment without taking up extensive real estate that is required for more complex approach lighting systems. Local Service Airports should preserve their existing approach lights, if any.
  - Airports with runway lighting have greater utility since this permits night operations. Additionally, runway lighting can enhance the effectiveness of an instrument approach by making the runway environment easier for pilots to identify during periods of low visibility. The target for runway lighting calls for high intensity runway lights (HIRL) at commercial service airports, where maximum runway utility is called for, and medium intensity runway lights (MIRL) at Regional Business Airports and Community Business Airports. Local Service Airports should preserve their runway lights, if any.
  - Visual glide slope indicators assist pilots in guiding their aircraft to the runway threshold along a safe and stable descent. Visual glide slope indicators (the most common being a precision approach path indicator, or PAPI) provide visual feedback to the pilot on his vertical position relative to a fixed path that descends smoothly to the runway. Such systems enhance safety by ensuring obstacle clearance and proper aircraft positioning for a safe landing. PAPIs are a target for all but Local Service Airports, which should strive to preserve any existing visual glide slope indicators.

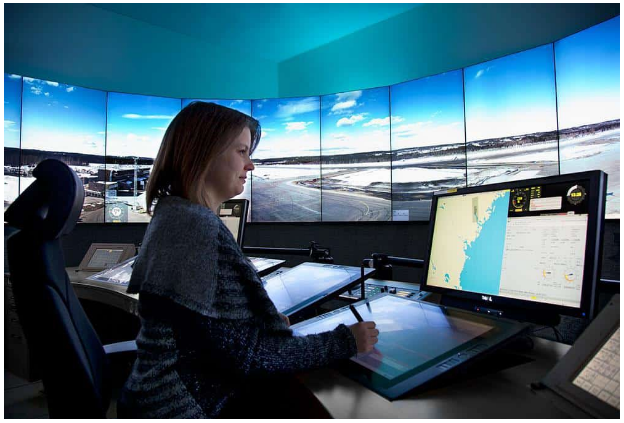
Source: DOAV.

- **Taxiway System** – The type of taxiway system at an airport is important for reasons of safety and efficiency. Without taxiways, aircraft must use the runway to back-taxi in order to line up for takeoff and to exit the runway after landing. This increases runway occupancy times for aircraft, which is both inefficient and increases collision risks for aircraft. Commercial Service and Regional Business

Airports are expected to accommodate larger aircraft, which tend to be less maneuverable, giving them a greater need for taxiways. For this reason, full parallel taxiways are recommended for Commercial Service and Regional Business Airports. Community Business Airports serving more maneuverable aircraft can increase safety and efficiency with partial parallel taxiways without incurring the expense of a full parallel taxiway. Therefore, partial parallel taxiways are recommended for Community Business Airports. Local Service Airports are recommended for turnaround stubs.

Source: Mead & Hunt, Inc.

- **Automated Weather Reporting** – Weather conditions, especially as they relate to visibility, determine if an aircraft is capable of getting into an airport. Knowing what those weather conditions are ahead of time greatly assists pilots with flight planning. It is also of use when making a diversion decision. Weather reporting at most airports is automated, by either an Automated Weather Observing System (AWOS) or Automated Surface Observing System (ASOS). Automated weather reporting is recommended for all except Local Service Airports.
- **Visual Guidance** – This FE&S captures two items intended to assist pilots in identifying the airport and providing guidance for wind direction and velocity. These are an airport rotating beacon and visual wind indicators.
  - An airport rotating beacon is an alternating white and green light that aids pilots in identifying the airport from a distance, especially at night. It is also used to signal during the day when weather conditions are below visual flight rule minimums at airports with weather reporting capability. It is a fundamental component of any lighted airport and therefore a target for all system airports.
  - A windcone provides a reliable, easy to use and maintain mechanism for visually indicating wind direction and speed. It is a fundamental component of any airport and therefore a target for all airports. Some models are capable of lighting for use at night, which is recommended for all but Local Service Airports.
  - A segmented circle provides visual indications of wind and runway traffic patterns through the use of a windcone and landing strip and direction indicators. It is employed at airports without air traffic control tower services, so it is recommended for those Commercial Service Airports that lack air traffic control services around the clock.
- **Instrument Approach Procedure Minimums on Primary Runway** – The type of instrument approach affects the overall utility of an airport and can make it possible to land during inclement weather. Virginia's aviation system is so well developed that every system airport has an instrument approach procedure, so DOAV's objective is to achieve incremental improvements in the approach minimums (cloud ceiling and flight visibility) where feasible. At Commercial Service Airports, the recommended target for its primary runway approach is a 200-foot cloud ceiling and ½ statute miles of flight visibility, typically referred to as 200 and ½. Regional Business Airports are urged to achieve a 250 and 1. Community Business Airports have a recommended target of 500 and 1, while minimums for Local Service Airports are recommended at 1,100 and 3.
- **Remote Towers** – A recent development in the area of air traffic control is the implementation of remote towers. These are "virtual" air traffic control towers that are staffed by remote controllers that make use of a network of on-airport video cameras to monitor and control aircraft operations. Virginia's Leesburg Executive Airport (JYO) is among the first airports in the U.S. to successfully trial this technology. The system is recommended for airports that fall short of the need for a conventional air traffic control tower but would greatly benefit from the added air traffic separation services a remote tower could provide. Airports with a mix of jet and piston aircraft, which typically have greatly varying approach characteristics, are prime candidates for the safety benefits offered by air traffic control towers. For these reasons, a remote tower is recommended at any Commercial Service Airports that lack a conventional air traffic control tower, and at Regional Business Airports without a conventional air traffic control tower that have three or more based jets.



Source: DOAV.

- **Terminal Facilities** – Airports that are expected to handle general aviation passenger traffic have a need for a terminal/administration building where passengers can take shelter from the weather and environment, as well as provide a central meeting point for parties coming to the airport. Terminal buildings also provide essential services for passengers and pilots. Terminal facilities can range in size based upon several factors, the most important being the type of users. Buildings can range from a small pilot room for flight planning and resting to a large multi-room building that provides services for multiple uses. A terminal building provides visitors with their first impression of a community, so it is important for a terminal building to be welcoming and provide a positive experience for the visitor. Specific areas or uses in a terminal building can include waiting areas, restrooms, pilots lounge, vending, conference rooms, and airport manager offices. For this reason, a terminal building is recommended for all airports.
  The recommended space for these facilities varies based on airport role. Terminal buildings for Commercial Service Airports are designed for the airline and passenger demands expected at that airport and should be based on the master plan for that particular airport. For Regional Business Airports and Community Business Airports, the recommended terminal building size is based on DOAV's Terminal Building Area Calculator, a formula that DOAV uses to estimate terminal needs. This calculator uses annual aircraft operations to estimate the portion of the terminal that is eligible for state funding. This portion is approximately 70 percent of the average terminal building's size and was adjusted to reflect total terminal building size needed. Local Service Airports are recommended for a terminal building with 1,236 square feet of public space.

Source: DOAV.

- **Hangar Space** – Aircraft storage is a key component of airport infrastructure, especially as the cost of aircraft has risen and incentivized aircraft owners to protect their investment. The target for hangar space at all airports except Local Service Airports is to provide adequate hangar space for all based aircraft at the airport. Doing so makes aircraft storage available to aircraft owners. Depending upon local conditions, additional hangar space may be needed at airports that have high transient aircraft activity, or demand for aircraft services such as maintenance or painting. Local Service Airports should strive to maintain existing hangar space.
- **Fueling Available** – In order for an airport to fulfill its designated classification, it must provide the basic services to the users of the airport. Fuel is the most fundamental of these services, with users of turbine engine aircraft needing jet fuel and the users of nearly all piston engine aircraft needing 100LL avgas. All system airports, except for Local Service Airports, are encouraged to be able to fuel piston aircraft, and those airports with significant amounts of jet traffic are encouraged to have jet fuel (i.e., Commercial Service Airports and Regional Business Airports). If Local Service Airports have any fuel capability, they should preserve it.
- **Fuel Delivery** – In addition to the types of fuel available, when and how it is delivered is important. It is recommended that all airports, except Local Service Airports, make fuel available 24 hours per day through self-fueling equipment, which is typically equipped with a credit card reader. If Local Service Airports have any fuel delivery systems, they should preserve them.
- **Snow Removal Service** – Winter use of airports in many parts of Virginia depends upon the ability to remove snow from the airfield. The two means of providing snow removal at an airport are either for the airport to own, maintain, and operate the snow removal equipment (referred to as on-airport), or contract with another party to provide the snow removal services as needed (referred to as off-airport). On-airport snow removal provides greater reliability, but at higher cost, while off-airport snow removal is typically less expensive but may not be as responsive in situations where the provider may have higher priority snow clearance duties than keeping the airport clean. Commercial Service Airports and Regional Business Airports, where maximum operational efficiency is important for supporting the maximum economic potential of these airports, are recommended for on-airport snow removal, while the other airports have no target.
- **Snow Removal/Maintenance Equipment** – To support the on-airport snow removal target for Commercial Service Airports and Regional Business Airports, it is recommended that these airports obtain adequate snow removal equipment. The other airports have no target for snow removal equipment since they may opt for off-airport snow removal service.

- **Ground Transportation** – Providing ground transportation services to visitors who arrive in Virginia by air is important to airports fulfilling their system role. For Commercial Service Airports, efficient movement from aircraft to ground transportation is a critical element of making the most of air transportation, so the target for these airports is to have on-site rental car services. For Regional Business Airports and Community Business Airports, on-site rental car service may not be financially feasible, so rental car access through a pick-up service or rental car delivery on demand service is an appropriate target for these airports. Local Service Airports should maintain the rental car access they have, if any.

Source: Mead & Hunt, Inc.

