Washington State Aviation System Plan

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Washington State
Department of Transportation

WASP
Washington Aviation System Plan

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CHAPTER 1 – OVERVIEW

1.1 Background

The Washington State Department of Transportation (WSDOT) has responsibility for the integrated stewardship of the state's multimodal transportation system. WSDOT's Aviation Division (WSDOT Aviation) supports aeronautical activities and the state's aviation system in the Division's role of advocating for preservation of aviation facilities, safe air transportation, airport capacity to meet demand, and mitigation of environment impacts. The state's ability in meeting this interest is achieved primarily through advocacy and partnership.

Understanding the importance of aviation to the transportation system and economy within the state, WSDOT Aviation has taken a comprehensive approach to aviation system planning to ensure the agency is primed to handle future challenges and opportunities. The Division provides technical resources and uses a cooperative approach to work with public-use airports, communities, planning organizations, and local decision makers to set a policy direction for the aviation system. The objective of providing these resources and this approach is to ensure the viability and adequacy of air transportation for the State and its citizens. Meeting this objective requires planning and WSDOT Aviation continues to plan for its airport system through several programs, including conducting long-term planning such as this Washington Aviation System Plan (WASP) in order to address the challenge of maintaining and improving the statewide aviation system for the future.

1.2 Overview of 2015 WASP

Authorized by Revised Code of Washington (RCW) 47.68, WSDOT's Aviation Division initiated an update of the WASP in 2015 to study the performance and interaction of the state's entire aviation system and the contribution of the individual airports to that system. Together, the airports that comprise the system function as a whole in serving aviation demand, driven by economic and transportation needs.

WSDOT's focus is on the public-use airports in the state that include both publicly owned and privately owned facilities. Over time, airports can change their status going from private use to public use or vice versa, impacting the number of airports considered to be part of the WSDOT system at any point in time. At the outset of the WASP, 136 airports were identified as being open to the public; these airports are analyzed and identified in all subsequent WASP analyses. However, during the course of the study, an additional airport became public use. This change does not affect the WASP's overall findings in terms of future demand, capacity needs, or the policy recommendations.

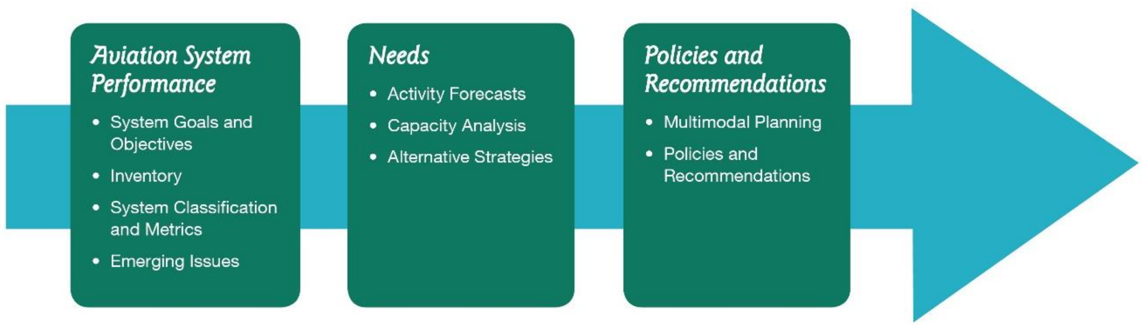
The State's first Aviation System Plan was adopted in 1973 and has been updated numerous times including in 1993, 1998, 2001, and 2009. **The WASP provides WSDOT with analysis of the system's needs from examining the existing available facilities, to estimating future demand, evaluating future needs, and providing recommended policy direction to support the system's future development.**

The priorities of the WASP are to:

- Identify issues and evaluate impacts to determine needed airport and system improvements
- Develop performance goals and metrics to better meet the aviation needs of communities and the aviation system as a whole
- Serve as an effective decision-making tool for the development of policies and recommendations that will advance Washington's aviation system

There are three main elements of the WASP as depicted in Figure 1-1. The tasks within the elements are described below.

Figure 1-1. Main Elements of Washington Airport System Plan



1.2.1 Aviation System Performance

The first element included developing a series of system goals and performance objectives that define what is important for the system and how the goals should be measured and evaluated. To support the measurement of performance, an inventory of the airport system was conducted. The inventory is used to support subsequent analyses of the WASP, providing a baseline of information about the existing system's facilities and its ability to serve demand. The inventory also reviewed the existing multimodal infrastructure in the State and how aviation ties into the overall transportation system.

A key task needed to support evaluation of the system's performance was the update of airport classifications for the Washington system of airports. Airport classifications are used to convey how airports contribute to community and state in terms of functions and activities at airports and measuring the system's performance in achieving the established goals and objectives. Airport metrics were also established that relate the types of activities served within the different airport classifications to minimum standards or recommended minimums. These metrics can help the system work toward target performance levels for the system goals and objectives. The airport metrics provide parameters for airports to understand what is needed to fulfill their roles within the system, increasing the overall system's performance and its ability to better serve the aviation activities that occur throughout Washington.

A series of emerging trends and issues such as the Next Generation Air Transportation System (NextGen), general aviation infrastructure funding challenges, alternative fuels, aerospace manufacturing, and unmanned aerial systems (UAS) were reviewed to determine their potential impact to the system, especially as they relate to their impact on future activities, policies, and infrastructure needs. The emerging issues were considered in subsequent tasks of the WASP including the alternatives analysis and policy recommendations.

Needs

Activity forecasts were developed for each airport for indicators such as operations and based aircraft. Commercial service and air cargo forecasts were also developed, where appropriate, to ensure a comprehensive evaluation of the future demand for aviation activity at the airport, regional, and statewide levels for the three pillars of aviation demand: air cargo, commercial airline service, and general aviation. The forecasts and information gleaned from the emerging issues were compared to the inventory effort to determine future capacity and other infrastructure needs within the system. The capacity analysis provides an understanding of the primary needs to support operational and storage capacity in the state.

Based on the infrastructure needs, a series of alternative strategies were analyzed at the statewide, regional, and airport levels to determine the system's interactions and how to support emerging issues, aviation activities, and capacity needs. These strategies were developed to assist airports in better serving customer needs, increasing revenue, creating a competitive advantage, and enhancing ties to the community served by the airport.

Policies and Recommendations

The airport alternative strategies and airport metrics, along with evaluation of system needs related to achieving the goals and objectives, resulted in development of policy recommendations. Multimodal planning was a key factor in the recommendations process, and recommendations on integrating aviation into statewide planning and practical solutions were developed to support statewide policies.

Throughout the WASP process, community engagement was a key component to ensure a comprehensive and thoughtful evaluation of the needs and impacts was conducted that results in recommendations that support the aviation system and public's best interest. **WSDOT Aviation's mission statement identifies that the organization "fosters the development of aeronautics and the state's aviation system to support sustainable communities and statewide economic vitality".** Stakeholders were provided information through a variety of sources including media releases, websites, social media, newsletters, workshops, and surveys.

1.3 Prior WSDOT Aviation Planning Studies

WSDOT Aviation has a long history of supporting its aviation system and engaging stakeholders through numerous efforts including conducting studies, convening working groups, and promoting aviation outreach and education. WSDOT Aviation understands the value of evaluating needs that help to maintain and improve the preservation of the system and its safety, as well as document the important contributions of the aviation system to the state's transportation and economic activities. Several of the key WSDOT Aviation studies are summarized below.

1.3.1 2009 Long-Term Air Transportation Study

The last statewide system plan for Washington was completed in 2009 as part of the Long-Term Air Transportation Study (LATS). **The LATS initiative was authorized in 2005 by the Washington State Legislature through Engrossed Substitute Senate Bill 5121.** The transportation bill required WSDOT to conduct a study of statewide needs for general aviation and commercial aviation. The purpose was to understand capacity conditions of the time. In addition to the traditional elements of a State Aviation System Plan, LATS examined commercial aviation needs across the State and included four special emphasis regions identified in the legislation: Tri-cities, Spokane, Puget Sound and Southwest Washington.

LATS identified the statewide air transportation needs and solutions based on demand expectations for a 25-year period. An Aviation Planning Council was established in the third phase of LATS to make policy recommendations to help realize the substantial economic resource present in the aviation system, which was viewed as not properly protected under state laws and was vulnerable to encroachment and a lack of funding. LATS developed a series of recommendations including WSDOT clarifying its role and responsibilities related to the aviation system as the primary steward and advocate. This specifically included providing adequate land use protections, recommending system improvements and strategic investments to support and maintain critical aviation facilities throughout the state, and work as a partner to various stakeholders to aviation.

1.3.2 2012 Aviation Economic Impact Study

The 2012 Aviation Economic Impact Study was intended to provide a broad understanding of the role and contribution of Washington's public use airports to the statewide economy. An update to previous economic impact analysis work conducted as part of the 2001 Aviation Forecast and Economic Analysis Study, and building on other WSDOT planning efforts such as the 2009 LATS/Washington Aviation System Plan (WASP), recommendations of the Washington State Aviation Planning Council, and the development of the Airport Information System (AIS), the 2012 Study also served to establish the types of activities that are accommodated at airports.

Airports create economic output by providing jobs, support of businesses, and access for tourism, but the impacts are not widely recognized, especially how individual airports contribute to local communities both quantitatively and qualitatively**. The study identified 17 aviation-related activities that are supported by the airport system, providing information on the user value of each airport.** The study estimated the total impact attributed to airport-related activity at the 135 public use airports included: 248,500 jobs, $15.3 billion in wages and $50.9 billion in total economic activity. The study also noted that more than $791 million in tax revenue was generated from aviation activities, with over $548 million supporting the State of Washington general fund, while cities, special purpose districts, and counties collected approximately $243 million in tax revenue.

The study's findings assisted WSDOT with promoting and advocating for the protection and enhancement of the aviation system interests. The study provided suggestions on how WSDOT and other policymakers could use the results in regard to strengthening state legislation; preserving airport capacity; reviewing and ensuring adequate land use, accessibility, and mobility; the importance of rural airports; and the impact of costs, job growth, and diversity.

1.3.3 2013 (and prior) Airport Pavement Management System

Starting in 1999, with subsequent updates in 2005 and 2012/2013, WSDOT Aviation initiated an Airport Pavement Management System (APMS) to provide the airports, State, and Federal Aviation Administration (FAA) with information on the costliest piece of infrastructure in the aviation system, the pavement. Approximately every five years, WSDOT Aviation conducts a system-wide study of the relative condition of pavements for selected Washington airports. **The APMS serves as a tool to identify system pavement needs, shape programming decisions for federal and State grant aid, provide information for legislative decision making, and assist airport sponsors in making informed planning decisions.** The program also develops accurate pavement inventories and identifies necessary maintenance, repair, rehabilitation and reconstruction projects. The APMS updates enable WSDOT Aviation and the FAA to make proactive, cost-effective, and strategic investments into the pavements at Washington's airports, and allows for effective communication with legislators, decision makers, and airports regarding the pavement needs at Washington airports.

1.3.4 2014 Airport Investment Study

WSDOT initiated a two-phased Airport Investment Study project to evaluate current funding levels for airport preservation and safety projects, assess short-term and long-term airport improvement needs, and determine the consequences of doing nothing relative to changing the investment in airports in terms of economic and aviation system impacts. Initiated in 2013, phase one included stakeholder meetings and concluded with the publication of a comprehensive report for future stakeholder reference. Phase two, also referred to as the Airport Investment Solutions Study, identified and analyzed potential solutions to meet Washington's aviation system needs.

The first phase of the Airport Investment Study found that the State's public-use airports needed $3.6 billion in projects during 20-year period from 2014-2034. The existing funding programs were not sufficient to meet the identified needs, with an estimated average of $8.4 million per year as the State's portion of the overall $3.6 billion in project needs. The second "Solutions Phase" reviewed potential strategies to address the shortfall and noted the potential consequences of not meeting the project needs. The study's solutions included both funding and nonfunding related approaches that benefit the aviation system and as many of its users as possible. The study provided WSDOT Aviation with feasible solutions and implementation strategies that WSDOT or other aviation stakeholders may leverage to address the statewide airport preservation and capital needs.

1.4 Report Layout

The remainder of the WASP is organized by chapter including the following:

- **Chapter Two: Goals, Objectives, and System Performance Measures**—This chapter identifies the aviation system's goals, objectives, and establishes performance measures for the airport system. The goals from this chapter are used throughout the WASP, serving as a cornerstone of the plan's elements.
- **Chapter Three: Inventory**—This chapter documents the existing airport system's conditions. In addition to airport infrastructure, the chapter provides information on aviation activities at the airports and provides a summary of Washington-specific state, regional, and local issues.
- **Chapter Four: Aviation Trends and Projections**—This chapter summarizes the national and Washington-specific trends in aviation demand that influence projections of future activity. Forecasts of demand through 2034 relative to commercial aviation, general aviation, and air cargo are also included. From enplanements at commercial service airports to based aircraft and operations at all airports and cargo at the existing airports with this activity, this chapter establishes the future demand projects for the airport system through 2034.
- **Chapter Five: Capacity Analysis—**This chapter examined the capacity of the system in terms of airfield, aircraft storage and parking, and air cargo facilities. The results of the analysis are used to inform potential alternative strategies and the policy recommendations of the WASP.
- **Chapter Six: Classifications and Airport Metrics—**This chapter evaluates existing classification systems and recommends a new classification system for Washington's airports. These classifications

are used in conjunction with the goals of the system to develop airport metrics, some of which are considered minimum standards and others are recommended minimums that airports should strive to achieve. An analysis of Washington's airports relative to current FAA National Plan of Integrated Airport Systems (NPIAS) criteria is also included.