- **Airport Parking (non-revenue)** – The amount of automobile parking available is an important component of providing adequate services to airport users. This Plan breaks parking into revenue-generating parking (generally found only at larger Commercial Service Airports) and non-revenue-generating parking, which is found at all airports. Airports need adequate parking for employees of the airport, employees of businesses on the airport, and customers of the airport and its businesses. For Commercial Service Airports, it is recommended that the airport provide one auto parking space for every two employees (airport or business tenant employee) on the airport. For all other airports, it is recommended that the airport provide one auto parking space for every employee and add 1.5 auto spaces for every based aircraft departure on an average day in the peak month.
- **Airport Parking (revenue)** – Parking that generates revenue typically does so from airline passengers, so the target for this facility is only applied to Commercial Service Airports. For every 100,000 annual enplanements, it is recommended that the airport have 100 auto parking spaces. With the growth of transportation network companies, such as Lyft and Uber, and the promise of innovative transportation business models, there may be reduced demand for parking at airports in the future. It is recommended that DOAV periodically re-evaluate the ratio of recommended parking spaces to enplanements.
- **Pavement Maintenance** – Maintaining an airport's pavement is a key component of an airport fulfilling its role in an aviation system. The industry standard for evaluating pavement status is a calculated pavement condition index (PCI) that scores pavement on a scale of 1 to 100. All airports are recommended to maintain their pavement at a PCI value of 70 or greater.
- **Utilities** – Key infrastructure elements of an airport include electricity, water, sewer, and internet access. All airports, except Local Service Airports, are recommended to have electricity, water, sewer, and internet access. The utility targets for Local Service Airports, which can be more remote than other airports, are electricity and internet access. Refer to the inventory in the appendix for the availability of public water and sanitary sewer services at Regional Business and Community Business Airports.

In addition to developing targets for the various airport roles in the Virginia aviation system, this Plan also considered the minimum requirements necessary for an airport to be included in the system. Virginia has two sets of airport minimum standards that are detailed in the next section.

Minimum Facilities of the VATSP

The VATSP evaluates airport facilities using two sets of minimum requirements. The first is a set of licensing requirements found under the *Virginia Administrative Code 24VAC5-20-140 Minimum requirements of licensing*. The second comes from the definitions of a Basic Airport Unit as stipulated in the *Virginia Department of Aviation Airport Program Manual* as revised in March 2021.

Licensing of Virginia Airports

Airport licensing requirements for Virginia's airports are established in the Code of Virginia § 5.1-7 *Licensing of airports and landing areas*, which calls for licensing of an airport open to the public (whether privately or publicly owned) by DOAV. The licensing process, which also applies to runway extensions, involves DOAV inspecting the proposed airport or runway extension, evaluating the conditions, and ensuring that the facility meets the minimum requirements for airports. Periodic renewals of the license are required. Details of the licensing process are stipulated in Virginia Administrative Code, under 24VAC5-20-120 *Licenses*, 24VAC5-20-140 *Minimum requirements for licensing* and, 24VAC5-20-145 *Waiver of minimum requirements*.

Virginia Administrative Code 24VAC5-20-120 *Licenses* stipulates that:

- Airports and landing areas, except private landing areas as set forth in § 5.1-7.2 of the Code of Virginia, shall be licensed by the department pursuant to § 5.1-7 of the Code of Virginia and 24VAC 5-20-140. Private landing areas as defined in § 5.1-7.2 of the Code of Virginia shall only be registered as provided for in 24VAC 5-20-170, which requires that private airports within five miles of a licensed public use airport are required to be licensed, while those beyond five miles only require registration.
- Airports and landing areas that are issued licenses pursuant to § 5.1-7 of the Code of Virginia shall be open to the general public on a nondiscriminatory basis. An application for a license shall be signed by the airport sponsor, under oath, on a form prescribed by the department and submitted to the department accompanied by the required supporting documents as specified on the form. An initial license, or renewal thereof, will be issued following department review and determination of compliance with § 5.1-7 of the Code of Virginia and 24VAC 5-20-140. A license shall remain in effect for the period specified until modified, suspended, or revoked by the department.
- Airport sponsors proposing to add or extend runways of an airport or landing area shall apply for a modified license pursuant to § 5.1-7 of the Code of Virginia.
- If an airport or landing area should continually cease to be open to the public for one year, and the airport sponsor wants to reopen the facility to the public, the airport sponsor must reapply for a license in accordance with § 5.1-7 of the Code of Virginia and 24VAC 5-2-120 and must be in compliance with 24VAC 5-20-140.
- Licenses must be renewed every seven years or at the discretion of the department based on demonstrated need. License expirations shall be staggered in accordance with criteria set by the department, which include, but are not limited to, changes in legislation, standards, policy, processes, and procedures.

Licensing Regulations for Virginia's Airports

Code of Virginia § 5.1-7 Licensing of airports and landing areas

Virginia Administrative Code:

- 24VAC5-20-120. *Licenses*,
- 24VAC5-20-140. *Minimum requirements for licensing*
- 24VAC5-20-170. *Private airports or landing areas*

Virginia Administrative Code 24VAC5-20-140 *Minimum requirements for licensing* stipulates minimum criteria for several different types of airport license. This includes conditions for issuing licenses for heliports, seaplane bases, day/Visual Flight Rules (VFR) use only airports, and standard airports. For purposes of this Plan, the focus will be on the requirements for a day/VFR use only license, and a standard license. The requirements are similar for either license. The standard license minimum requirements are:

- An effective runway of at least 2,000 feet in each direction
- A minimum runway width of 50 feet
- A runway safety area length equal to the length of the runway plus 100 feet at each end of the runway, or longer
- A runway safety area width of 120 feet or wider, centered on the runway centerline
- An unobstructed approach surface of 15:1 at each end of the runway
- An approach surface that is centered along the runway centerline and that begins at the threshold at a width of 250 feet, expands uniformly for a distance of 2,250 feet to a width of 700 feet, and continues at the width of 700 feet for a distance of 2,750 feet
- An unobstructed runway object free area length equal to the length of the runway, or longer
- A minimum unobstructed runway object free area width of 250 feet or wider, centered on the runway centerline
- If an airport has an approach surface to either end of the runway with an obstruction, it must have a displaced threshold located down the runway at the point where the obstruction clearance plane intersects the runway centerline.

The minimum requirements for a day/VFR use only are the same as those listed above with two notable exceptions:

- The approach surface is centered along the runway centerline and that begins at the threshold at a width of 120 feet, expands uniformly for a distance of 500 feet to a width of 300 feet, and continues at the width of 300 feet for a distance of 2,500 feet.
- There is no runway object free area requirement.
- There is no requirement for a displaced threshold for obstructions in the approach surface.

As stipulated in Code of Virginia § 5.1-7 *Licensing of airports and landing areas*, any airport with a license issued before October 1, 1995, that did not meet one or more of the above listed criteria is exempt from that requirement. Subsequent analysis will call out those airports that are grandfathered under this exemption.

Basic Airport Unit

In December 2004, the Virginia Aviation Board (VAB) passed a resolution defining the facilities that comprise the Basic Airport Unit. Those facilities consist of:

Source: Heather Ream.

- Runway
- Airport lighting system
- Visual navigational aids
- Stub taxiway
- Aircraft parking apron
- Terminal facility
- Automobile parking
- Airport access road
- Fuel facility
- A terminal that provides adequate shelter from inclement weather, electric lighting, accessible public phone, and restroom facilities.

The Basic Airport Unit does not define any minimum size or quantity for any of these facilities. The only stipulation is that a system airport should have these facilities. Subsequent analysis will assess the system airports that meet the definition of the Basic Airport Unit and document those airports that are lacking any of these facilities.

Summary

The Virginia aviation system consists of 66 airports that support numerous types of aviation activity throughout the state. These airports may be classified into various roles through the NPIAS, and these classification systems suit the purposes for which they were intended. However, DOAV has used its own system of airport roles to address its purposes. Because of changing conditions, DOAV recognized the need to revisit its airport roles and decide whether changes were needed. DOAV examined how other states made use of their airport role classifications and system plans, with a particular focus on how those airport roles were used to allocate funding.

After assessing the Virginia aviation environment, DOAV determined that it could better serve aviation users by revising its process for assigning airport roles. It also concluded that four airport roles would best serve the aviation system:

- Commercial Service Airport
- Regional Business Airport
- Community Business Airport
- Local Service Airport

These airport roles will assist DOAV in evaluating the performance of the Virginia aviation system, both at the individual airport level and the system as a whole. Through the use of judiciously assigned facility, equipment, and service targets, each airport will be assessed for how suitable it is for its assigned role. This will also aid DOAV in identifying potential facility improvements that could enhance the performance of Virginia's aviation system.

DOAV is also responsible for the licensing of airports in Virginia. Part of the licensing process involves ensuring that airports meet certain minimum requirements that primarily focus on maintaining safe operating conditions at the airports. DOAV is supportive of Virginia Airports meeting Basic Airport Unit standards. These are facilities that the VAB determined should be found at each Virginia airport. Subsequent analysis will ascertain whether Virginia's airports are meeting these standards.

Chapter 4: Issues Affecting Virginia Airports

The aviation industry has seen major changes over the last decade and continues to adapt to new business models, aircraft types, and technological innovations. Airports and state aviation systems across the country are facing significant issues across a variety of areas. At the forefront are the continuing efforts to recover from the COVID-19 pandemic and manage the safety, security, and underlying health of the aviation system to ensure continued economic growth and sustainability. In addition to this, Virginia airports and the Virginia Department of Aviation (DOAV) are also well positioned to be leaders in the integration of Uncrewed Aircraft Systems (UASs) and Advanced/Urban Air Mobility (AAM/UAM) concepts into existing airspace and airport infrastructure. Vertiports, futuristic aircraft design concepts, and sustainable aviation fuels are expected to bring substantial changes to airport and airspace operations in Virginia. These and other advanced airport and Air Traffic Management (ATM) concepts are supported by the continuous adoption of Next Generation Air Transportation System (NextGen) systems and technologies, including artificial intelligence (AI) and machine learning (ML) strategies for data analytics purposes and to improve operations and management across the aviation system. These emerging technologies will have impacts on operational procedures, regulatory policy and guidance, investment planning, and the supporting infrastructure. The current near-term issues that impact Virginia airports are:

- COVID-19 Pandemic Recovery Impacts
- Uncrewed Aircraft Systems
- Advanced Air Mobility
- Vertiports
- UAS Traffic Management
- Remote Towers
- Electric Vehicles
- Future Aircraft Concepts
- Sustainable Aviation Fuels
- NextGen Concepts and Systems
- Artificial Intelligence and Machine Learning

Each of these topics is discussed in more detail below.