- **Chapter Seven: Alternative Strategies**—This chapter provides insight and information related to strategies or options at the statewide, regional, and airport levels available to meet Washington's aviation needs. The chapter starts with identification of considerations related to key emerging issues from a statewide perspective. Analysis of regional activities and capacity concerns and accessibility of the system is provided to inform future decision making on the regional level. Finally, a process is proposed to develop airport alternative strategies for consideration by the airports, with examples provided based on working group input.
- **Chapter Eight: Multimodal Planning—**This chapter provides information on planning for multimodal connections between airports and other modes of transportation. Practical Solutions are identified, including policies and recommendations related to airport land use.
- **Chapter Nine: Policy Recommendations**—This chapter is the culmination of the WASP and summarizes the policy recommendations according to each of the goal categories. It also identifies a continuous planning process and potential studies for consideration to preserve the longevity of the WASP.
- **Appendix A: Acronyms**—A listing of acronyms utilized throughout the WASP is provided.
- **Appendix B: National, State, Regional and Local Emerging Issues**—This appendix is a compilation of the eight papers prepared on the emerging issues topics including:
  - B.1 Unmanned Aircraft Systems in Washington State
  - B.2 Aircraft Innovation
  - B.3 Preparing Airports for NextGen Implementation
  - B.4 Decline in General Aviation Activity
  - B.5 Contract Tower Funding Challenges
  - B.6 Aerospace Manufacturing
  - B.7 Aircraft Fuels
  - B.8 General Aviation Infrastructure Funding Challenges
- **Appendix C: Airport Classification Lists**—This appendix provides a summary of the airport classifications by associated city and by classification, by associated city.
- **Appendix D: Public Outreach Summary**—This appendix summarizes the public outreach efforts conducted throughout the WASP.

CHAPTER 2 – GOALS, OBJECTIVES, AND SYSTEM PERFORMANCE MEASURES

The Washington State Department of Transportation (WSDOT) initiated an update of the Washington Aviation System Plan (WASP) to study the performance and interaction of the state's entire aviation system. Together, the airports that comprise the system function as a whole in serving aviation demand, driven by economic and transportation needs. The WASP provides WSDOT with analysis of the system's needs from examining the existing available facilities to estimating future demand, evaluating future alternative scenarios, and providing recommended policy direction to support the system's future development.

The first step in the WASP consisted of establishing goals, objectives, and system performance measures. *Goals* are used to define what is important for the system. *Objectives* describe the goals, providing a framework around understanding the goals from the aviation system's perspective. *System performance measures* identify quantitative means to evaluate how the system is achieving the goals and objectives. Together, the goals, objectives, and system performance measures establish the foundation for subsequent evaluation of the system's needs.

2.1 Process

The WASP serves as the roadmap for Washington's aviation system, one of many modes within the State transportation system. As part of establishing goals for the WASP, the Washington Transportation Plan (WTP) 2035 policy goals, which are organized based on transportation system policy goals from RCW 47.04.280, were reviewed in reference to the aviation system. The six transportation policy goals include the following:

- **Economic Vitality:** To promote and develop transportation systems that stimulate, support, and enhance the movement of people and goods to ensure a prosperous economy
- **Preservation:** To maintain, preserve, and extend the life and utility of prior investments in transportation systems and services
- **Safety:** To provide for and improve the safety and security of transportation customers and the transportation system
- **Mobility:** To improve the predictable movement of goods and people throughout Washington state including congestion relief and improved freight movement
- **Environment:** To enhance Washington's quality of life through transportation investments that promote energy conservation, enhance healthy communities, and protect the environment
- **Stewardship:** To continuously improve the quality, effectiveness, and efficiency of the transportation system

Through meetings and workshops with the WASP Advisory Committee, eight goals were identified for the WASP. The WASP goals reflect the core of the above six transportation policy goals, as well as provide for additional goals that are needed to support the aviation system. The WASP goals are as follows:

- Aeronautical and airport safety
- Economic development and vitality
- Education, outreach, and community
- Infrastructure improvement, preservation, and capacity
- Aviation innovation
- Modal mobility, capacity, and accessibility
- Stewardship
- Sustainability

The goals above are listed in the general priority determined through the meetings and workshops, indicating those goals that are most critical to the Washington aviation system's future. The following summarizes each of the Goals and provides more description of the objectives and system performance measures for each goal. As described in a subsequent development, as part of the WASP, WSDOT established a series of airport metrics that support the overall strategic goals of WSDOT. The airport metrics are tied directly to each goal for the WASP and address specific parameters to evaluate how each airport is supporting the aviation activities that exist at the airport, which allows the overall system to function most effectively.

2.2 Aeronautical and Airport Safety

The goal of *Aeronautical and Airport Safety* is intended to ensure airports are improving safety performance and efficiencies. The objectives of this goal include attaining and maintaining WSDOT's airport metrics and FAA design standards, including maintaining safe and clear approaches.

As identified in a series of advisory circulars and orders, FAA publishes design standards that facilitate development of a national system of airports that is safe, accessible, and cost-effective. FAA's design standards represent standards and recommendations for airport design are mandatory for obligated airports, and represent "best practices" for unobligated airports relative to airport design based on extensive research. The FAA design standards reflect an effective national approach for meeting the long-term aviation demand in a manner that is consistent with national policy, with safety being the highest priority. Significant effort should be made for airports to meet applicable standards not only for safety purposes but also, for those airports that are obligated, and because funding may depend on it. Airports that are included in the FAA's *National Plan of Integrated Airport Systems* (NPIAS) are those designated as eligible for federal funding that is focused on ensuring airports are meeting design standards and providing safe and efficient facilities.

WSDOT has placed a priority on ensuring airports have safe approaches, including having clear Federal Aviation Regulation (FAR) Part 77 surfaces, and that there are no obstructions in the threshold siting surfaces (TSS)[1] for the primary runway ends. These surfaces are analyzed by airports during planning and design and correspond directly to the types of aircraft and approach procedures available at the airports.

Following are the system performance measures for the Aeronautical and Airport Safety goal:

- Airports that meet WSDOT performance objectives, including NPIAS airports that meet current FAA design standards
- Airports with clear Part 77 approaches and threshold siting surfaces (TSS)
- NPIAS airports that meet current FAA/state design standards

2.3 Economic Development and Vitality

The goal of *Economic Development and Vitality* is to ensure airports are advancing the business opportunities leading to economic prosperity in the airport environment and within the surrounding community. The objectives for this goal include supporting and increasing the opportunity of the transportation of goods and passengers utilizing air service, enhancing collaboration between the airport and its community to maintain and support economic growth and development, and increasing tenant revenues by promoting on-airport aerospace manufacturing jobs.

The most recognizable forms of aviation by the majority of consumers are commercial passenger service and air cargo or freight service. Many consumers utilize commercial passenger service to fly either for business or pleasure and are familiar with scheduled passenger airlines, while others may utilize air cargo or freight to ship packages. Definitive links exist between aviation and the vitality of the state's economy, as well as opportunities for future economic development. Support and increased opportunities for commercial passenger and air cargo services is an important objective of the State's aviation system.

Air cargo provides connectivity of communities and businesses by providing quick access to time-critical, high-value products. Most airports can handle air cargo, whether it is a load of vehicle repair parts to a remote area by seaplane or large nationwide carriers that move millions of tons of air cargo annually. Many of Washington's airports accommodate air cargo, however, much of the cargo data is not tracked. Airports can benefit from monitoring and measuring the cargo carried by commercial airlines and small 'express' package carriers, to demonstrate a variety of supported aviation activities, job and wage contributions, and airport support to the community.

By actively developing partnerships with local economic organizations, airports are able to identify and capitalize on future opportunities that will grow the airport in a manner that is consistent with the community's drivers. Within Washington State, an important economic driver is the aerospace industry, which supports thousands of jobs. Many of these jobs are located at or near airports, which provide opportunities for airports to support the regional and statewide economy as well as provide a mechanism to generate revenue for the airports. The collaboration and partnerships between airports and economic development are an important objective in achieving economic vitality for the state.

Following are the system performance measures for the Economic Development and Vitality goal:

- Airports with documented air cargo activity (by type) and strategy/market and airports with growing (greater than 1 percent per year) commercial airline service

[1] The threshold siting surfaces ensure compatibility between nearby objects and the runway's threshold, which is defined as the first part of pavement available and suitable for landing.

- Airports with active development partnerships with chambers of commerce, tourism bureaus, service organizations, industries, governments, and recreational user groups
- Airports with business parks or landside real estate development (existing and available) and those with on-site aerospace manufacturing leases

2.4 Education, Outreach, and Community Engagement

The goal of *Education, Outreach, and Community Engagement* is to promote aviation and its importance, impact, and activities on a broad level extending beyond just the airports. The objectives include promoting aviation education to enhance safety and community support, increasing community knowledge of the aviation systems to communicate airport benefits and contributions to local communities and economies, and promoting aviation activities matched to local and aviation community needs.

By promoting aviation through education, the airport helps further aviation to create a sustainable future of aviators and promotes a more knowledgeable community that understands aviation and airports. Education programs may be in need of land to build facilities, existing facilities to host events, aircraft and automobile parking, or access to the airfield depending on the type of program. This may also include supporting programs such as Young Eagles that introduces children to aviation through flights from local pilots or airport staff participating in a career development day at a local school. Additionally, by providing opportunities for the aviation and non-aviation community to provide feedback to the airport helps in the overall success of the airport. As airports seek to maintain and improve facilities, community support is needed and the knowledge and understanding generated through education, outreach, and engagement helps to build this support for airport development.

Following are the system performance measures for the Education, Outreach, and Community Engagement goal:

- Airports that host aviation education/schools and communities with aviation educational programs
- Airports that host community events that include aviation expert guest speakers related to their airport activities and role
- Airports that host community input programs that solicit feedback on airport meeting community aviation needs

2.5 Infrastructure Improvement, Preservation, and Capacity

The goal of *Infrastructure Improvement, Preservation, and Capacity* is focused on ensuring the existing system is maintained and improved to handle the current and forecasted capacity. The objectives include providing access for aircraft during all weather conditions, maintaining the facilities to established WASP classification levels, and planning to meet emerging requirements in technology and infrastructure, such as the Next Generation Air Transportation System (NextGen).

When the weather is clear and pilots can see where the aircraft is going, many pilots do not need to rely heavily on their aircraft's instrumentation for navigation, especially in general aviation operations. As weather worsens and certain conditions exist, pilots must utilize their instrumentation more, particularly when landing at airports via instrument approach procedures (IAP). IAPs provide continued and better access to airports by helping aircraft land at specific runway ends, especially during inclement weather. Different types of IAPs with different requirements are available based on infrastructure and surroundings of the airport. While it may have greater requirements for the airport, the lower the visibility minimums are for an IAP, the closer the pilot may fly to the runway end utilizing only the aircraft's instrumentation panel. By providing more precision and lower visibility minimums, IAPS provide better access for aircraft to airports during all weather conditions.

A critical part of an airport enabling transportation is its physical infrastructure and capacity. As discussed subsequently, the WASP identified airport metrics to evaluate how airports are supporting the system goals as well as aviation activities that are occurring at the airports. The airport metrics relate to how airports should preserve and improve existing infrastructure to effectively support the aviation activities that the system accommodates and provide a means for measuring progress toward meeting established objectives/standards for airport infrastructure and safety.

Technology continues to evolve and the aviation system continues to change to respond to new technologies, with different issues emerging as a result. A prominent emerging issue based in technology is the modernization of the National Airspace System (NAS) by NextGen.

NextGen initiatives will affect flight plans and can have noise impacts, as well as impacts to navigation aids, airspace, airfield capacity, and obstruction management. While some initiatives are already being implemented, like performance based navigation (PBN) and automated dependent surveillance-broadcast (ADS-B), more programs are in their initial stages of deployment, such as weather, voice systems, information management, and data communications. Each of these programs is geared toward improving one facet of the safety and efficiency of the aviation transportation system. Airports should ensure they are preparing for future requirements and impacts for these technologies.

Following are the system performance measures for the Infrastructure Improvement, Preservation, and Capacity goal:

- Airports with instrument approaches (by type of minimums, including CAT I/II/III)
- Airports making progress toward established objectives/standards for airport infrastructure and safety
- Airports that are capable of meeting FAA NextGen requirements for specific approach procedures (parallel taxiway, other facilities)

2.6 Aviation Innovation

The goal of *Aviation Innovation* is aimed at supporting new and emerging technologies and processes related to aviation with objectives in supporting innovation in the aviation system and aeronautics. Recent innovations affecting many facets of airports include NextGen, unmanned aircraft systems (UAS), alternative fuels, aircraft innovation, and the use of new technologies at airports and in flight. The use of UAS, or drones, needs to be actively addressed to optimize integration into the current aviation system while ensuring any negative impacts to the general public are minimized. Aircraft innovation and UAS may evolve to allow for general use, requiring future intermodal connections to roadways and unique airport improvements.

By supporting and partnering in the research and advancement of the technologies through industry providers, aviation related associations, and academia, sponsors can stay informed and be involved in evolving programs. This allows developers and researchers a chance to better understand how it may impact airport operations and provide airports a chance to provide input at the earlier stages. This will also allow for a better understanding of the future infrastructure needs of airports based on these innovations. Programs may be as simple as participating in a survey or providing meeting space or as complex as testing out new material for a construction project.

The following are the system performance measures for the Aviation Innovation goal:

- Airports that partner with industry, associations, and academia
- Projects that develop new aviation mobility concepts

2.7 Modal Mobility, Capacity, and Accessibility

The goal of *Modal Mobility, Capacity, and Accessibility* is intended to ensure the airport is easily accessible to the general public. Connectivity to airports has been identified as a reoccurring concern across the nation as airports are not always involved in the local, regional, or statewide transportation planning process. Objectives include providing adequate ground access to and from the airport, supporting a performance-based approach to solving connection needs, and supporting and improving multimodal connections.

Adequate access for an airport means ensuring the road and parking capacity is optimized on the surrounding roadways. Airports should ensure they’re being represented within the local transportation and comprehensive plans to reduce delays and coordinate with public transit. If the airport is not considered, it is likely that ground access will diminish or not improve with future growth. As roadways become more congested, passengers are encouraged to take alternative, or intermodal, modes of transportation. By reviewing connections and opportunities for other modes of transportation, such as rail, public transit, or bicycle, an airport will be better connected to the community to support continued growth.

Adequate access also involves signage that alerts users to the various components of the airport, including its location. By providing signage that directs passengers to their respective terminal, parking area, or other amenities as well as how to exit the airport to their destination, the overall flow and capacity of the airport improves. Airports can also provide rental or courtesy cars, which allow passengers to reach their final destination located off the airport.

Following are the system performance measures for the Modal Mobility, Capacity, and Accessibility goal:

- Airports that are adequately accessible in terms of signage and access road quality and that provide rental or loaner cars
- Airports involved in regional transportation and comprehensive plans
- Airports with intermodal options (rail, public transit, seaplane)

2.8 Stewardship

The goal of *Stewardship* is intended to ensure an airport is looking after its long-term welfare enhancing planning and management of resources. Resources at an airport include the physical infrastructure (such as the pavement, terminals, and hangars), personnel (such as staff, tenants, and users), and financial funds (such as grants, bonds, and general funds). Objectives include protecting investments by implementing and maintaining planning documents, conducting preventive and corrective maintenance of the infrastructure, and advocating for land-use protection and height hazard zoning.

Airport planning documents may include an airport master plan or an airport layout plan (ALP), which are the basis of airport planning at the local level. These planning documents are a comprehensive analysis of an airport that ultimately illustrate the short- and long-term development plans to meet the future aviation demand. By involving the community, industry, and academia in the planning process, awareness and partnerships are established or renewed to promote and grow the aviation industry and provide additional insight into current and future considerations. Planning documents should be reviewed every 5 to 10 years for applicability to the current goals and conditions of the airport.

Preventive maintenance programs demonstrate an interest in and expectation to maintain an airfield to a standard that provides a safe operating environment for pilots, the main users of airports. WSDOT conducts a system-wide study of airfield pavements to assess the relative condition of many of the state's airports approximately every five years, referred to as the *Airport Pavement Management System* (APMS). The APMS supplements analyses conducted by many airports to evaluate conditions and determine pavement-related project needs and timing.

The encroachment of incompatible land uses, tall structures, or bright lights can threaten the continued operation of an airport. Incompatible land uses can lead to an increase in noise complaints or restrictions on operating times or aircraft. Tall structures that penetrate the surrounding airspace may lead to raising visibility minimums to ensure adequate pilot safety, which then limits the accessibility of the airport. Municipalities are encouraged to address protection of airports and their future improvements in the future land use, transportation, intergovernmental coordination, and capital improvement program elements of their local government's comprehensive plan. This may include adopting land use compatibility and height hazard zoning into the municipal code. WSDOT provides an *Airports and Compatible Land Use Guidebook* that is used as a reference in the state of Washington to working cooperatively and proactively with local jurisdictions.

Following are the system performance measures for the Stewardship goal:

- Airports with approved master plan/airport layout plan in last 5 years
- Airports with established preventive maintenance programs
- Airports within adopted height and land use zoning for impacted jurisdictions

2.9 Sustainability

Sustainability can mean different things to different people and organizations, but the aviation industry has mainly adopted the "EONS" approach. This approach consists of economic vitality (E), operational efficiency (O), natural resources (N), and social responsibility (S). The goal of sustainability for the WASP includes reducing environmental impacts, providing an aviation system that is sustainable, and implementing financial sustainability measures. Airports that have adopted sustainability practices typically see reduced operating costs, better relationships with their community, and better customer service and satisfaction.

Airports can adjust their environmental impact in simple and complex ways, from establishing recycling programs to utilizing alternative fuels to managing wildlife on the airfield. The specific programs and practices need to be developed and tailored by the individual airports as facilities, services, and policies vary widely. Airports are encouraged to focus on waste, air and water quality, alternative energy sources, and wildlife management.

Financial sustainability is a key topic for many airports as they strive to become self-sufficient and continue to provide their local share of the funds for development projects. Airports should be innovative and strategic in the methods they use to obtain and grow their revenue sources. Traditional methods of generating revenue include land leases for offices and tenants, aircraft storage, fuel sales, landing fees, and concessions. By reviewing the existing fee schedule, policies, and procedures, an airport may be able to determine if it is obtaining the best return on its investments, if it is charging the market rates, and potentially discover methods of obtaining future revenue sources. Conducting a business plan can help ensure an airport is choosing development projects that give them the best returns on their investments, charging the correct rates, operating and marketing the airport properly and efficiently, and review additional sources of revenue.

By connecting sustainability to the other goals at the airport, it is outlining a successful program that is more easily achieved. These programs and practices can be implemented into any planning, design, or construction project as well as in an overall sustainability plan that outlines the overall goals and objectives of the airport. By measuring the success rate and reviewing the goals periodically, the airport can better formulate an effective plan.

Following are the system performance measures for the Sustainability goal:

- Airports with storm water pollution prevention plans (SWPPP), recycling programs, alternative fuel vehicles, and noise contours in last 10 years
- Airports with sustainability plans that have energy conservation goals
- Airports that have implemented financial sustainability measures

Table 2-1 summarizes the WASP goals, objectives, and system performance measures.

Table 2-1. Summary of Goals, Objectives, and System Performance Measures

GOAL	OBJECTIVES	SYSTEM PERFORMANCE MEASURES
Aeronautical and Airport Safety	▪ Attain/maintain WSDOT performance objectives and standards (FAA standards, as appropriate) ▪ Maintain safe/clear approaches ▪ Attain/maintain applicable FAA/State design standards/metrics	▪ Airports that meet WSDOT airport metrics, including NPIAS airports that meet current FAA design standards ▪ Airports with clear Part 77 approaches and threshold siting surfaces ▪ NPIAS airports that meet current FAA/state design standards
Economic Development and Vitality	▪ Support transport of goods and passengers by air, including increasing service opportunities ▪ Collaborate with airport sponsors and other agencies to maintain and support high, stable levels of community economic growth and development ▪ Increase airport tenant revenue growth, including promoting on-airport aerospace manufacturing jobs	▪ Airports with documented air cargo activity (by type) and strategy/market and airports with growing (>1% per year) commercial airline service ▪ Airports with active development partnerships with chambers of commerce, tourism bureaus, service organizations, industries, governments, and recreational user groups ▪ Airports with business parks or landside real estate development (existing and available) and those with on-site aerospace manufacturing lessees
Education, Outreach, and Community Engagement	▪ Promote aviation education to enhance safety and community support ▪ Increase community knowledge of the aviation system to communicate airport benefit and contribution to local communities/ economies ▪ Promote aviation activities matched to community need	▪ Airports that host aviation education/schools and communities with aviation educational programs ▪ Airports that host community events that include aviation expert guest speakers related to their airport activities and role ▪ Airports that host community input programs that solicit feedback on airport meeting community aviation needs

Table 2-1. Summary of Goals, Objectives, and System Performance Measures (continued)

GOAL	OBJECTIVES	SYSTEM PERFORMANCE MEASURES
Infrastructure Improvement, Preservation, and Capacity	▪ Provide aeronautical access to airports during all weather conditions ▪ Maintain airport facilities at established airport classification levels ▪ Plan for new capabilities to meet emerging requirements, including NextGen technologies	▪ Airports with instrument approaches (by type of minimums, including CAT I/II/III) ▪ Airports making progress toward established objectives/standards for airport infrastructure and safety ▪ Airports that are capable of meeting FAA NextGen requirements for specific approach procedures (parallel taxiway, other facilities)
Aviation Innovation	▪ Support innovation in the aviation system ▪ Support innovation in aeronautics	▪ Airports that partner with industry, associations, and academia ▪ Projects that develop new aviation mobility concepts
Modal Mobility, Capacity, and Accessibility	▪ Provide adequate ground access to/from airports ▪ Support road capacity access initiatives ▪ Support and improve multimodal connections, including multiple transportation options for users	▪ Airports that are adequately accessible in terms of signage and access road quality and that provide rental or loaner cars ▪ Airports involved in regional transportation and comprehensive plans ▪ Airports with intermodal options (rail, public transit, seaplane)
Stewardship	▪ Protect the investment in the aviation system, including implementing and maintaining current airport planning documentation ▪ Conduct requisite airport infrastructure preventive and corrective maintenance ▪ Advocate local governments for land-use protection and height zoning	▪ Airports with approved master plan/airport layout plan in last 5 years ▪ Airports with established preventive maintenance programs ▪ Airports within adopted height and land use zoning for impacted jurisdictions

Table 2-1. Summary of Goals, Objectives, and System Performance Measures (continued)

GOAL	OBJECTIVES	SYSTEM PERFORMANCE MEASURES
Sustainability	▪ Reduce environmental impacts ▪ Provide an aviation system that is sustainable ▪ Implement airport financial sustainability measures	▪ Airports with storm water pollution prevention plans, recycling programs, alternative fuel vehicles, and noise contours in last 10 years ▪ Airports with sustainability plans that have energy conservation goals ▪ Airports that have implemented financial sustainability measures

Source: WSDOT Aviation, 2016

CHAPTER 3 – INVENTORY

3.1 Introduction

The Washington State Department of Transportation Washington Aviation System Plan Update (WASP) includes a study of the existing capacity, aviation trends, system performance, and market demand and needs of the Washington State public airport system. Information collected from a system-wide survey as well as the WSDOT Airport Information System (AIS) database update effort provides a look at the existing conditions of the state's airport facilities and provides the basis from which to evaluate future demands in airline passenger traffic, air cargo and general aviation activity, system performance, and future system needs. The information collected in this study provided a set of criteria from which to base a new state classification system to improve system performance. The data collected in this process was used to update the WSDOT AIS database for all airports included in the inventory. This chapter provides an overview of the 2015 WASP survey and inventory effort.

3.1.1 Inventory Process

A total of 136 Washington State public-use airports are included in the 2015 WASP study. The inventory includes all public-use facilities; those included in the Federal Aviation Administration's (FAA) 2015-2019 National Plan of Integrated Airport Systems (NPIAS) and those that are not. It is important to note that the FAA updates the NPIAS every two years. The most recent NPIAS (2017-2021) was submitted to Congress on September 30, 2016, well into the progress of the WASP. Therefore, the WASP references the prior 2015-2019 NPIAS.

The inventory data was collected primarily by means of a written survey that was provided to airport management via email and U.S. mail. Participants were also informed that the survey could be conducted over the phone if this was their preference. Surveys were distributed in October 2015 and responses were received through January 2016. The survey included requests for information in the following categories:

- General airport information
- Operation activity
- Historical activity
- Fueling infrastructure and services
- Economic development and vitality
- Education and outreach/community engagement
- Infrastructure improvement, preservation, and capacity
- Innovation

Airport managers, WSDOT aviation division staff, and study consultants participated in providing data for the survey. Follow-up phone calls were made by study consultants to maximize the survey responses, and many incomplete surveys were completed by phone or additional email correspondence with airport management or administrative staff. In addition, information was verified and supplemented through the following secondary sources:

- FAA Form 5010, Airport Master Record

- FAA Air Traffic Activity System
- AirNav.com
- WSDOT Airport Information System database
- WSDOT Aviation Division 2012 Aviation Economic Impact Study
- WSDOT Aviation Division 2013 Washington State Airport Pavement Management System Report
- WSDOT Aviation Division 2016 Statewide Airports Profile Report
- Airport master plans (as available)
- Airport layout plans (as available)

A total of 112 surveys of the 136 WASP study facilities were completed and submitted—an 82-percent response rate. The inventory data are presented in the following narrative, supplemented by tables and figures. An inventory summary is provided at the end of this chapter to highlight key findings and to summarize the data collected.

3.1.2 Existing Airport System

There are 544 aviation facilities, including 360 airports 165 heliports, 16 seaplane bases and 3 ultralight fields in Washington State, of which 136 airports are listed as public-use facilities (Figure 3-1) and the other 240 airports are listed as private-use.[1] Airport classifications have been updated during the preparation of this study to more closely tie each airport facility to the size of the community it serves. The new Washington State Classification naming conventions include "Major," "Regional," "Community," "Local," and "General Use" airports. The new classifications will be used throughout this chapter to describe the existing aviation system. A complete description of the classification methodology and criterion is presented in Chapter 6.