COVID-19 Pandemic Recovery

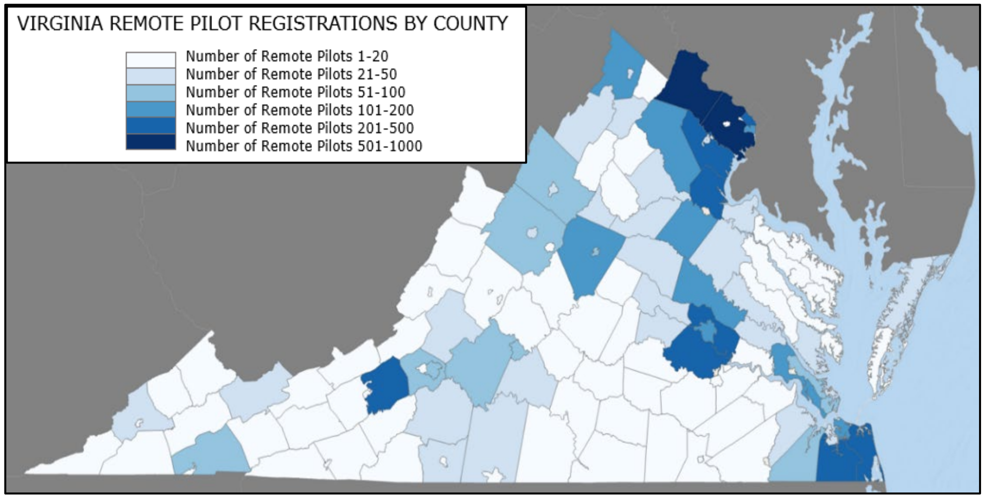
Since the beginning of the COVID-19 pandemic in 2020, airports in Virginia and across the country have seen severe impacts on passenger travel demand and resulting airline service. According to a recent International Civil Aviation Organization (ICAO) Economic Impact Study published early in 2022, total domestic U.S. airline seat capacity is still 10 percent to 15 percent below 2019 levels with the international market nearly 25 percent lower. With the Delta and Omicron variants prevalent across the world, international travel restrictions and advisories are expected to remain in place at least through early 2023, further slowing the recovery of the aviation sector in the United States.

Although aviation demand forecasting has been difficult given the continued impacts and re-emergence of COVID variants, the overall Virginia air transportation system appears to be on track for a recovery. The impacts on Virginia general aviation (GA) airports have largely been negligible, and, while business-related GA travel in large urban areas has seen some reduction in demand, activity in smaller and more rural areas seems to have recovered to nearly 2019 levels. The topics of airport and air travel demand are discussed in detail in **Chapter 5**.

Airports and operators – commercial service and GA – are managing the myriad of COVID-19 restrictions and guidelines that have been imposed by various federal and state agencies. Commercial service airports have implemented policies and developed pandemic preparedness plans to minimize future impacts on passenger safety and ultimately travel demand.

Uncrewed Aircraft Systems (UAS)

The demand for UAS operations has seen a significant increase in Virginia over the last several years. Virginia has been a leader in UAS research, development, and implementation for over a decade and continues to embrace the integration of the various platforms into the recreational and commercial market. The commitment to advance the integration of UAS into day-to-day operations is documented in the 2014 report *The Future of Unmanned Vehicle Systems in Virginia.* Further economic and aviation system benefits are explored in the *Commonwealth of Virginia Unmanned Aerial Systems Strategic Economic Development Plan* published in 2017. Both of these reports reinforce the commitment of the Commonwealth to advancing the use and integration of UAS operations and the economic benefits to be gained.



Source: Cignus, LLC.

Figure 4-1: FAA Remote Pilot Registrations by County

UAS operations and users are divided into recreational and commercial with federal and state guidance and policies further delineated by uncrewed aerial vehicle (UAV) weight. Federal guidance under 14 CFR Part 107 specifies that commercial operators gain a remote aircraft pilot certification registered with the Federal Aviation Administration (FAA) and that recreational users pass the FAA TRUST certification – or recreational drone license – test before flying uncrewed aerial vehicles (UAV). To date, the FAA lists more than 860,000 drone registrations and 260,000 registered remote pilots across the country. More than 7,000 active remote pilot certifications are listed across Virginia. The majority of these pilots are registered in large metropolitan areas including Washington, D.C., Richmond, Norfolk, and Charlottesville. County registrations – as illustrated in **Figure 4-1** – show the highest number of registrations in Northern Virginia's Fairfax and Loudoun counties.

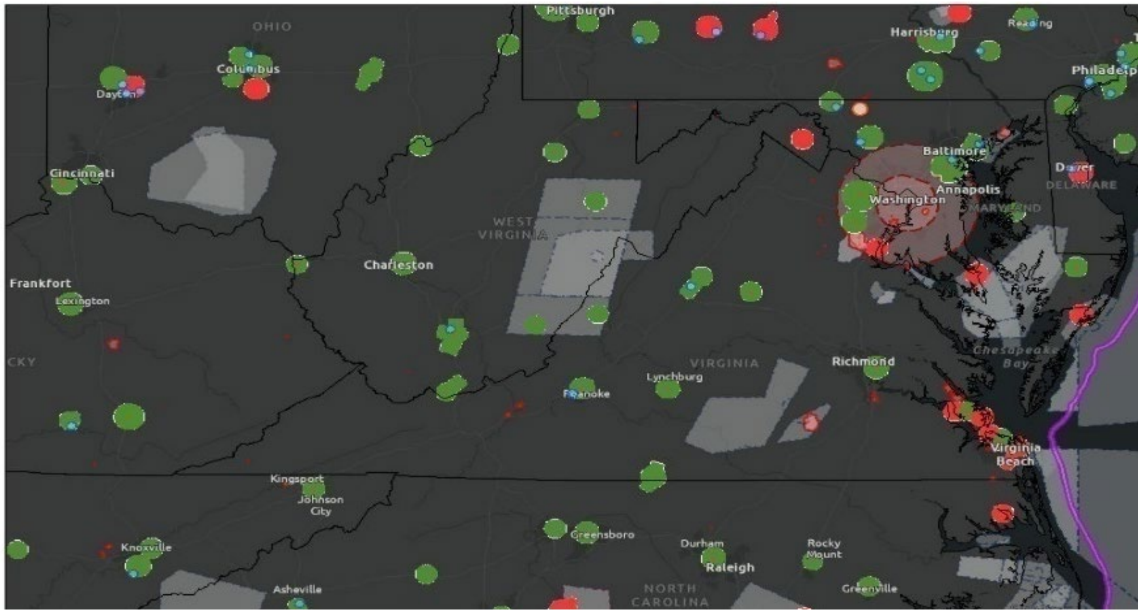
A UAS is the combination of UAV – alternatively called a drone – with a ground control station, or GCS, which manages the operation and communication with the UAV. The GCS also manages communication with external elements including air traffic control (ATC) if necessary. Airframes classified as small UASs (sUAS) can weigh up to 55 lbs. with larger platforms requiring registration as traditional aircraft under 14 CFR Part 47. Flights in Class G (uncontrolled) airspace below 400 feet are generally allowed with the exception of certain airspace. Flights in controlled airspace (Class B, C, D, and E) are only allowed with prior FAA authorization from the FAA's Low Altitude Authorization and Notification Capability (LAANC) or DroneZone. LAANC is available at 726 airports nationwide, including these 10 Virginia airports:

- Charlottesville-Albemarle (CHO)
- Danville Regional (DAN)
- Ingalls Field (HSP)
- Lynchburg Regional/Preston Glenn Field (LYH)
- Norfolk International (ORF)
- Shenandoah Valley Regional (SHD)
- Newport News-Williamsburg (PHF)
- Richmond International (RIC)
- Roanoke-Blacksburg Regional/Woodrum Field (ROA)
- Washington Dulles International (IAD)

The FAA manages and monitors access to airspace for UASs through an industry partnership with several service providers and through a web portal called B4UFly (https://b4ufly.aloft.ai/). This portal provides drone operators with no-fly zones as well as other flight guidance based on location including boundaries for Special Use Areas, Temporary Flight Restrictions (TFRs), national parks, Class B/C/D controlled airspace, and LAANC managed airspace. **Figure 4-2** provides a snapshot of the B4UFly website focused on Virginia with LAANC managed airspace marked in green and no-fly zones in gray colors. Virginia UAS operators should also consult the Virginia Flight Information Exchange (VA-FIX) program that provides state and local data to UAS service suppliers and pilots for improved planning and safety analysis.

The use of UASs across the state for recreational and commercial purposes is growing, even with state and local agencies. In addition to traditional hobby sUAS operators, commercial applications and demand have increased significantly over the last five years. This includes research and development, training, and operational platforms for:

- Real Estate and Insurance
- Construction Inspections
- Urban Planning Studies
- News/Entertainment
- Agricultural/Forestry/Land Monitoring
- Law Enforcement
- Disaster Response



Source: FAA UAS Data on a Map.