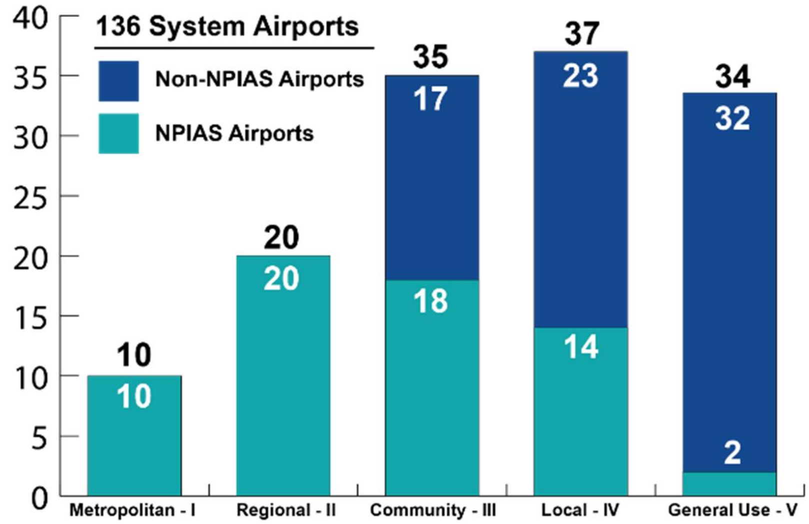
In Washington State, a total of 10 airports are classified as *Major* airports, providing commercial service and serving communities of 2.2 million to 55,000 residents. *Regional* airports do not provide commercial service, however, they do serve communities of 34,000 to 2.1 million residents with corporate and business travel or commuter passenger service. There are 20 airports in the state that fit this classification. The remaining 106 airports are categorized as *Community*, *Local*, or *General Use* airports.

These airports have a variety of owners and operators, with over 100 public-use airports operating under public ownership and management, including city/municipality, port district, and state, county, or joint government ownership. According to the AIS state profile report, 29 are privately owned. There are a total of 16 state-managed airports, 9 of which are state-owned with the others operated by special-use permit, lease, or right-of-entry.[2]

[1] FAA, Airport Data as of 3/31/2016, NFDC Facilities Report, http://www.faa.gov/airports/airport_safety/airportdata_5010/menu/#datadownloads

[2] WSDOT, Airport Information System Database, 2016

Figure 3-1. Distribution of System Airports Amount Classifications



3.1.3 National Plan of Integrated Airport System

The National Plan of Integrated Airport System (NPIAS) are those facilities that are deemed by FAA to be significant to the national air transportation system. The NPIAS is maintained by FAA and published and reported to Congress every two years. The NPIAS includes a plan for the type and cost of eligible airport development that the Secretary of Transportation, "…considers necessary to provide a safe, efficient, and integrated system of public-use airports adequate to anticipate and meet the needs of civil aeronautics, to meet the national defense requirements of the Secretary of Defense, and to meet the identified needs of the United States Postal Service."[3] Airports included in the NPIAS are eligible to receive federal airport improvement plan (AIP) funding. A total of 64 airports in the Washington state system are NPIAS facilities. Three of these are privately owned facilities (Harvey Field, Kenmore Air Harbor Lake Washington and Whidbey Airpark) and the remaining 61 are publicly owned (Figure 3-2).

Primary Airports

According to the Report to Congress, NPIAS 2015–2019, primary airports are those public-use airports that receive scheduled air service with 10,000 or more enplaned passengers per year.[4] These airports are grouped into four categories: large, medium, small, and non-hub. There are 10 primary airports in the Washington State system as listed in Table 3-1 (Figure 3-3).

[3] FAA, NPIAS Report to Congress (2015–2019)
[4] FAA, NPIAS Report to Congress (2015–2019), Appendix A

Figure 3-2. Washington State Public Use Airports

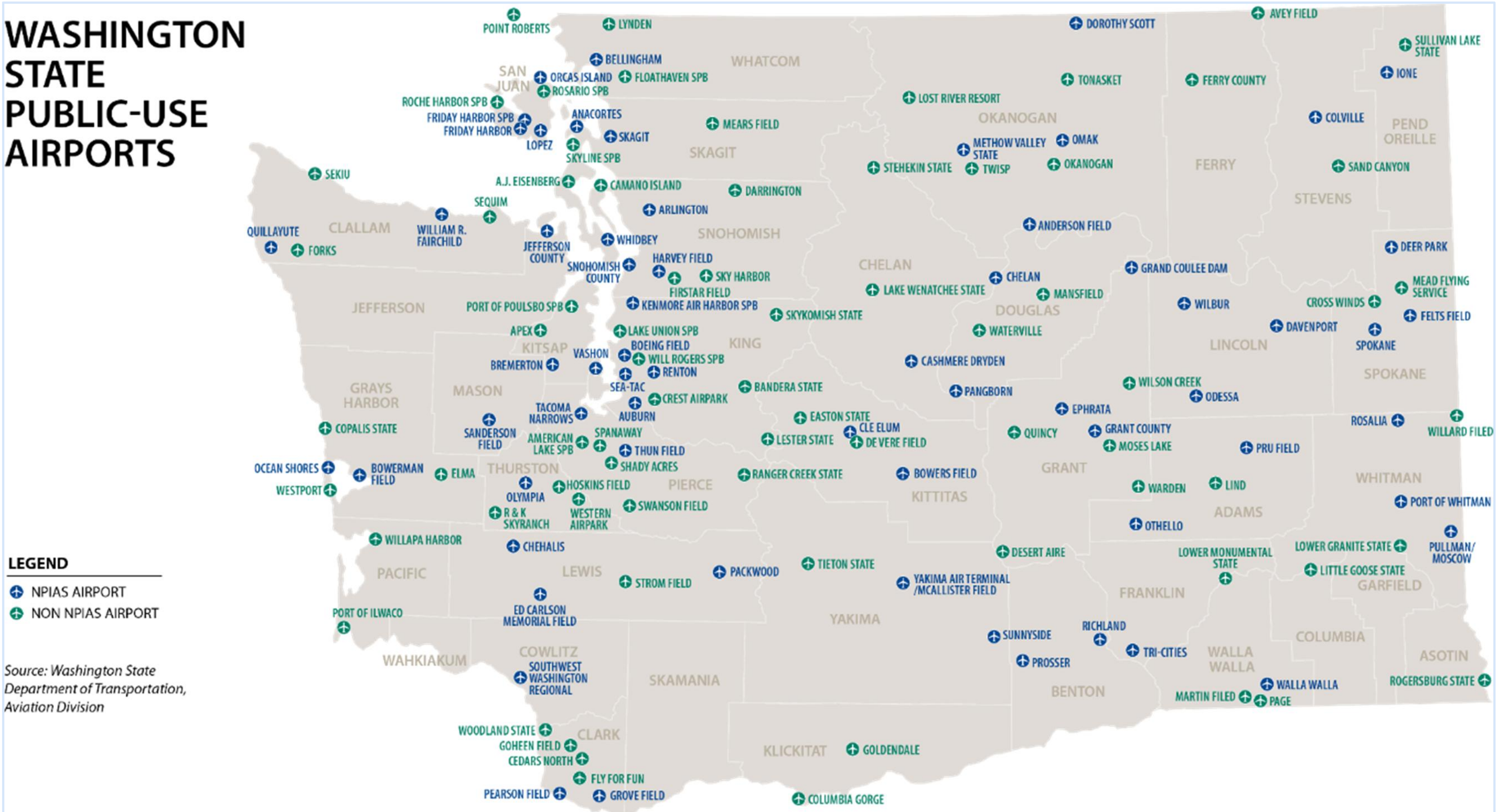


Figure 3-3. NPIAS Primary and Non-primary Airports

Table 3-1. NPIAS Primary Airports

CITY	AIRPORT
Bellingham	Bellingham International
Friday Harbor	Friday Harbor
Pasco	Tri-Cities
Pullman	Pullman/Moscow Regional
Seattle	Boeing Field/King County International
Seattle	Seattle-Tacoma International
Spokane	Spokane International
Walla Walla	Walla Walla Regional
Wenatchee	Pangborn Memorial
Yakima	Yakima Air Terminal/McAllister Field

Source: FAA, NPIAS Report to Congress (2015–2019), Appendix A.

Non-primary Airports

Non-primary airports are facilities that are used by general aviation aircraft and include non-primary commercial service airports (public facilities that receive scheduled passenger service between 2,500 and 9,999 enplaned passengers per year), general aviation airports, and reliever airports.[5] Reliever airports are defined as those airports designated by FAA as having the function of relieving congestion at a commercial service airport and providing more general aviation access to the overall community. Non-primary airports are grouped into five FAA categories: national, regional, local, basic, and unclassified. Of the 54 non-primary airports in Washington, 5 airports have the "reliever" designation, as shown in Table 3-2.

Table 3-2. General Aviation Reliever Airports

CITY	AIRPORT	CATEGORY
Auburn	Auburn Municipal	Regional
Everett	Snohomish County (Paine Field)	National
Renton	Renton Municipal	Regional
Snohomish	Harvey Field	Local
Spokane	Felts Field	Regional

Source: FAA, NPIAS Report to Congress (2015–2019), Appendix A.

[5] FAA, NPIAS Report to Congress (2015–2019), Appendix A

3.1.4 FAA Asset

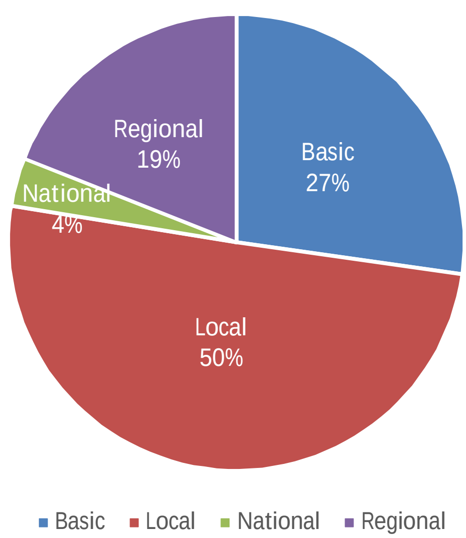
FAA conducted an 18-month study to further classify the general aviation airports included in the NPIAS, the results of which were published in the report titled *General Aviation Airports: A National Asset* (ASSET) in May 2012. This report documented the importance of the general aviation airport system, the need for new general aviation categories, a description of each of the four ASSET categories, and a list of each airport in the NPIAS categorized by ASSET category (Figure 3-4).

ASSET noted five key aeronautical functions provided by the general aviation airport system which include[6]:

- Emergency preparedness and response
- Critical community access for remote areas
- Commercial, industrial, and economic activity functions
- Access to tourism and special events
- Other aviation specific functions, including corporate flights and flight instruction

The ASSET categories were developed to provide policy makers with a better understanding of the vast and diverse general aviation system. While more detailed than the previous category designation of either general aviation-reliever or general aviation, these federal categories are broad and do not replace existing statewide system planning or airport master planning roles or categories that utilize unique and more-detailed site-specific data to determine their role in the state or community. Figure 3-4 shows the percentage of Washington state airports in each FAA ASSET category.

Figure 3-4. Washington State Airports by FAA ASSET Category



[6] FAA, General Aviation Airports: A National Asset, May 2012

3.1.5 Non-NPIAS Airports

There are 72 airports included in the study that are non-NPIAS airports. Non-NPIAS airports represent over 50 percent of the state's system that does not meet FAA's minimum NPIAS entry criteria; however, these airports are included in the state's system plan as they have a state or regional significance. Because these airports are not eligible to receive federal AIP funding—funding and support typically comes from non-federal sources, such as local, state, or private funding. In other words, more than half of the Washington state airport system is reliant on funding sources outside AIP funding. Non-NPIAS airports are shown on Figure 3-2.

3.2 Airside Facility Inventory

This section includes a summary of the major airside facilities for study airports. This includes an inventory of runways and taxiways as well as a discussion of runway safety areas and protection zones.

3.2.1 Runways

Of the 136 study airports, there are a total of 368 runways inventoried in the AIS database. These include primary, parallel, crosswind, and other supplemental runway types (Table 3-3 and Table 3-4). A runway is a defined rectangular area prepared for the landing and takeoff of aircraft. Runways may be either a man-made surface or a natural surface. Having a complete inventory of the total number of runways in a system allows the State to calculate and understand the capacity of the state's aviation system. All of the *Major* airports have multiple runways.

Length

Runway lengths across the state's aviation system vary at each facility depending on the types of aircraft and uses needed. Many insurance providers require that insured aircraft operators only operate on runways with a length of 5,000 feet; this includes many air ambulance operators as well as corporate jet operators. The impact of this runway length requirement can be felt at smaller, more rural communities where air ambulance aircraft cannot operate and at airports where increased corporate jet activity is taking place.

According to WSDOT's AIS database, primary runway lengths range from 1,471 feet to 11,900 feet. Approximately 27 percent of the systems runways are 5,000 feet or longer and 62 percent of the *Major* airport runways meet this criterion. Table 3-5 shows the number of runways and percentages of runways meeting the 5,000-foot criteria. Several *Major* classified airports have more than one runway and lengths can be both over and under the 5,000-foot length. The average primary runway length at *Major* airports is 8,966 feet (Table 3-6).

Top 5 airports by longest paved runway (Based on the WSDOT Aviation Division 2016 Statewide Airports Profile Report):

1. *Grant County International*
2. *Sea-Tac International*
3. *Spokane International*
4. *Boeing Field/King County International*
5. *Snohomish County/Paine Field*

Surface Type and Condition

The Washington State system airport primary runway surfaces include paved concrete, concrete/asphalt, paved asphalt, turf, turf/gravel, as well as water. Of all "paved" runways in the system, 6 percent are paved concrete, 3 percent are asphalt/concrete, and 66 percent are paved asphalt. Approximately 9 percent of all runways are water surfaces, 11 percent are turf or turf and gravel runways. Figure 3-5 shows all runway surfaces and Figure 3-6 shows primary runway surface types.

Table 3-3. Runway Types and Surfaces by Classification

AIRPORT CLASSIFICATION AND RUNWAY/SURFACE TYPE	NUMBER OF RUNWAYS
Major	26
Crosswind runway	3
Asphalt	1
Concrete	2
Supplemental runway	1
Asphalt	1
Primary runway	22
Asphalt	14
Asphalt/concrete	3
Concrete	5
Regional	35
Crosswind runway	5
Asphalt	5
Supplemental runway	4
Asphalt	3
Water	1
Primary runway	26
Asphalt	21
Concrete	3
Other	1
Turf	1
Community	44
Crosswind runway	1
Turf/gravel	1
Primary runway	43
Asphalt	40
Asphalt/concrete	2
Turf	1
Local	40
Primary runway	40
Asphalt	37
Concrete	1
Null	1
Other	1
General use	38
Supplemental runway	1
Water	1
Primary runway	37
Other	6
Turf	13
Turf/gravel	4
Water	14

Source: WSDOT, Airport Information System database, 2016

Table 3-4. Average Number of Runways per Airport by Classification

CLASSIFICATION	AVERAGE NUMBER OF RUNWAYS
Major	2.6
Regional	1.75
Community	1.25
Local	1.1
General Use	1.1

Source: WSDOT, Airport Information System (database, 2016)

Table 3-5. Number and Percent of System Runways that are 5,000 feet or Longer

CLASSIFICATION	RUNWAYS 5,000 FEET OR LONGER	PERCENT OF RUNWAYS 5,000 FEET OR LONGER
Major	32	62%
Regional	34	49%
Community	5	6%
Local	2	3%
General Use	24	32%
Overall System	97	27%

Source: WSDOT, Airport Information System database, 2016, as reported by Kimley-Horn, 2016

Table 3-6. Primary Runway Length Averages by WA State Classification

CLASSIFICATION	AVERAGE PRIMARY RUNWAY LENGTH
Major	8,966
Regional	4,974
Community	3,041
Local	3,092
General Use	3,405

Source: WSDOT, Airport Information System (AIS) database, 2016, as reported by Kimley-Horn, 2016

Figure 3-5. Runway Surfaces for all Runways System-wide

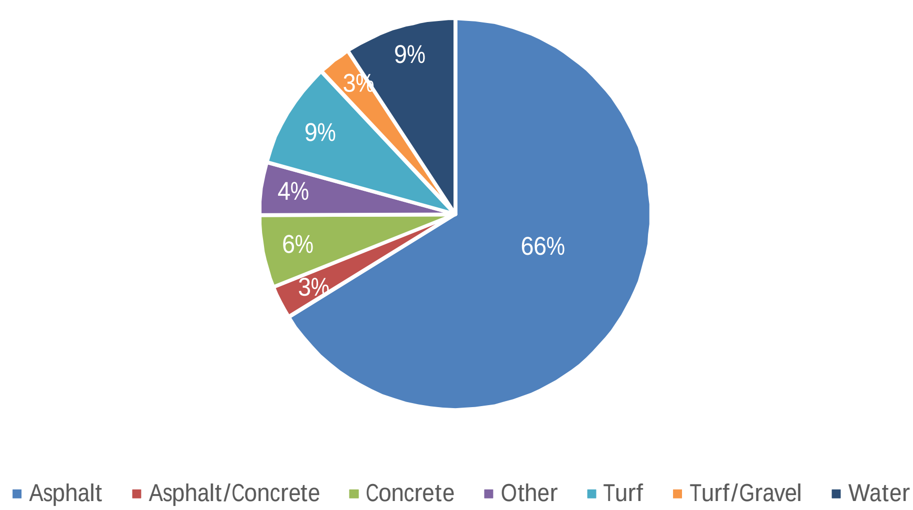
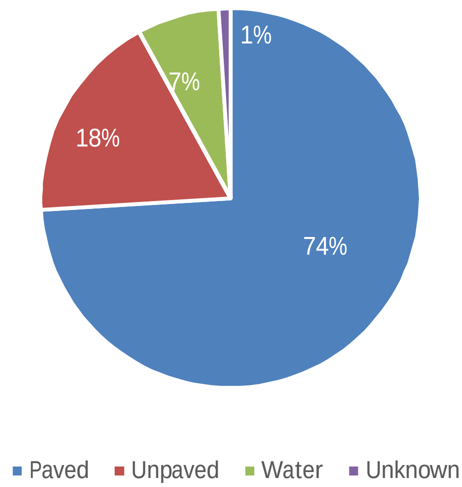


Figure 3-6. Primary Runway Surface Types



WSDOT Aviation conducts a system-wide study of airport pavement condition approximately every five years to identify pavement needs and to provide information for programming and decision making in the maintenance of facilities statewide. The condition of runway, taxiway, and apron pavement is an important performance measure of the system's safety and cost effectiveness. Pavement preservation and maintenance is noted to be "one of the largest capital investments in the aviation system."[7]

At the airports that were evaluated, approximately 71 percent of the pavement area was in need of preventative maintenance and 29 percent had deteriorated to a condition that would require either major rehabilitation or possibly reconstruction, which is far more costly than preventative maintenance

According to the *2013 Washington State Airport Pavement Management System* report, primary NPIAS airports have shown improved condition in pavement since 2005, while non-primary NPIAS and non-NPIAS facilities show a significant decrease in condition.[8]

3.2.2 Runway Safety Areas

Aircraft can and do occasionally overrun the ends of runways, sometimes with devastating results. An overrun occurs when an aircraft passes beyond the end of a runway during an aborted takeoff or while landing. Data on aircraft overruns over a 12-year period (1975 to 1987) indicate that approximately 90% of all overruns occur at exit speeds of 70 knots or less and most come to rest between the extended runway edges within 1000 feet of the runway end. To minimize the hazards of overruns, the FAA incorporated the concept of a safety area beyond the runway end into airport design standards. To meet the standards, the safety area must be capable, under dry conditions, of supporting the occasional passage of aircraft that overrun the runway without causing structural damage to the aircraft or injury to its occupants.

[7] WSDOT, Washington State Airport Pavement Management System, Executive Summary, 2013
[8] WSDOT, Washington State Airport Pavement Management System, Executive Summary, 2013

A Runway Safety Area (RSA) is a defined surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot, or excursion from the runway.

The identification of compliant vs. noncompliant RSAs allows the Aviation Division to focus on those airports needing assistance in mitigating their RSA issues so they can meet FAA Design Criteria identified in FAA Advisory Circular 150/5300-13A.

According to the WSDOT AIS database, approximately 36 percent of the aviation system's runways are RSA compliant. Table 3-7 shows RSA-compliant runway percentages by state classification. Only 3 percent of *General Use* airport facilities have runways that meet RSA length and width standards.

Table 3-7. Percentage of RSA-compliant Runways

CLASSIFICATION	PERCENT RSA COMPLIANT
Major	37%
Regional	66%
Community	37%
Local	39%
General Use	3%
Overall System	36%

Source: WSDOT, Airport Information System database, 2016

3.2.3 Taxiways

Taxiways create mobility for aircraft that have just landed or those aircraft preparing to land/depart and are a critical part of an airport's facilities and airfield safety. There are three common types of taxiways at Washington State airports: parallel, entrance/exit, and crossing taxiway (Table 3-8). A parallel taxiway runs parallel to the runway, either fully or partially, providing separation from the runway for clear takeoff and landing, as well as an approach to the apron. The entrance/exit taxiway provides entrance and egress on a bidirectional runway, and the crossing taxiway provides access between dual parallel taxiways.

Table 3-8. Taxiway Types by Classification

AIRPORT CLASSIFICATION AND TAXIWAY TYPE	NO. OF TAXIWAYS
Major	134
Crossing taxiway	5
Entrance-exit taxiway	112
Parallel taxiway	17
Regional	155
Entrance-exit taxiway	126
Parallel taxiway	29
Community	150
Entrance-exit taxiway	113
Parallel taxiway	37
Local	100
Entrance-exit taxiway	79
Parallel taxiway	21
General Use	1
Parallel taxiway	1

Source: WSDOT, Airport Information System database, 2016

The taxiway safety area is a graded area extending from the taxiway centerline to a certain distance beyond the pavement that must be capable, under dry conditions, of supporting the occasional passage of aircraft that veer off the taxiway without causing structural damage to the aircraft or injury to its occupants.

Overall, 62 percent of the taxiways in the system meet the safety area width standards and 29 percent have no information available in the AIS database, including over half of the *Major* taxiways.[9] Generally, most of the taxiways in each classification meet the taxiway safety width standards (Table 3-9).

Table 3-9. Taxiway Safety Area Width Compliance by State Classification

SAFETY WIDTH COMPLIANCE	OVERALL SYSTEM	MAJOR	REGIONAL	COMMUNITY	LOCAL	GENERAL USE
Meets standards	62%	41%	72%	66%	71%	100%
Does not meet standards	9%	0%	0%	25%	11%	0%
FAA approved modification to standards	0%	0%	1%	0%	1%	0%
No information available	29%	55%	18%	7%	9%	0%
NULL	5%	4%	8%	2%	8%	0%

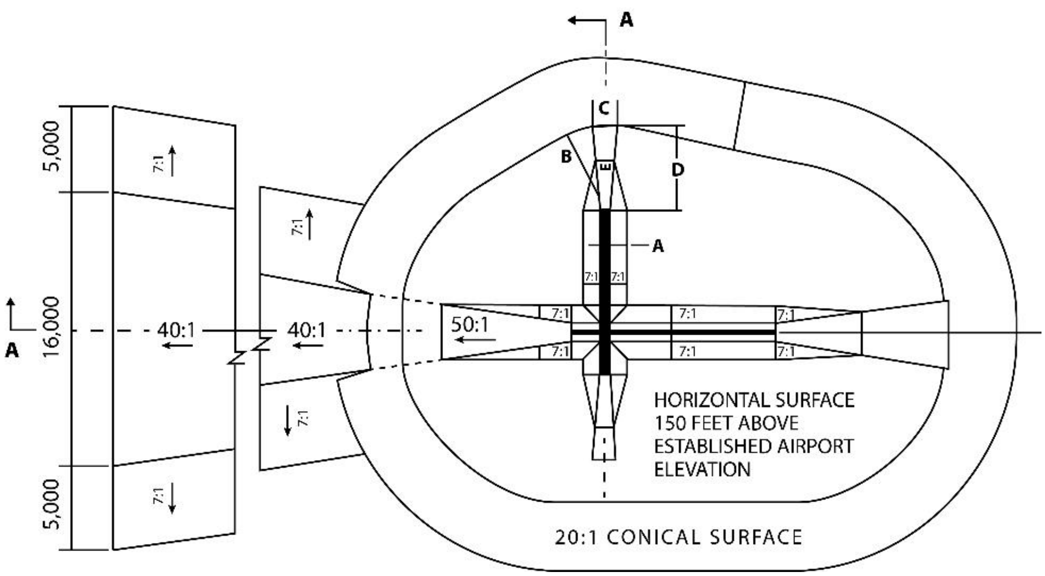
[9] WSDOT, Airport Information System Database, 2016

Source: WSDOT, Airport Information System database, 2016

3.3 FAR Part 77

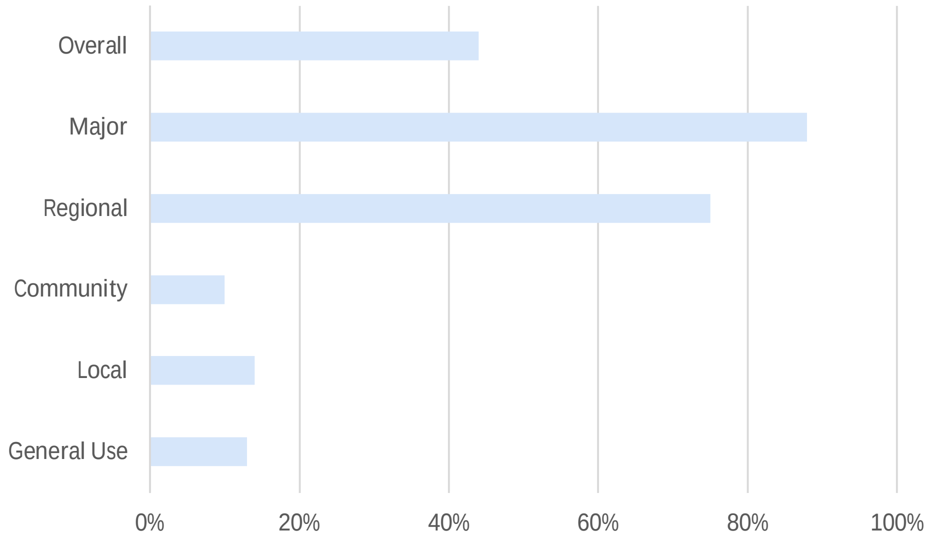
Federal Aviation Regulation (FAR) Part 77 establishes standards and notification requirements for objects affecting navigable airspace, allowing the FAA to identify "potential aeronautical hazards" to prevent or minimize "adverse impacts to the safe and efficient use of navigable airspace."[10] FAR Part 77 defines imaginary surfaces around airports that should be kept clear for flight operations. Objects that penetrate these imaginary surfaces are called obstructions. FAA determines if an obstruction is a hazard to air navigation. Figure 3-7 shows the imaginary surfaces defined by Part 77. Approximately 44 percent of NPIAS and Non-NPIAS airports included in the study responded that the facility has clear Part 77 approaches. Percentages of airports reporting clear Part 77 approaches is presented in Figure 3-8.