Figure 4-2: FAA No-Fly Zones including LAANC

To mitigate the impacts of commercial and recreational UASs on airport operations, more airports may want to consider integrating with the FAA's LAANC platform to manage UAS airspace reservations and restrictions more proactively in the airport vicinity. In addition to these wide-spread applications for commercial UASs, several airports have started to extend the use of UAS to on-airport applications. Six of the Virginia airports that participated in the survey indicated a based UAS presence on the airport. Several others noted increasing levels of near airport UAS activity, with two airports, Front Royal – Warren County (FRR) and Allen C Perkinson Blackstone AAF (BKT), indicating that they host UAV and UAS test locations. In the case of FRR, the airport is host to a commercial manufacturing, testing, and training facility for a service provider and original equipment manufacturer of UAS with a focus on airfield inspections. At BKT, a UAS support services, research and development (R&D), and logistics facility is located on airport property, primarily to support military R&D, operations, and training.

Although UAS operations on or near airports will likely be overseen by commercial entities with significant hands-on experience, airports still need to understand the operational impacts and safety risks associated with such applications and have knowledgeable staff on hand to oversee studies and manage operational risks.

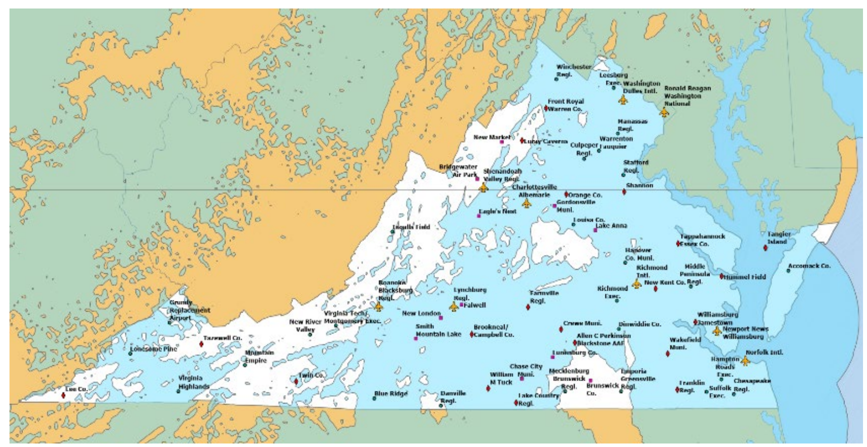
Other on airport applications include the use of UASs to conduct infrastructure and airplane inspections. In fact, three airports indicated that they are currently using UASs for runway inspections. Compared to manual inspections, aerial inspections using UAVs can provide higher accuracy information much faster using AI/ML to analyze airport imagery data and provide geospatial visualizations. The same company that operates at FRR is also working with the FAA to define repeatable standardized processes and procedures for using sUAS to supplement pavement management inspections using drone-mounted sensors for the delineating, analyzing, maintaining, and reporting of airport pavement data. In response to the growing UAS market and to ensure continued oversight, DOAV in 2019 developed a detailed report entitled *Unmanned Aircraft System (UAS) 2019 Guide for Virginia Airports.* This document provided detailed regulatory, security, safety, and management guidance for airport operators regarding sUAS operations on airport property. It also provided checklists for on-airport and near-airport sUAS operators including information on counter UAS technologies. Other potential airport-centric uses for UASs include

Source: DOAV.

on-airport deliveries, perimeter security, animal control, and flight/navigation system testing and verification. However, none of these other uses were noted by Commonwealth airports in the survey.

Virginia is host to one of seven official UAS Test Sites, called the Mid-Atlantic Aviation Partnership (MAAP), designated by the FAA at Virginia Polytechnic Institute & State University. The R&D system currently in place with MAAP provides an ideal conduit for UAS innovation in terms of communication, navigation, and surveillance technologies and advanced safety and operational concepts for the advancement of UAS integration in the National Airspace System (NAS). Areas that continue to show a heavy research focus include enhanced UAS detect and avoid systems, surveillance/navigation systems, and risk/safety management, ultimately with a view on longer range beyond visual line of sight (BVLOS) operations. Many of the technologies, procedures, and policies being developed for uncrewed aircraft will eventually feed into the integration of AAM/UAM operations into the NAS, which is expected to use a phased approach. Integration is expected to gradually evolve from initial proof-of-concept operations to a highly automated environment capable of high density and complex operations. The National Aeronautics and Space Administration (NASA) has outlined this phased approach using UAM Maturity Levels (UML) 1 through 6. To address initial NAS integration requirements and impacts, the FAA has similarly introduced a UAM Concept of Operations (Version 1.0 in 2020) that defines notional UAM use cases and proposed UAM operating environments. The current FAA concept includes the use of dedicated UAM airspace corridors, self-separation concepts, and integration with – and evolution of – the existing UTM system for automation and traffic management services.

As technologies, policies, and operating concepts mature, AAM stakeholders will need to adapt to changing requirements for infrastructure, procedures, and intermodal integration. Although the UTM platform is evolving through continued growth in UAS operations, issues with communication, navigation, and surveillance capabilities still need to be resolved to enable higher density and more complex AAM operations. For instance, issues with frequency saturation, message security, Automatic Dependent Surveillance – Broadcast (ADS-B) coverage, and overall UAS Traffic Management (UTM) system capacity will need to be addressed by federal and state authorities as well as local airports. Specifically, low altitude ADS-B coverage gaps in suburban areas may limit UTM system functions and impact operations. As AAM vehicles are expected to operate just above the 400-foot UAS ceiling, ADS-B coverage between 500 and 1,000 feet may be critical to enable broader geographic operations in a safe manner. As **Figure 4-3** shows, ADS-B service capabilities at 500 feet above ground level (AGL), depicted as the shaded blue areas, are well established on the eastern side of Virginia, but some mountainous and rural areas still lack full ADS-B coverage.



Source: FAA.

Figure 4-3: ADS-B Coverage at 500' AGL

Current research continues to focus on the localized impacts of high density AAM operations surrounding vertiports where ADS-B bandwidth is expected to be problematic for higher density operations. Alternatives including long range Wi-Fi and other Internet Protocol-based networking solutions are some of the concepts currently under consideration for high-density AAM operations.

Many of the guidelines required for a broader adoption of UAS operations across airports and the NAS are still being developed by federal/state governments alike. For instance, FAA recommendations on BVLOS operations were published in March 2022 through an

Advisory Rulemaking Committee (ARC) publication. Since only select larger UAS platforms are allowed to use ADS-B Out capabilities due to anticipated frequency saturation problems in high density airspace, Remote ID is designed to provide a limited range (Wi-Fi/Bluetooth) broadcast capability for other vehicles, law enforcement, and other interested parties to locate and identify UAVs.

The ARC publication also recommends changes to FAA regulations, approaches, licensing, sense and avoid technologies, and other aspects to ensure a risk-based and safer integration of UAS operations with manned aircraft. Historically, the FAA has allowed industry to drive UAS business, technology, and integration concepts. With the anticipation of UAS operations becoming more complex, extending their range, and increasing the density of operations, regulations and equipment requirements still need to be formalized and the UTM needs to take on a larger role in terms of traffic, safety, and service management.

Advanced Air Mobility (AAM)

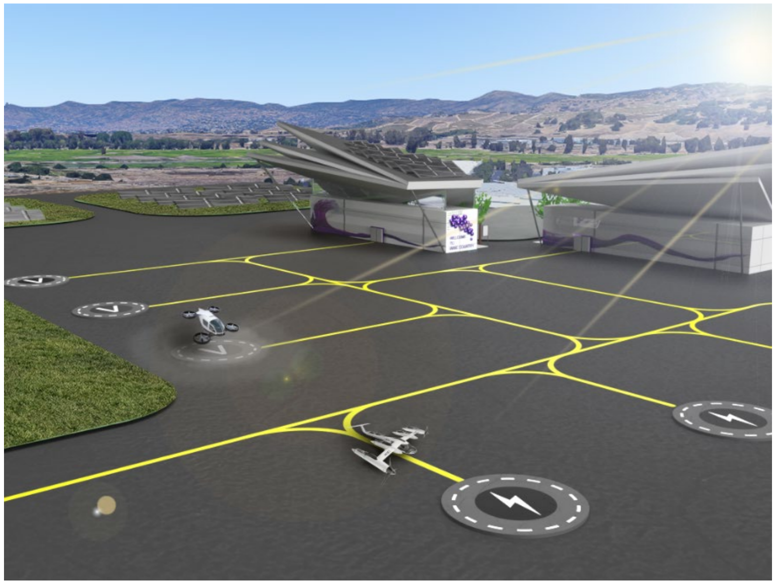
The concept of AAM is focused on the broad integration of electric vertical takeoff and landing (eVTOL) aircraft into the NAS. In many ways, AAM is essentially a scaled-up version of UASs in terms of vehicle size, supporting infrastructure, and automation systems required to ensure safe and efficient integration. In fact, AAM operations are expected to operate just above the current UAS altitude restriction of 400 feet using dedicated corridors to safely segregate vehicles and operations with commercial, military, and GA traffic. Depending on range and function, AAM operations can generally be segregated into UAM or Regional Air Mobility (RAM) concepts and, although initially expected to be piloted, can eventually also include uncrewed mobility platforms. Operational characteristics and use cases for each concept include:

Urban Air Mobility (UAM)	Regional Air Mobility (RAM)	Uncrewed Aircraft Systems (UAS)
• Local operations near metropolitan areas • Novel vertiport infrastructure • eVTOL and potentially short/conventional takeoff and landing vehicles • Limited passenger capacity (up to 4)	• Regional operations between metropolitan areas • Partially based at smaller airports • Longer range electric conventional/short takeoff and landing (eCTOL/eSTOL) aircraft • Larger capacity focused on regional connector market	• Local commercial work or cargo delivery • Operate from vertiports, airports, and smaller control stations • Typically, eVTOL aircraft

NASA has been spearheading the integration of AAM for many years and continues to support the development of aircraft vehicle platforms, traffic management systems, and operational procedures for a variety of AAM use cases, including:

- Passenger transportation and air taxi applications
- Cargo/package delivery
- Emergency services and public interest, including air ambulance and Emergency Medical Transport (EMT)
- Aerial services, including infrastructure inspection and photography.