Figure 3-7. FAR Part 77 Two-Dimensional Graphic of Surfaces



[10] WSDOT Aviation, FAR Part 77 Basics, http://www.wsdot.wa.gov/NR/rdonlyres/2CFA42E4-2718-4884-8FD3-AD2000491AE6/0/FAA_Part77_Basics.pdf

Figure 3-8. Airports Reporting Clear Part 77 Approaches



Source: NOAA, Aeronautical Survey Program, http://www.ngs.noaa.gov/AERO/yplanfar77.gif

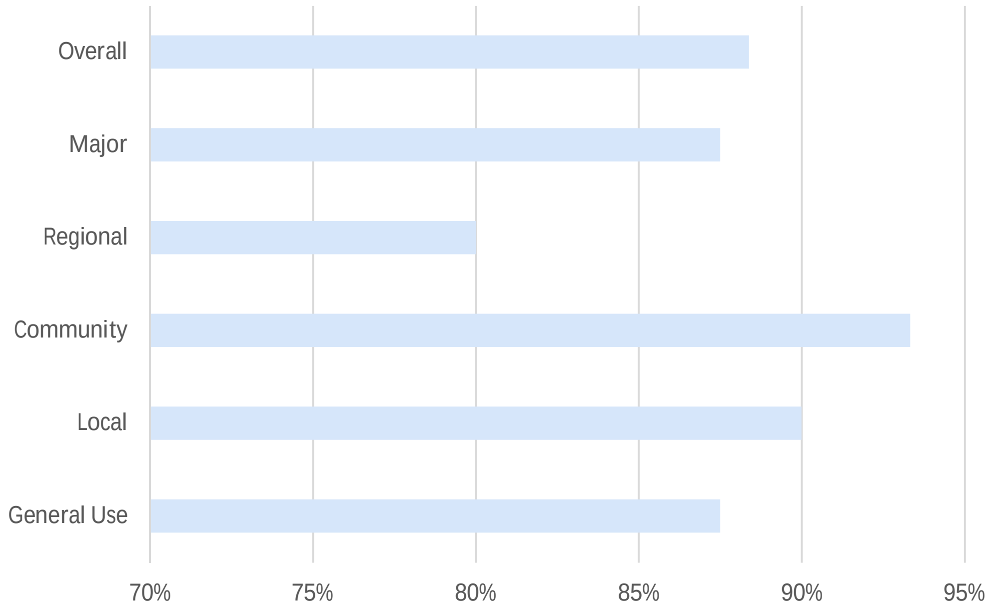
3.4 Landside Facilities and Aviation Services

3.4.1 Accessibility

The ability to provide sufficient access to an airport is critical to its function. Airport access roads provide connectivity between major highways and interstates and key facilities located at the airports throughout the state. Commercial service airports depend on accessibility to/from these roadways to provide their passengers with access to public parking, pick-up/drop-off, as well as the delivery of goods such as cargo, time-sensitive packages, and mail. Highways maintained by WSDOT typically provide accessibility to airports. Airports throughout the state are clearly identified using airport location signs posted along key routes to the airport.

The inventory survey included inquiries about adequate road access and airport signage. According to the survey responses, approximately 88 percent of the overall respondents replied that the airport had adequate access roads and 74 percent indicated that airport signage was adequate (Figure 3-9). Of the *Major* airport facilities that responded to this inquiry, all replied that access roads were adequate.

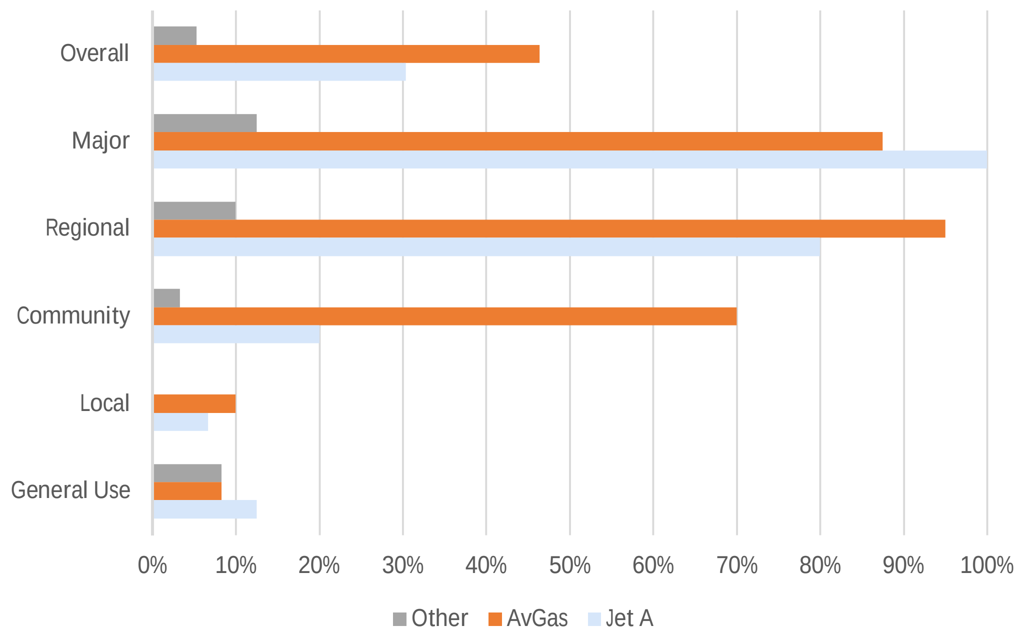
Figure 3-9. Airports Reporting Adequate Access Roads



3.4.2 Fuel Services

Fuel services are provided by many, but not all, public-use airports in the system. Approximately 65 percent of surveyed airports reported providing fuel, including Jet A, 100LL/AvGas, or automotive gas (MoGas). All the *Major* airport facilities reported Jet A fuel services and *Regional* airports reported 80 percent, as the larger turbo prop and jet powered aircraft use Jet A fuel. Figure 3-10 displays the percentage of airports by airport classification that reported having fuel.

Figure 3-10. Fuel Types provided by WA State classification



3.4.3 GA Terminal Facilities

In addition to fuel, most general aviation airports provide a terminal building/facility. This building is utilized by pilots for the use of telephones, restrooms, rest/sleeping quarters, and flight planning activities. At a minimum, a terminal building should include a restroom, phone, and flight planning area. Many times a pilot lounge is sufficient to provide these basic services. All commercial service airports have such facilities. Table 3-10 shows the primary terminal facilities by state classification.

According to the WSDOT AIS database, few airports have passenger terminal facilities, only 18 percent (Table 3-10). All *Major* airports have passenger terminals and all *Regional* airports have passenger/pilot-waiting room facilities.

Table 3-10. Pilot and Passenger Terminal Facilities at Washington State Airports

CLASSIFICATION	PASSENGER TERMINAL	PASSENGER/PILOT-WAITING ROOM	LODGING
Major	10	10	2
Regional	7	20	2
Community	4	19	0
Local	1	8	1
General Use	2	2	1

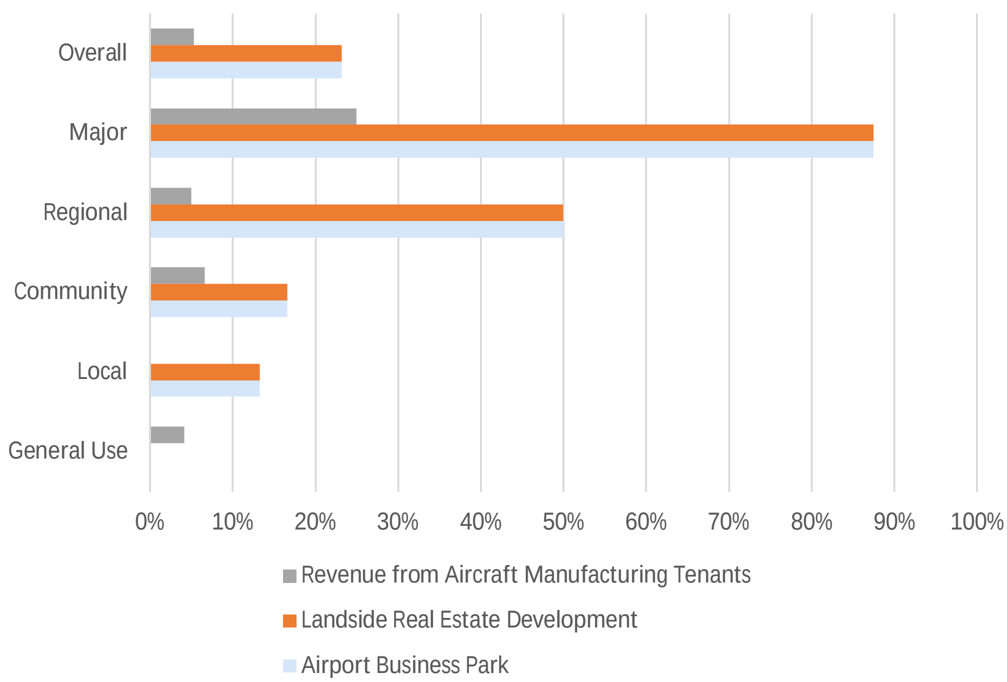
Source: WSDOT, Airport Information System database, 2016

3.4.4 Real Estate/Business Park/Manufacturing Leases

Several airports in the Washington state system have associated business parks or landside real estate developments. A few facilities reported revenue from aircraft manufacturing tenants, including Anacortes, Kenmore Air Harbor (Lake Washington), Pangborn Memorial, Skagit *Regional*, and Snohomish County/Paine Field. Approximately 23 percent of the airports surveyed reported an airport business park or landside real estate development as shown in Figure 3-11. Only 5 percent reported aircraft manufacturing tenants.

Approximately 88 percent of *Major* airports are associated with business park and landside real estate development and 50 percent of the *Regional* airports surveyed. None of the *General Use* airports surveyed indicated business park or landside real estate development; however, 4 percent report revenue from aircraft manufacturing tenants (Figure 3-11).

Figure 3-11. Airport Facilities Reporting Airport Business Park, Landside Real Estate Development, or Revenue from Aircraft Manufacturing Tenants



3.4.5 Aircraft Hangars

Most aircraft owners prefer to store their aircraft indoors to protect against weather. Both public and private entities offer aircraft tie down and hangar facilities for lease at many airports in the state. Tie downs include both based and transient aircraft. Individual T-hangars are adequate for small aircraft, but larger box or corporate hangars are needed to accommodate larger aircraft and are also needed for maintenance businesses. Table 3-11 depicts the percent of tie down and hangar types for each airport classification.

According to the data collected from the survey, 27 percent of respondents reported a wait list for hangar space. A couple of facilities responded that the existing hangar facilities were dilapidated or that there is no existing capacity at the facility for hangar space, so often waiting lists were not maintained even though there is a demand.

The data in the AIS database indicates that most hangar facilities are located at *Major* and *Regional* airports. *Major* airports provide 66 percent of the publicly owned large aircraft hangars and 22 percent of the small aircraft hangars. Snohomish/Paine Field has 85 of the 311 publicly owned large aircraft hangars. *Community* airports provide 33 percent of the system's publicly owned small aircraft hangars with Auburn Municipal providing 232 hangars. *Regional* airports provide the most privately owned facilities with 63 percent of the small aircraft hangars and 47 percent of the large aircraft hangars; Arlington Municipal alone has 405 of the 644 privately owned large aircraft hangars inventoried in the database.

Table 3-11. Percent of Tie Downs and Hangar Types by Airport Classification

TYPE	MAJOR	REGIONAL	COMMUNITY	LOCAL	GENERAL USE	COUNT
Based Aircraft Tie Downs	28%	33%	30%	7%	2%	2,803
Transient Aircraft Tie Downs	16%	30%	33%	17%	3%	1,403
Public Owned Small Aircraft Hangar	22%	38%	33%	6%	1%	2,435
Private Owned Small Aircraft Hangar	8%	63%	23%	5%	2%	2,295
Public Owned Large Aircraft Hangar	66%	19%	11%	3%	2%	311
Private Owned Large Aircraft Hangar	25%	47%	26%	2%	0%	644

Source: WSDOT, Airport Information System database, 2016

3.5 Aviation Activity

3.5.1 Based Aircraft

A total of 63 percent of survey respondents reported based aircraft at their airport facility. The total number of based aircraft reported by the surveyed airport facilities is 13,327. Based on the WSDOT Aviation Division 2016 Statewide Airports Profile Report, the total based aircraft for the system overall is 8,025 (Table 3-12). According to the data reported in the survey, *Community* airport facilities have the most based aircraft. The total based aircraft reported by the surveyed facilities is provided by airport classification in Figure 3-12.

Top 5 airports by based aircraft (Based on the WSDOT Aviation Division 2016 Statewide Airports Profile Report):

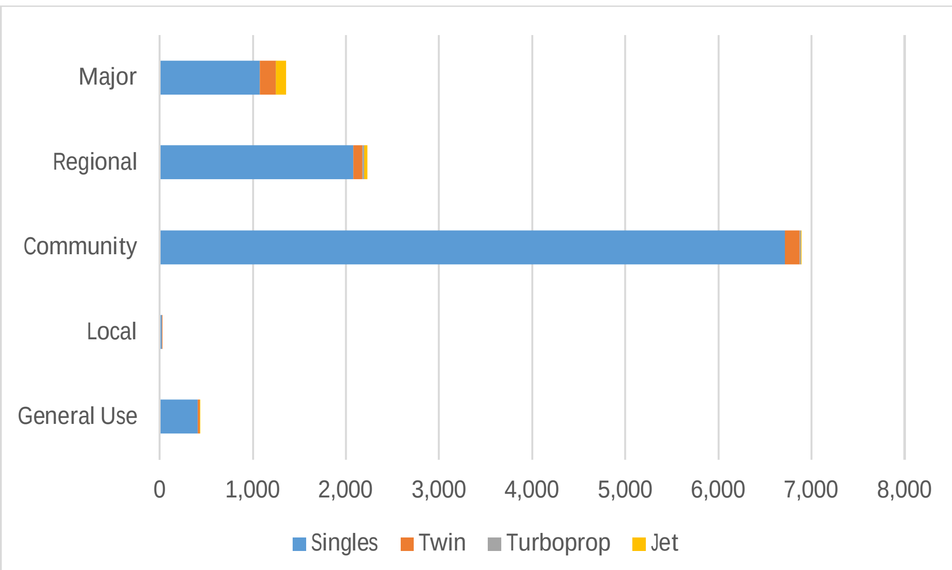
1. *Snohomish County/Paine Field*
2. *Arlington Municipal*
3. *Boeing Field/King County International*
4. *Crest Airpark*
5. *Harvey Field*

Table 3-12. Baseline 2015 Based Aircraft Data Reported in Survey by State Classification

CLASSIFICATION	SINGLE ENGINE	TWIN ENGINE	TURBO-PROPS	JET	HELI-COPTER	OTHER	TOTAL
Major	1,080	170	3	109	52	22	1,436
Regional	2,085	92	25	31	1,064	1,159	4,456
Community	6,716	163	11	2	34	27	6,953
Local	26	1	0	0	0	4	31
General Use	410	22	0	5	11	3	451
Total	10,317	448	39	147	1,161	1,215	13,327

Source: WASP Survey and Inventory, 2015

Figure 3-12. Fixed Wing Aircraft by State Classification



3.5.2 Aircraft Operations and Passenger Enplanements

In 2007, the statewide aircraft operations and passenger enplanements totaled 3.4 and 17.8 million, respectively. The total aircraft operations reported for 2015 by the surveyed airport facilities is 2.2 million with passenger enplanements totaling 16.8 million. Based on the WSDOT Aviation Division 2016 Statewide Airports Profile Report, total operations for the system overall is a little over 3.2 million and total number of enplanements is over 16.8 million. It is important to note that the survey was conducted in late 2015 and many respondents did not provide year-end totals. When available, the data was supplemented by the AIS database.

Top 5 airports by enplanements (Based on the WSDOT Aviation Division 2016 Statewide Airports Profile Report):

1. *Sea-Tac International*
2. *Spokane International*
3. *Bellingham International*
4. *Tri-Cities*
5. *Yakima Air Terminal-McAllister Field*

Major airports reported the most passenger enplanements

(16.8 million) while *Regional* airports reported the most total aircraft operations (990,000). The *General Use* airports reported the least passenger enplanements. All the operations and enplanement data reported in the survey is provided in Table 3-13.

Table 3-13. Baseline 2015 Operations and Enplanement Data Reported in Survey by State Classification

CLASSIFICATION	TOTAL AIRCRAFT OPERATIONS	PASSENGER ENPLANEMENTS
Major	584,322	16,805,768
Regional	990,606	53,597
Community	416,824	7,375
Local	78,852	2,700
General Use	163,057	100
Total	2,233,661	16,869,540

Source: WASP Survey and Inventory, 2015

Top 5 airports by air cargo tonnage (Based on the WSDOT Aviation Division 2016 Statewide Airports Profile Report):

1. *Sea-Tac International*
2. *Skagit Regional*
3. *Boeing Field/King County International*
4. *Spokane International*
5. *Snohomish County/Paine Field*

Based on the WSDOT Aviation Division 2016 Statewide Airports Profile Report: Total number of air cargo tons 816,527

3.5.3 Activities

The WASP survey requested information from each airport regarding aircraft operations activity types. There are three major services for transporting passengers for a fee: commercial service, air taxi and charter. A commercial flight operates on a regular schedule that can be daily, or only on certain days of the week. It adheres to a regular schedule and is operated by a commercial airline, such as Alaska Airlines. With a charter flight the entire aircraft, rather than just one seat. The aircraft can be large or small, and flights can be one-way or round-trip. Air taxi is an aircraft operator who carries 30 or fewer passenger seats and a payload capacity of 7,500 pounds or less, for hire or compensation. Air taxis operate on an on-demand basis and does not have scheduled flights. Respondents were asked to indicate which activities occur at the airport and to what level, a rating of 1 to 5—1 being

Top 5 airports by operations (Based on the WSDOT Aviation Division 2016 Statewide Airports Profile Report):

1. *Sea-Tac International*
2. *Boeing Field/King County International*
3. *Crest Airpark*
4. *Auburn Municipal*
5. *Harvey Field*

“minimal” and 5 being “major.” Of the 112 surveys received, some noteworthy revelations emerged; a total of 76 percent of the airports reported emergency medical aircraft operations to some degree occurring at the facility, 70 percent pilot or flight training, 69 percent personal transportation operations, and 55 percent search and rescue operations as well as military exercises. The “Other” activity category included responses such as parachuting, glider operations, winter recreation, as well as helicopter, hot air balloon, and banner towing activities. Angel Flight is the name used by a number of groups whose members provide free transportation for needy patients and perform other missions of community service. All the airport activity data reported in the survey is provided in Table 3-14.

Table 3-14. Aircraft Activity Reported by Surveyed Facilities

AIRCRAFT OPERATIONS	OVERALL	MAJOR	REGIONAL	COMMUNITY	LOCAL	GENERAL USE
Air cargo	21%	100%	35%	17%	10%	4%
Air taxi	27%	75%	40%	23%	13%	21%
Aircraft charter	34%	100%	60%	30%	10%	25%
Emergency medical aircraft operations	76%	75%	85%	80%	80%	58%
Disaster response aircraft operations	47%	50%	45%	40%	50%	54%
Blood tissue and organ transportation	25%	63%	40%	30%	20%	0%
Angel flight operations	35%	75%	60%	40%	20%	13%
Search and rescue operations	55%	63%	50%	53%	60%	54%
Agricultural aircraft operations	43%	38%	30%	43%	47%	50%
Law enforcement aircraft operations	51%	50%	50%	53%	60%	38%
Pipeline control aircraft operations	14%	25%	40%	10%	7%	4%
Pilot/flight training	70%	88%	85%	67%	53%	75%
Military exercises	55%	75%	80%	43%	47%	54%
Skydiving operations	8%	0%	15%	10%	10%	0%
Forest or grassland firefighting	52%	50%	50%	57%	53%	46%
Corporate flight department	17%	100%	35%	10%	3%	0%
Aerial sightseeing	42%	88%	55%	43%	33%	25%
Aircraft manufacturing tenants	14%	63%	30%	13%	0%	4%
Aerial photography	32%	63%	55%	40%	27%	0%
Scientific research	37%	50%	35%	23%	37%	50%
National security	28%	25%	25%	23%	17%	50%
Personal transportation	69%	88%	90%	80%	77%	21%
Business and corporate transportation	48%	100%	85%	43%	43%	13%
Commercial passenger services	20%	75%	20%	10%	7%	29%
Unmanned Aircraft Systems (UAS) manufacturing/research	1%	0%	0%	3%	0%	0%
Other	15%	13%	15%	13%	13%	21%

3.6 State, Local, and Regional Issues

3.6.1 Land Use Compatibility

Incompatible land use encroachment issues have led to airport closures in the state in the past. Incompatible land uses near an airport can result in safety concerns for pilots as well as the general public on the ground near the airport. Additionally, quality of life may be reduced for nearby residents.

Washington State *Senate Bill 6422* (RCW 36.70 and RCW 36.370A.510) requires local land use authorities to protect airports from incompatible development and included technical assistance programs for cities and counties to support land use planning for areas adjacent to airports. In addition, WSDOT Aviation Division created the Airport Land Use Compatibility Program, which supports partnerships between land use jurisdictions and airport sponsors as well as advocating for compatible land uses adjacent to airport facilities. The WSDOT Aviation Division Airport and Compatible Land Use Guidelines (1999) provides local land use authorities with an understanding of how to make the best use of the tools and resources offered by the Airport Land Use Compatibility Program.

The AIS database has an inventory of the predominant zoning classifications adjacent to airport facilities, which is a mix of airport zoning and other land uses and zoning. Table 3-15 illustrates the variety of predominant zoning that exists for the system airports.

Approximately 60 percent of *Major* airports are noted to have airport zoning. Figure 3-13 shows the percentage of airports by classification with Airport Zoning as a predominant zoning class per the AIS database. The survey respondents indicated that 60 percent of the airport facilities have surrounding jurisdictions that have adopted height and land use zoning to protect the airport.

Figure 3-13. Percentage of Airports with Airport Zoning as Predominant Zoning Class

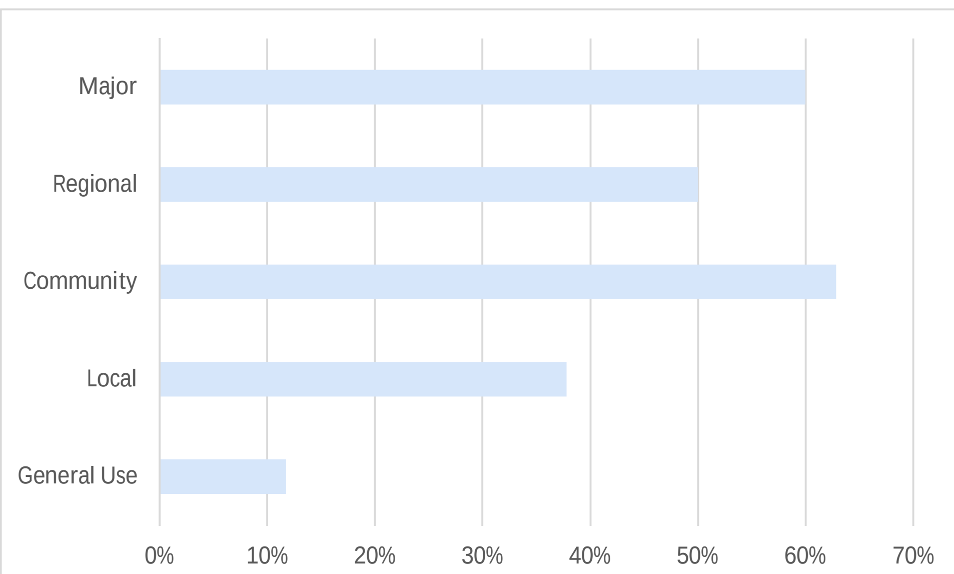


Table 3-15. Predominant Zoning by State Classification

AIRPORT CLASS AND ZONING	NO. OF AIRPORTS
Major	13
Agricultural Zoning	1
Airport Zoning	6
Commercial Zoning	2
Industrial Zoning	4
Regional	26
Agricultural Zoning	2
Airport Zoning	10
Commercial Zoning	1
Industrial Zoning	10
Mixed Use Zoning	2
Public Use Zoning	1
Community	40
Airport Zoning	22
Commercial Zoning	1
Industrial Zoning	9
Mixed Use Zoning	1
NULL	3
Public Use Zoning	3
Rural Zoning	1

AIRPORT CLASS AND ZONING	NO. OF AIRPORTS
Local	39
Agricultural Zoning	2
Airport Zoning	14
Commercial Zoning	4
Industrial Zoning	9
Mixed Use Zoning	1
NULL	5
Public Use Zoning	2
Residential Zoning	1
Rural Zoning	1
General Use	31
Airport Zoning	4
Commercial Zoning	1
Forest Zoning	1
Industrial Zoning	1
Mixed Use Zoning	3
NULL	18
Public Use Zoning	1
Rural Zoning	2

3.6.2 Funding Availability

As mentioned, a total of 64 airports are identified as significant to the national system by FAA and included in the NPIAS. The NPIAS provides the basis of apportioning federal AIP funding. Non-NPIAS airports are not eligible for AIP funding; however, public use facilities included in the WASP are eligible for the Airport Aid Grant Program administered by WSDOT Aviation. The annual competitive grant program provides funding support for critical airport safety, pavement, maintenance, security, and planning projects. NPIAS facilities are also eligible for these funds. The Washington State Classification system is an important tool for helping to identify and prioritize airport improvement and funding needs.

3.6.3 Wildlife Management Plan

Wildlife in and around airports is a difficult issue to manage. Wildlife management plans help mitigate safety hazards associated with wildlife, such as birds, mammals, or reptiles. Of those facilities surveyed, 28 percent indicated that they maintained an active Wildlife Management Plan; however, several respondents noted that a plan was in progress or that, while a formal plan is not in place, public and pilot education activities help to address wildlife concerns. A few facilities reported that wildlife fences are in place to protect wildlife and airport operations.