The first AAM use cases based on emerging eVTOL vehicles will likely include cargo and medical transport services, with passenger transport following soon thereafter. The introduction of air taxi and commuter platforms at competitive prices as well as airline plans to use AAM platforms to feed hub airport demand alone promise to change how the public thinks about transportation options. Vehicle types will vary by market and range and are expected to include eVTOL as well as eCTOL and eSTOL aircraft.



Source: Mead & Hunt, Inc.

Although detailed standards and guidance are still under development by NASA and the FAA, the amount of use cases, vehicle designs, and vertiport development concepts are rapidly growing. This will require attention from state and local agencies to ensure that federal planning and policy requirements align with regional implementation strategies and industry needs.

Nevertheless, there are many questions that airports need to ask themselves in terms of land availability, vertiport location, integration with existing operations, security, electrical infrastructure, and connectivity to existing terminals or other modes of transportation. Underutilized airports may be able to promote the use of their facilities for eVTOL aircraft. But, to ensure sustainable AAM operations, airports should define their individual business cases and economic impacts for hosting AAM vehicles and services. This may include collaborating with existing airport fixed base operators (FBOs) given their expertise in providing these services today.

According to the survey conducted across all Virginia airports, more than half (39 airports) indicated that they have started to assess the impact of AAM operations on their airfield and electric infrastructure. Most responses indicate a bias towards re-purposing helipads and GA ramps and re-fitting the apron areas with electric charging capabilities. Several Virginia GA airports have indicated that they are considering AAM – or eVTOL – aircraft operations at their facilities. A vast majority of Virginia airports are within range of Virginia's major metropolitan areas, which opens up the commuter transport and regional mobility markets across most of central and eastern Virginia. Considering anticipated AAM ranges of 75 and 150 nautical miles (nm) based on proposed vehicle type designs for the UAM market, one way commute distances of 30nm and 75nm are likely to represent common use cases. This provides access to metropolitan areas located on Virginia's eastern shores to nearly 70 percent (within 30nm) and 81 percent (within 75nm) of the total Virginia population. The cost of procuring land for dedicated vertiports in urban areas may be substantial. Even heliport conversions or the use of existing airport facilities will require significant electrical infrastructure upgrades and updated security protocols. Much of this will only be feasible with public-private partnerships (P3) or other cooperative ventures, which presents an opportunity for Virginia to shape the local AAM environment. An increased burden on the electrical infrastructure for battery charging presents a pathway to use alternative and sustainable energy sources. This may also provide an additional opportunity for P3 to offset installation and maintenance costs.

AAM vehicles are being developed by several companies – including large aerospace manufacturers such as Boeing and Airbus – and business plans are in place for operators to capitalize on this emerging market. Aircraft manufacturing companies are targeting certification, testing, and initial entry to the market as early as 2024. Given the vehicles being introduced, early adoption is expected to focus on markets within 75nm of urban centers prioritizing cargo, medical flights, and air taxi connector operations to/from urban areas and airports. In fact, major airlines, including United Airlines and American Airlines, have already committed significant funding to AAM vehicle manufacturers such as Archer and Vertical Aerospace for aircraft to support regional connectivity with their hub airports.

The introduction of eVTOL aircraft will likely have a larger impact on Virginia airports and the aviation system in terms of necessary ground infrastructure for power generation and electric vehicle charging capabilities. Although historically electric aircraft have seen issues with range and flight endurance primarily due to battery capabilities, improved battery technologies and vehicle platforms are starting to be introduced as part of AAM concepts. These eVTOL aircraft are expected to operate across the state at existing airports, heliports, and newly developed vertiports in urban and sub-urban areas. Given the strategic locations of airports across Virginia and the existing infrastructure for passenger travel, it is likely that AAM companies and operators may lean towards operating out of these existing facilities for inter-city and regional travel.

Source: Mead & Hunt, Inc.

Hosting eVTOL aircraft at airports requires strategic planning regarding the integration of battery charging stations with the existing airport electrical infrastructure. A combination of low voltage and rapid charging stations will be needed to service AAM/UAM vehicles. The airport survey showed that 23 percent (or 15 out of Virginia's 66 airports) are currently planning for the integration of eVTOL aircraft, both in terms of electrical infrastructure and hangar and parking spaces dedicated to these types of operations.

The introduction of new AAM/UAM operational concepts and technologies also requires specialized skills and a supporting workforce. Several universities in Virginia already offer specializations in UASs that include the design, manufacture, and maintenance of electric aircraft, batteries, and supporting infrastructure. The need for these skills will only increase when eVTOL vehicles finally take off.

The need for renewable and sustainable energy to support the growth of UAS and AAM/UAM operations provides an opportunity for airports to leverage airport-owned land and infrastructure for revenue generation. This includes offsetting electricity grid requirements with sustainable on-airport energy generation such as solar farms. Although only one airport in Virginia, Warrenton-Fauquier (HWY), noted the use of solar and geothermal power for on-airport purposes, airports across the state could see benefits from integrating these sustainable energy sources into their infrastructure. The installation of these types of sustainable power sources is a significant capital expenditure that might not be covered by federal or state funds but may be offset by additional airport charges and P3s.

Vertiports

One of the prominent factors that will impact transportation planning at the local and regional levels is the introduction of vertiports into the existing airport and airspace infrastructure. Vertiports are dedicated AAM operating hubs that provide passenger movement facilities along with takeoff/landing, vehicle storage, and battery charging capabilities. The initial expectation is that AAM operations will focus on reusing or repurposing existing GA apron and heliport facilities that have already been approved by the FAA. However, several companies are already working on designs and concepts for dedicated vertiports in major metropolitan areas around the country, including the re-purposing of existing heliports on high-rise buildings. Larger facilities with multiple vertiports operating as AAM hubs in close proximity, also called vertiplexes, with highly integrated arrival and departure operations are also envisioned as demand grows.

To address the growing need for regulatory guidance in the development of vertiports, the FAA's Office of Airports is developing a new vertiport Advisory Circular (AC) specifically for eVTOL aircraft. Engineering Brief No. 105 – "Vertiport Design" was published in March 2022 with final guidance expected in the coming years. The EB provides interim guidance for existing safety-critical vertiport elements and is intended for manned VTOL operations in visual flight rule (VFR) conditions using specific aircraft performance and design criteria. The final AC is expected to provide expanded guidance on advanced operations including autonomy, different propulsion methods, instrument flight rule (IFR) conditions, and more aircraft types and performance characteristics. NASA is also working on integrated traffic management systems and applications for vertiports, which will eventually be deployed to the UTM platform. Both the FAA and NASA are actively conducting research into AAM operational concepts, technologies, safety, and traffic management concepts to support future operations and regulatory guidance.

Vertiports, whether based on existing facilities or newly developed, are an integral part of the AAM system. Aviation and transportation planners will need to adapt to vertiport design strategies that cater to different business processes, vehicle types, and operating procedures. Some of the areas that will require attention are:

Source: DOAV.

- **On-Airport versus Purpose-Built Vertiports.** Land availability may dictate where vertiports are developed. Vertiports located on airport property may benefit from existing airport and FBO facilities and the close proximity to passenger terminals but may be limited by existing operations. Newly developed vertiports have more freedom in terms of operations but may need to adapt their business models to the given location, facility services, and connectivity to other modes of transport.
- **Airport Airside versus Landside.** Depending on airport land availability and business concepts, vertiports may be located either airside or landside. Benefits exist for both locations in terms of intermodal connectivity, security, regulatory impacts, and supporting infrastructure. Airside vertiports will need to ensure segregation between AAM vehicles and fixed-wing aircraft and will have to observe airport obstacle free areas. Siting of vertiports on airport property will be critical to minimizing impacts on existing

operations while enabling efficient connectivity between takeoff/landing pads and existing terminal facilities. Landside vertiports may require completely new planning in terms of integration with airport operations. The survey conducted for this effort indicates a bias towards re-using airside facilities in terms of existing GA and FBO aprons as well as on-airport heliports. This is likely because airport operators understand the impacts of increased flight operations and demand on the airfield and GA/FBO operators have already shown a willingness to adopt AAM operational concepts. Landside vertiports, on the other hand, still require analysis in terms of operational and safety impacts, connectivity to airside operations, and commercial viability.

- **System Automation and Information Management.** Virginia has several metropolitan areas that are candidates for AAM operations in an urban and suburban setting. Several airports in Virginia are also in ideal locations to consider the development of dedicated vertiports. Given the anticipated future growth in AAM traffic levels, once operations commence in the 2024/25 timeframe, AAM traffic management systems, UTM services, and other aircraft platforms need to be able to access local and regional information on topics such as noise abatement rules, regulatory issues, and intermodal connectivity. Virginia's Flight Information Exchange (VA-FIX) system[2] is an initial step towards supporting automation and traffic management systems. Additional integration projects with regards to information and existing operational systems can ensure situational awareness for AAM operators and maximize aviation safety as demand for AAM grows.
- **Security.** Aircraft and passengers at commercial airport facilities operate within known security boundaries and protocols. Passengers arriving or departing at an airport are generally assumed to have passed security checks at their origin airports. For airside vertiports, security facilities may need to be provided to screen connecting passengers and luggage arriving from other origin vertiports which operate at a lower trust level. Whether these security services are provided by airports or the Transportation Security Administration (TSA) is yet to be determined. For vertiports located landside, security may well be the sole responsibility of airport operators and may depend on the level of federal funding and the relative impacts on airport operations.
- **Supporting infrastructure.** Given the predominant use of eVTOLs at vertiports, electricity may become an issue. Airports and vertiport developers should engage with local authorities and electricity providers to evaluate power grid capabilities at selected locations. Where possible, alternative renewable energy sources can be explored to meet sustainability goals set forth by DOAV and individual airports. Facilities such as weather reporting systems and ground-based systems that augment the existing Global Positioning System (GPS) used for navigation may also need to be adapted to provide more complete and accurate data and handle higher frequency operations and increasingly mobile and maneuverable air vehicles. Aircraft rescue and firefighting equipment, training, and procedures will need to be updated to consider a predominantly electric infrastructure with potential future hybrid fuel sources for eVTOL aircraft on the horizon.
- **Noise and Environmental Impacts.** Although AAM vehicles are expected to predominantly use electric propulsion methods, noise concerns and environmental impacts associated with operations, battery storage, and supporting equipment remain an issue. These will need to be managed across all stakeholders including DOAV, local officials and agencies, and vertiport operators.
- **Land Use and Permitting.** Whether adapting existing heliports for eVTOL operations or designing new vertiports at existing airports or dedicated locations, DOAV and other Virginia regulatory agencies will be required to issue operating licenses. Building and fire codes may need to be updated to address large scale

Source: Richard Lewis.

[2] The VA-FIX pilot program promotes safety and open access to information for UAS stakeholders by providing state and local government information on key safety and policy concerns regarding the integration of UAS operations into the NAS. See https://doav.virginia.gov/programs-and-services/aviation-technology/virginia-flight-information-exchange/ for more information.

battery storage and power infrastructure. Land use and zoning plans and practices may also need to be adapted to address novel commercial business types. Greater involvement with metropolitan planning organizations and planning district commissions will be necessary to address land use issues as they become more pressing.

- **Funding.** Significant investments into AAM technologies and vertiports have already been made by a variety of aviation industry stakeholders. A majority of these investments assume privately owned vertiport infrastructures with some potential for vertiports owned by aircraft manufacturers or maintenance, repair, and overhaul facilities. Irrespective of the ownership, vertiports will likely challenge power grids in a similar manner to electric vehicles. Several survey responses indicated current or planned infrastructure upgrades to provide electric charging stations at GA, FBO, and corporate hanger locations. Based on the survey responses, some airports have also started to explore partnerships with commercial businesses to install and manage electric charging stations, mainly for dedicated R&D sites. Vertiport supporting infrastructure, security services, intermodal connectivity, and other factors similar to airports will also need to be funded and managed.
- **Community Integration.** AAM operations will undoubtedly have a large impact on the community in terms of travel options, connectivity, and alternative delivery services. Although aircraft designs are predominantly electric, noise concerns, environmental impacts, and public perception remain significant factors to consider. NASA has been spearheading a community outreach initiative and is also working on community integration platforms to ensure that the general public is educated on AAM designs, operational impacts, and safety concerns. Local and state governments may also consider more targeted community outreach efforts and platforms to address and manage AAM operational, safety, and community impacts.

Vertiports do not operate in a vacuum and require passenger connectivity to other modes of transportation. Akin to electrical infrastructure, this factor should be a consideration when determining the location and size of vertiports and an early discussion point with local and state agencies.

UAS Traffic Management (UTM)

The backend infrastructure that supports UAS operations in the NAS is the UTM, which is based on a collaboration between several federal agencies and industry stakeholders. UTM manages UAS traffic in the NAS entirely segregated from the FAA's ATM systems. It takes a service-oriented approach where government and industry partners deploy drone registration, airspace reservation, flight management, and supporting service functions and provide access to users, operators, and other integrators. In line with this philosophy, DOAV has recently started to explore VA-FIX as a value-added service to UTM. VA-FIX was designed as a catalyst for collaboration among state and local agencies and UAS industry by creating an open, public information hub that everyone can use. As a software service deployed to UTM and available to operators, VA-FIX has the potential to be adapted for AAM operations and possibly address operational safety, regulatory, and noise concerns in a more dynamic fashion.

Source: DOAV.

The current approach to managing UAS traffic in the NAS is through airspace segregation and reservation. Services deployed to UTM provide registration, notification, and basic traffic management services to stakeholders but refrain from managing individual UAV traffic and trajectories. This is likely because only larger, FAA approved airframes integrate ADS-B Out location broadcasts for traffic management purposes. Smaller UAVs, according to the latest FAA guidance, are only expected to comply with Remote ID requirements to broadcast identification and location information on a local network. As UTM evolves along with AAM/UAM concepts, capabilities to integrate enhanced flight information broadcast over local and 5G cellular networks will likely evolve.

Automated vertiport traffic management systems will require this type of information for traffic sequencing, route planning, and irregular operations management. Community engagement platforms that educate vertiport and eVTOL operators as well as the general public on local/state regulations and procedures may also be helpful to manage concerns. DOAV will also need to continue its involvement with the FAA and UAS industry to ensure that agency priorities are communicated and integrated into the overall UAS system.

Remote Towers

The FAA manages and operates air traffic control towers (ATCT) at many of the nation's busiest airports. These ATCTs are federally staffed and funded. ATCT may also be staffed by private companies licensed under the FAA's Federal Contract Towers (FCT) program. A more recent FAA program called Remote Towers (RT) presents an additional opportunity for smaller non-towered GA airports through the use of fully virtual ATC environments for traffic management and situational awareness.

Currently still in the pilot program stage, the FAA has designated two initial sites for system trials focused on VFR operations at previously non-towered airports: Virginia's Leesburg Executive Airport (JYO) and Northern Colorado Regional (FNL) in Fort Collins, Colorado. As the initial pilot program airport, Leesburg Executive started in 2014 as a P3 between Saab, Virginia SATSLab, and the Town of Leesburg. Having been operational for nearly six years, the FAA's Air Traffic Services organization recently issued its Operational Viability Decision on the Saab Remote Tower system in September 2021, and subsequently has authorized the continued provision of ATC services using the RT system at Leesburg Executive. Northern Colorado Regional Airport is expected to receive an Operational Viability Decision soon using an RT system developed by Searidge Technologies.

The RT program is expected to progress through additional trial and pilot program stages to assess the viability of RT systems in increasingly complex environments. Following the initial non-towered airport installations operating in VFR meteorological conditions, subsequent pilot programs are anticipated to focus on replacing aging FAA-owned FCTs, and eventually IFR operations. Pilot program test sites are expected to favor the mid-Atlantic region due to their proximity to other FAA facilities.

Source: Leesburg Executive Airport.

Source: Leesburg Executive Airport.

Using information collected from these initial pilot programs, the FAA issued, in February 2022, a revised draft AC entitled *Remote Towers (RT) Systems for Non-Federal Applications*, which clarifies the processes and requirements for implementing RT services at single runway airports in Class D airspace environments. Specifically, the AC identifies:

- RT system approval requirements and standards
- Processes used to certify RT systems
- Processes used to commission a non-federal RT facility.

The FAA has also issued a document entitled *Remote Tower (RT) Systems Minimum Functional and Performance Requirements for Non-Federal Applications* (v3.0 in January 2022) to guide future implementations. RT installations also need to consider AC 90-93 *Operating Procedures for ATCT that are not Operated by, or Under Contract with, the United States (Non-Federal)* to ensure minimum operational requirements are considered.

One of the greatest challenges for the RT program has been the assurance of equivalent levels of safety and more directly the integration of safety requirements and the mapping to system requirements, designs, and architectures. Significant focus has been placed on verification and validation efforts to validate concepts, systems, and operations throughout the entire RT implementation process including system design approvals (SDAs), siting, installation, and commissioning. This focus is also the reason the FAA does not anticipate additional applications for system certifications until standards and guidance have been finalized.

Near-term impacts and implementations of RT systems appear limited across Virginia. Although Leesburg Executive has a certified RT system in operation, the current standards only apply to VFR single runway operations in Class D airspace. This, and the cost and maintenance of installations, are likely the reasons why, according to the survey, only five Virginia airports had considered RT systems.

Although the full range of benefits may not be achievable until RT systems, processes, and guidance have evolved to include FCT and full VFR/IFR conditions, it is clear that RT operations have the potential to improve airports. Expected benefits include cost savings from:

- Reduced control tower facility maintenance and operating costs
- More efficient use of ATC staff through the ability to serve multiple airports
- Limited requirements to maintain local ATM systems in favor of centralized RT systems
- Better level of service to operations outside of core airport hours as well as non-scheduled traffic such as ambulance and search-and-rescue operations.

In addition to these economic benefits, RT systems also present the potential for improving operations at smaller airports, including:

- Improved traffic pattern safety and reduced incident potential
- Improved traffic efficiency and reduced delays
- Reduced airspace conflicts with surrounding facilities

Full scale implementations will require airports to work with system integrators like Saab and Searidge Technologies to assess the feasibility of installing and commissioning at the local level. Given the relatively significant estimated costs of installation, operation, and maintenance, airports may consider funding options through P3 to maximize the potential of RT systems. RT system benefits should also be considered alongside of anticipated AAM operations at airports across Virginia, although these combined impacts have yet to be fully explored.

Another potential opportunity is increased involvement with upcoming FAA Remote Tower pilot programs, which will focus on replacing existing FCTs with RTs. There are only two FCTs in Virginia: Charlottesville-Albemarle (CHO) and Lynchburg Regional/Preston Glenn Field (LYH). Out of these two FCTs, Charlottesville-Albemarle may present the best opportunity to replace an aging facility with an updated RT system. The proximity to Washington, D.C. may also favor Virginia facilities for the next RT pilot program stages.

Source: DOAV.

Electric Vehicles

Sustainability is a key focus area for many airports and the aviation industry as a whole. This was recognized by DOAV in a 2016 report entitled *Virginia Airports Sustainability Management Plan,* which provided a strategic approach to airport planning, development, asset management, and resource protection, including financial, environmental, community relations, and other factors. Under the energy and emissions focus areas, energy efficiency, alternative transportation fuels, and on-airport energy generation were noted as key enablers to support sustainability practices. Until recently, electric vehicle platforms were limited to automobiles and ground support vehicles. However, aircraft manufacturers, along with federal agencies such as NASA and the FAA, are working on the development, manufacturing, and integration of electric aircraft into the NAS.

Electric Aircraft

The development of electric aircraft offers potential benefits including:

- Reduced emissions and improved air quality
- Reduced on/off-airport noise
- Reduced maintenance and ownership costs.

The continued integration of electric aircraft and vehicles will require more robust connections to the Virginia electrical grid for battery recharging stations. Charging stations can be configured to be low voltage or rapid charge capable depending on the application, customer needs, battery life expectancy, and the airport connections to the electrical grid. As business cases mature for AAM/UAM operations, commercial battery charging, and maintenance facilities may appear near designated vertiport locations that provide charging and replacement services using a mix of rapid and slow charging technologies.

Both electric ground and air vehicle applications are expected to grow in demand, particularly as on-airport UAS applications and AAM/UAM grow. This electrical infrastructure needs to be able to integrate fast and slow charging solutions at select locations on the airfield and designated facilities or hangars. Airports should ensure that appropriately sized power connections to the main power grid in combination with sustainable energy sources support this infrastructure.

Electric Ground Vehicles

Many airports across Virginia are already using electrically powered ground support equipment (GSE). The airport survey showed that nearly 25 percent of all airports have already adopted the use of battery powered vehicles for GSE. These platforms are clean and cost-effective alternatives to internal combustion vehicles that can be used across the airport for tugs/tows, refueling, and baggage carts. When considering the integration of electric GSEs, airports should consider a strategic and phased implementation approach that considers the life cycles of existing GSE along with needed updates to electrical infrastructure, regulations, and operational needs and configurations. Combinations of rapid-charging and opportunity-charging points across the airport should be considered to minimize downtime and reduce implementation and maintenance costs.

Airports with the need for landside transportation are also starting to integrate electric buses and shuttles. In March 2022, Washington Dulles International Airport announced the purchase of zero-emission electric buses as a replacement to the existing diesel-powered fleet. These buses can operate throughout an entire shift without the need to recharge.

Additional landside applications for charging stations are focused on parking structures for personal electric vehicles (EVs). As the use of EVs and hybrid vehicles continues to grow, airports are also expanding the amount of parking spaces that provide electric charging ports. According to the survey, eight Virginia airports offer electric charging capabilities throughout their parking structures. This includes primarily the large commercial airports such as Dulles International (IAD), Ronald Reagan National (DCA), Richmond International (RIC), and Norfolk International (ORF), but smaller airports such as Lynchburg Regional (LYH) and Warrenton-Fauquier (HWY) are also following suit. An even split of rapid versus

Source: Heather Ream.

low voltage charging capabilities have been observed across all Virginia airports that have implemented these charging stations in their parking structures. There appears to be a bias towards the use of rapid charging stations for EVs, based on observed airport parking preferences and the relatively small difference in costs associated with installation. Shenandoah Valley Regional Airport (SHD) installed slow charging stations and found one advantage was that nearby interstate travelers did not stop in for a recharge because of the time necessary. But the long charging time was perfectly suited for airport travelers that were leaving their vehicles in parking for multiple days. The benefit of reducing environmental footprints is an opportunity that many airports are already embracing. The conversion of existing gasoline powered vehicles into electric equivalents is an ongoing effort that has already been observed at airports across the Commonwealth. These efforts support the Commonwealths sustainability goals and a continued commitment to the environment.

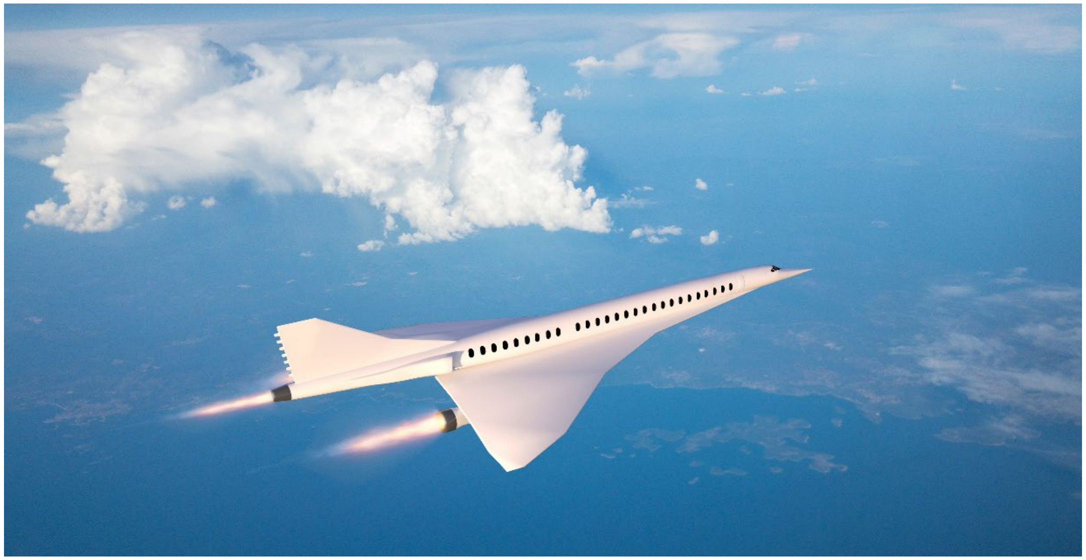
Future Aircraft Concepts

In addition to the introduction of AAM aircraft into the NAS and the development of vertiports across Virginia, other new aircraft concepts may change airport planning and operations. One such example is airlines re-introducing supersonic aircraft to commercial service airports. In 2021, United Airlines made a commitment to purchase a series of aircraft from Boom Supersonic with an anticipated introduction date set in 2029. The Boom Overture aircraft has a seating capacity similar to a regional jet, but the airframe and aircraft design is adapted to supersonic flight. The current expectation is that supersonic aircraft will operate much like conventional commercial aircraft at and near airports and only fly at supersonic speeds at higher altitudes across the NAS.

To prepare for new supersonic aircraft and enable a more wide-spread use, NASA is currently investigating the impacts of supersonic flight over the continental United States. Previously only certified in oceanic airspace due to sonic boom impacts, current NASA research is focused on mitigating and managing these noise impacts overpopulated areas using novel designs and procedures.

A more fundamental change that may impact airspace and airport operations across the country is likely to be the continued growth and evolution of the commercial space transportation industry. The demand for space vehicles using vertical launch and recovery platforms is expected to grow over the coming decades to support a variety of business ventures including orbital supply missions, space exploration, and space tourism. This includes existing and planned launch operations at Virginia's Mid-Atlantic Regional Spaceport, one of nearly two dozen spaceports licensed by the FAA across the United States. Additional horizontal take-off and landing vehicles are also currently being developed and tested, which have the potential of greatly reducing the cost of access to orbit. The use of existing airport runways and adapted supporting infrastructure and facilities for space vehicles may create new opportunities and business cases for GA airports.

For either of these operational concepts and business cases, a forward-thinking focus on operational and technological sustainability and relevant community impacts is needed to ensure successful early-stage adoption and continued growth.



Source: Mead & Hunt, Inc.

Sustainable Aviation Fuels

According to the U.S. Department of Energy (DOE), sustainable aviation fuel (SAF) reduces greenhouse gas (GHG) emissions compared to conventional piston and jet fuel options. In fact, existing piston-engine fuels still contain lead, but are slowly being replaced with lead-free options. According to the Environmental Protection Agency (EPA), GHG emissions have generally shown a decline across the aviation industry when compared to 1990 (even at the pre-Covid levels). But SAF has the potential to significantly reduce the aviation GHG footprint, which currently makes up 9 percent to 12 percent of U.S. transportation GHG emissions (see https://www.epa.gov/system/files/documents/2022-05/420f22018.pdf).

Source: Mead & Hunt, Inc.

On the GA front, the FAA has been working with industry stakeholders including aircraft manufacturers, fuel suppliers, and the EPA to develop and commercialize new lead-free high-octane alternatives to avgas 100 low lead (LL) since 2010 through industry groups such as the Piston Aviation Fuel Initiative. Based on these efforts, nearly 70 percent of GA power plants are now qualified for drop-in unleaded fuel. However, the remaining 30 percent of engines, all of which require higher octane fuel, account for nearly 80 percent of the total avgas use across the Unites States, leaving a large part of the fleet waiting for more environmentally friendly fuel options. The challenge to find a successful and safe alternative that is equally acceptable and desired by the public, pilots, and regulators remains. With this in mind, the FAA joined aviation and petroleum industry stakeholders in February of 2022 in a public-private partnership with the goal of lead-free aviation fuel for piston-engine aircraft by 2030. The initiative, called Eliminate Aviation Gasoline Lead Emissions, will focus on investments, policy, and necessary industry actions to operate lead-free without compromising safety and the economic and public benefits of the GA industry.

Jet aviation is equally keen on replacing existing fuels with more environmentally friendly options including biofuels. As the commercial aviation market and demand grows, SAFs are seen as a critical enabler for decoupling emissions and carbon growth from market growth. Depending on the source and thermochemical production process, SAF biofuels made from renewable biomass and recycled carbon waste products can match petroleum-based jet fuel performance at a fraction of the carbon footprint. They can also reduce emissions by up to 80 percent in a full life cycle.

According to a recent SAF Technical Pathway Report published by the DOE, the airline industry has committed to carbon-neutral growth in international commercial aviation beginning in 2021 and U.S. airlines have set a goal to reduce carbon dioxide emissions by 50 percent in 2050 compared to 2005 levels. This mainstream goal can only realistically be achieved when SAF prices match or beat petroleum-based jet fuel costs, which requires significant research, development, and investments in production technologies, supply chains, and ultimately airline commitment to drive demand. Although many current transportation policies and approaches are still leaning towards diesel as a renewable fuel in contrast to the commercial airline jet market, the production of biofuels is expected to scale up rapidly over the coming decade as the commercialization potential grows and environmental policies adapt.

For SAF implementation, stakeholders – including regulators, operators, and manufacturers – need to focus on:

- Improving SAF production and aircraft engine technologies
- Improving recycling and agricultural supply chain processes
- Forming unified global markets and agreements to address the carbon emission gap
- Implementing policies that reduce investment risks and support new market entries
- Committing to implementation policies with matching investment timeframes.

Given its location on the East Coast, airline commitments and demand in the region, the GA market size, and technological capabilities, Virginia is well positioned to support R&D as well as further the adoption of SAFs across the GA and commercial aviation community. DOAV has supported SAF research efforts by the University of Virginia's Center for Risk Management of Engineering Systems as far back as 2011. That research has highlighted that the waste products of Virginia's timber industry are an excellent feedstock for the creation of SAF. Coupled with the Colonial and Plantation pipelines running through the state, Virginia is well positioned to lead the development of the SAF market.

Regulatory agencies, operators, and other stakeholders need to jointly develop and implement federally and globally recognized standards that build on regional and local sustainability models through policy incentive frameworks that focus on aviation rather than other transportation modes and energy alternatives. Support for SAF R&D and demonstration projects can also be leveraged to engage in P3 for fuel production and supply and ultimately accelerate SAF price reductions and support industry-wide adoption.

NextGen Concepts and Systems

The FAA's NextGen is a modernization effort focused on the definition and implementation of operational, technological, and procedural improvements to the NAS. The goal is to increase NAS safety, capacity, predictability, and access while reducing noise and environmental impacts inherent to aviation. NextGen introduces various technologies, systems, and operational procedures that allow aircraft to safely operate in congested airspace, fly more direct routes, and overall reduce system delays. The following list contains some of the relevant components that make up NextGen and may impact Virginia airports, airlines, operators, and the aviation system as a whole:

- ADS-B
- System Wide Information Management
- Performance Based Navigation Procedures
- Trajectory-Based Operations (TBO)
- NextGen Weather
- Geographic Information Systems (GIS)
- Enroute and Terminal Automation System Updates
- Communication System Updates

While many of these upgrades are transparent to airport operators and state regulators, some of the components have defined impacts on operations and policy decisions. These include ADS-B, TBO, Information Management, and GIS.

Automatic Dependent Surveillance – Broadcast (ADS-B)

ADS–B is a surveillance technology by which aircraft use satellite navigation to determine and broadcast their positions to other aircraft as well as ground automation systems. Part of NextGen, ADS-B was originally intended as a secondary radar system replacement that provides higher frequency and accuracy of location information for aircraft throughout all phases of flight. ADS-B avionics broadcast aircraft information, position data, and limited flight intent even in areas where radar coverage may be degraded. ADS-B is supported by a terrestrial communications infrastructure to receive and re-broadcast messages for a variety of stakeholders.

As of 2020, ADS-B Out capabilities are mandated in the United States for aircraft operating in Class A, B, and C airspace, as well as certain other controlled airspace. Future concepts such as AAM and UAS (for BVLOS operations) are also depending on ADS-B to support operational concepts and automation systems. Ensuring adequate low-level ADS-B coverage across Commonwealth airspace will be essential to enabling these emerging concepts as well as operations in radar-limited locations.

Source: Nancy Lewis.

Trajectory Based Operations (TBO)

Various NextGen components call for ATC services to transition to TBO in the near future. Four-dimensional trajectories (4DT) are representations of predicted flight paths and trajectories along an aircraft's entire route. TBO will provide improved knowledge of the estimated time of departure and the arrival time at each waypoint along the entire route of flight. Shared via datalink systems, this will ensure the ground automation systems are aware of clearances provided to the flight deck, resulting in a consistent view of the 4DT across the NAS. TBO is expected to support enhanced traffic flow planning and increasingly improve the ability to handle demand-capacity imbalances or off-nominal events in a more strategic and efficient manner. The improved predictability associated with TBO may also lead to a reduction in the separation buffers that controllers use to account for uncertainty and a significant decrease in the use of less efficient tactical maneuvers issued to maintain safe separation. TBO provides the ability for aircraft to fly the most optimal route and for ground automation systems to manage NAS resources based on ground-generated estimates of aircraft arrival times along the route. Airports, vertiports, and other service providers will be able to offer navigation and traffic management services based on vehicle avionics and navigation performance, commonly known as performance-based navigation.

While ADS-B provides limited aircraft intent information, trajectory definitions provide the entire predicted aircraft path, which can be used by traffic flow management applications for strategic and tactical planning purposes. TBO is expected to play a significant role in future AAM/UAM and UAS BVLOS applications to ensure operational predictability and continually assess flight path conformance.

System Wide Information Management (SWIM)

SWIM and advanced datalink technologies support the sharing and negotiation of flight, airport, and weather information between aircraft and ground automation systems. Using standard XML-based protocols, information that is normally available through dedicated sources and applications can be shared across all SWIM network connected systems. SWIM enables the sharing of consistent flight data between all stakeholders (FAA, Department of Defense, Department of Homeland Security, flow management systems, airport operators, aircraft operators, and aircraft systems) and facilitates more informed real-time decision making while also increasing situational awareness, ultimately leading to capacity and safety improvements across the board. SWIM data models are organized around specific international standards including:

- Flight Information Exchange Model (FIXM) data for aircraft flight and flow information
- Aeronautical Information Exchange Model (AIXM) data for airport-related information
- Weather Information Exchange Model (WXXM) data for NextGen weather information

The SWIM information management and sharing capabilities support a key objective for the ATM community in support of an interoperable global air traffic management system. It gives stakeholders – including aircraft and airport operators – seamless information access and interchange capabilities between all providers and users of ATM information and services. This supports existing and future business processes, concepts, and applications for airport and aircraft operators at large, medium, and small airports. Particularly for smaller airports, the development of mobile applications that connect GA operators with relevant local traffic, weather, and regulatory information is a current focus for the FAA and industry.


Source: Mead & Hunt, Inc.

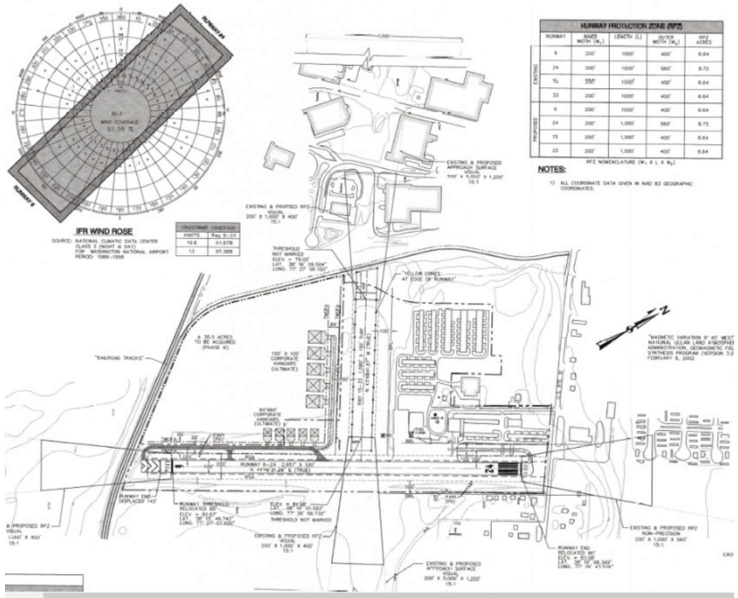
Using information sharing platforms such as SWIM, applications can be developed for airports – commercial service and GA – which integrate airport and flight information with additional data sources, such as ADS-B, to provide value-added services in areas such as:

- UAS/AAM traffic flow management
- AAM fleet management
- Ground/airborne-based sense and avoid
- GA airport & vertiport self-separation
- UAS/AAM/GA pilot advisory tools
- UAS BVLOS operations

Many of these applications can integrate AI/ML to study patterns in operations and provide for pathways to a safer NAS.

Geographic Information Systems (GIS)

Another area where standardized and centralized information management can support Virginia airports is in the area of GIS. Many airports lack GIS expertise and frequently contract out geospatial tasks to consultants including tasks such as the development of ALPs, land use compatibility, and obstruction analyses. As online GIS platforms become more mainstream and relevant FAA, and DOAV, data sources are standardized and made available online, GIS analyses may increasingly be carried out by airport staff. Using the FAA's Airport Geographic Information System, a part of the Airport Data and Information Portal, standard airport GIS artifacts can be maintained to help store planning, design, construction, and engineering information in standardized databases to leverage reports and applications for better decision-making purposes.



Source: DOAV.

Artificial Intelligence and Machine Learning (AI/ML)

Despite the potential advantages of using UASs in these capacities and the efficiency and accuracy of the data collected, many airports today do not fully understand or use existing information and data analytic functions at their disposal. Operational, financial, and administrative information is collected and stored but rarely used to make decisions.

The application and integration of AI/ML concepts as part of airport and aviation data analytics processes is already prevalent across the industry. Data analytics dashboards and ML algorithms are used to provide actionable and real-time insights in areas such as airport airside and landside operations, terminal processes, passenger trends and demographics, and energy consumption. These analytical concepts are combined with AI algorithms and functions including object recognition capabilities in passenger terminals and on airside aprons. Together, AI and ML provide airports with tools to develop accurate digital models of their operations and processes based on a combination of historic and real-time data. These can be used to provide prediction, alerting, and optimization functions to operators, managers, and front-line staff.

Like the rest of the United States, most airports across Virginia do not have dedicated capabilities and resources to embrace the integration of AI and ML concepts into daily operations or even periodic planning functions. Information is increasingly formatted and intended for integrated analytics platforms and functions at the local, regional, and state levels. However, the automation functions to ingest, process, merge, and ultimately extract results need to be developed and maintained to gain value from these concepts.

Summary

The Commonwealth of Virginia continues to embrace novel aviation, aircraft, and air traffic concepts. This includes the integration of AAM concepts into day-to-day operations as well as continued research and development into remote tower systems. Virginia's existing focus on the UAS market and its broad expertise in relevant technologies and operations provides a conducive environment for these emerging concepts.

As new concepts, aircraft types, technologies, aviation fuels, and analytical processes promise to reshape the aviation industry over the next decades and change the way the population thinks about transportation, it is important to ensure that planning practices, investment decisions, regulatory policies, and a community platform are aligned to maximize the respective benefits.