3.7 Inventory Summary

As stated previously, the data collected in the inventory process will serve as the basis from which to evaluate future demands in airline passenger traffic, air cargo and general aviation activity, as well as establishing a new state classification system to improve future system performance.

The data collected in this study will also serve as a baseline for future airport studies. Improvements to the system can be measured by comparing current conditions and facilities to the amount of progress achieved over the next several years and serve as a “report card” for future system performance. The summary below presents some of the key findings of the inventory collection process.

3.7.1 Findings

Airside Facilities

- Approximately 27 percent of the system’s runways are 5,000 feet or longer and 62 percent of the *Major* airport runways.
- *Major* airport primary runways average 8,966 in length.

FAR Part 77

Approximately 44 percent of airports included in the study responded that the facility has clear Part 77 approaches.

Landside Facilities

- According to the survey responses, approximately 88 percent of the respondents replied that the airport had adequate access roads and 74 percent indicated that airport signage was adequate.
- Approximately 65 percent of surveyed airports reported providing fuel including Jet A, 100LL/AvGas, or automotive gas (MoGas).
- According to the WSDOT AIS database, 18 percent of airports have passenger terminal facilities. All *Major* airports have passenger terminals and all *Regional* airports have passenger/pilot-waiting room facilities.
- Approximately 23 percent of the airports surveyed reported an airport business park or landside real estate development. Only 5 percent reported aircraft manufacturing tenants.
- According to the data collected from the survey, 27 percent of respondents reported a wait list for hangar space.

Aviation Activity

- A total of 63 percent of survey respondents reported based aircraft at their airport facility.
- The total number of based aircraft reported by the surveyed airport facilities is 13,327; however, the WSDOT Aviation Division 2016 Statewide Airports Profile Report indicates the total based aircraft for the system overall is 8,025.

- According to the survey, *Community* airport facilities have the most based aircraft.
- *Major* airports reported the most passenger enplanements (16.8 million) while *Regional* facilities reported the most total aircraft operations (990,000).
- Of the 112 surveys received, a total of 76 percent of the airports reported emergency medical aircraft operations to some degree occurring at the facility, 70 percent pilot and flight training, 69 percent personal transportation operations, and 55 percent search and rescue operations as well as military exercises.

State, Local, and Regional Issues

- Approximately 60 percent of *Major* airports are noted to have airport zoning.
- The survey respondents indicated that 60 percent of the airport facilities have surrounding jurisdictions that have adopted height and land use zoning to protect the airport.
- Of the airport facilities surveyed, only 4 percent reported a surrounding community that currently has a UAS policy. Many responses indicated that they were unfamiliar with UAS policy or that they were unsure if UAS policies were in place.

CHAPTER 4 – AVIATION TRENDS AND PROJECTIONS

4.1 Introduction

As a context for preparing and analyzing aviation demand forecasts for the comprehensive statewide system plan for the public-use airports in Washington, it is important to have an understanding of recent and anticipated trends for both commercial service and general aviation demand as well as cargo activity. Some trends in the aviation industry will undoubtedly have a greater impact on Washington airports than others; some trends may have no significant impact on aviation demand in the state. Information related to aviation demand trends and recent developments in air cargo will be included in this chapter when available.

The historical aviation demand trends examined consider commercial service airports separately from general aviation airports. These trends provide information and insight that were applied to the development of the aviation demand forecasts provided in this chapter. The forecasts include projections for commercial service airport enplanements and commercial operations as well as general aviation operations and based aircraft.

Because the trends (both recent and projected) in commercial service activity and general aviation activity are slightly different, varying methodologies were used to develop the forecasts for each. For commercial service airports, individual airport master plan demand forecasts and the Federal Aviation Administration's (FAA) Terminal Area Forecast (TAF) available as of March 2015 (2015 FAA TAF) were used and applied to 2014 activity data, as collected during the inventory process. The general aviation forecasts were developed using industry forecasts, with refinements for the application of growth rates by airport classification (i.e., major, regional, community, local, general use as discussed and defined in Chapter 5).

The following sections are included in the remainder of this chapter:

- Aviation demand profile and forecast
  - Industry trends
  - Washington aviation trends
  - Projections of Washington aviation demand
- Air cargo market profile and forecast
  - Air cargo industry background
  - North American West Coast and regional air cargo activity
  - Washington State air cargo
  - Washington State air cargo hub airports
  - Washington State air cargo forecast

4.2 Aviation Demand Profile and Forecast

Table 4-1 presents an overview of the results of the forecast. Details regarding the methodology used to develop these forecasts is provided later in this chapter.

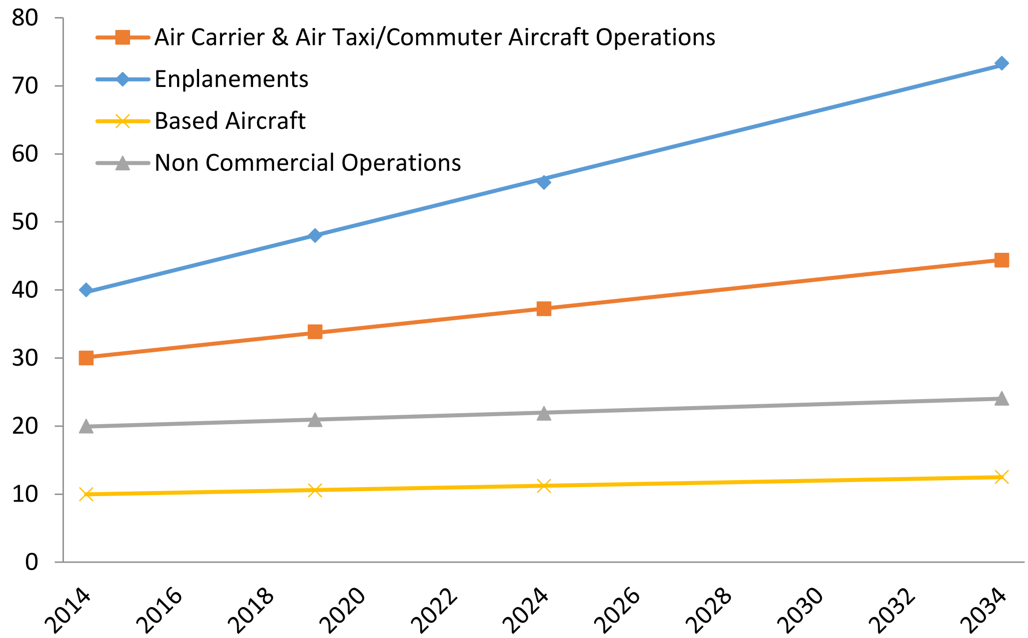
Table 4-1: Forecast Summary

Forecast Element	2014	2019	2024	2034	Total Change 2014–2034	Average Annual Growth Rate
Enplanements	21,266,635	25,507,926	29,662,115	38,975,299	83%	3.1%
Air Carrier and Air Taxi/ Commuter Aircraft Operations	594,438	670,398	738,004	879,595	48%	2.0%
Non-commercial Aircraft Operations	2,770,273	2,896,993	3,029,460	3,335,224	20%	0.9%
Based Aircraft	7,209	7,608	8,081	9,010	25%	1.1%

Source: Compiled by WSP | Parsons Brinckerhoff

Figure 4-1 graphically presents the elements of the aviation demand forecast. Details regarding the methodology used to develop these forecasts is provided later in this chapter. Note the data in the chart is not to scale and only illustrative of the growth in the elements of the demand forecast.

Figure 4-1: Illustrative Forecast Summary



Source: Compiled by WSP | Parsons Brinckerhoff

4.2.1 Industry Trends

Trends in the commercial airline industry could substantially impact air service in Washington, particularly as they relate to how the state's demand for commercial airline travel will be served in the future. Trends in general aviation are also important to consider because almost every airport in the Washington system, even the air carrier airports, accommodates some segment of general aviation activity. Because the vast majority of Washington airports support only general aviation aircraft operations, having an understanding of general aviation trends is important in considering the future demand for this component of the industry.

While there has been no overall growth from 2004 to 2014 in enplanements, it is expected that they will increase at an approximately average annual growth rate of 2% through 2035 over

This section reviews trends for both commercial service airports and general aviation airports. Trends that influence aviation demand, such as fuel prices, presented in this chapter are generally for the U.S. as a whole and are intended to provide insight into the factors that have recently and are anticipated to influence future aviation demand. The trends analysis sets the stage for an understanding of how aviation activity in Washington compares to aviation in the country, and it establishes a basis for predicting how aviation may be expected to grow and change in the future.

The demand for commercial service and general aviation over time has remained strong. During 2004 and 2005, demand returned to pre-September 11, 2001 (9/11), levels with additional growth through 2007. However, the economic crises that began in 2008 caused aviation activity levels to fall once again. Since that time, aviation demand has increased steadily but at rates much slower than during previous recoveries.

Commercial Aviation Trends

This section presents an overview of the historical and anticipated commercial aviation trends for aviation demand in the U.S. It includes an overview of historical enplanements as well as overall capacity in the system. These trends will assist in informing the forecast for these types of airports in the state. Key observations related to the information compiled for this section include the following:

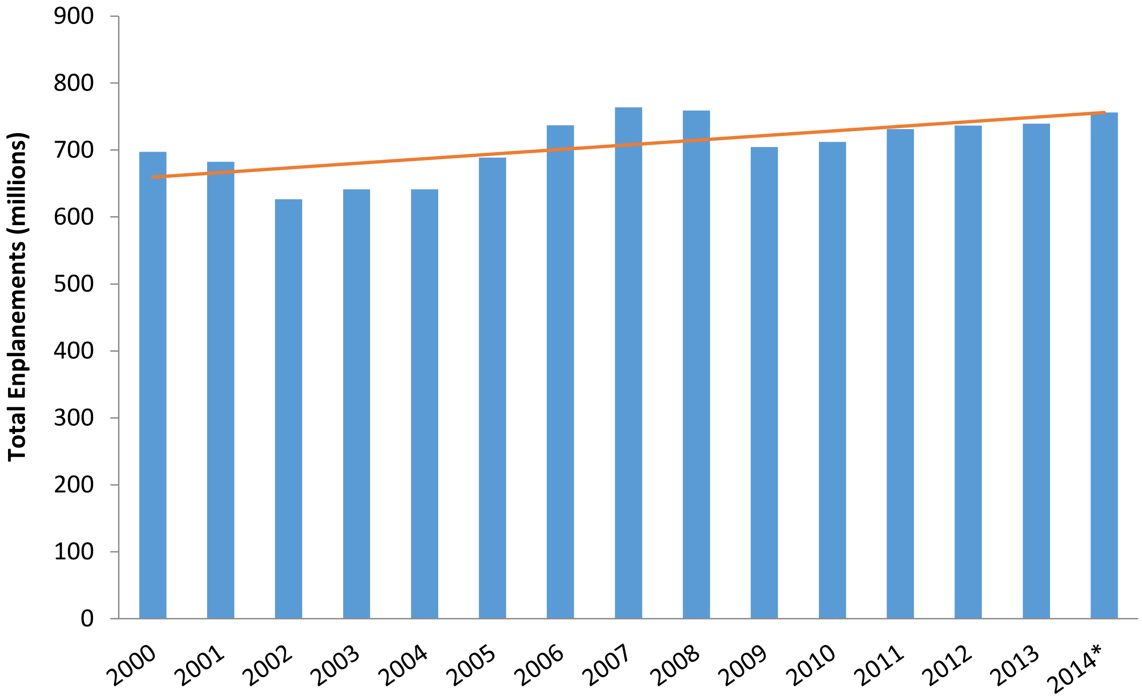
- Enplanements have experienced fluctuations in the last 15 years due to factors such as the events of 9/11 and the Great Recession of 2007, which ended in 2009.
- Enplanements were almost to pre-9/11 levels when the economic downturn occurred and were nearly back to those levels by 2014.
- Airline consolidation has impacted historical trends, resulting in a decrease in the number of aircraft operations. This is primarily due to airlines "right sizing" markets through the use of larger aircraft (movement from 50-seat regional jets to 70- and 90-seat aircraft) with less frequency as well as an increase in the overall load factor.
- While there has been no overall growth from 2004 to 2014 in enplanements, it is expected that they will increase at an approximately average annual growth rate of 2 percent through 2035 over 2014 levels.
- The largest growth in enplanements will be seen in the international markets over domestic activity.
- The trends related to aircraft size and load factors are expected to continue through 2035, with load factors increasing from 83.4 percent in 2014 to 84.2 percent by 2027 and remaining fairly stable through 2035.

Recent Commercial Trends

Following the events of 9/11, aviation forecasters anticipated that it would take about five years for commercial demand to return to levels experienced in 2000. However, by 2005, commercial traffic levels at almost all commercial service airports exceeded year 2000's levels and continued to grow through 2007. After the 2007 recession and 2008 collapse of the financial markets, commercial traffic levels again dropped and were not expected to recover until the economy as a whole recovered. In 2014, U.S. enplanements had still not reached levels that surpassed those from before the recession and financial collapse. Figure 4-2 presents the trend in total U.S. enplanements since 2000, as compiled from the *FAA Aerospace Forecasts, Fiscal Years 2015–2035* (*FAA Aerospace Forecasts*)[1].

[1] All data presented herein and referred to from the *FAA Aerospace Forecasts* is taken from the FAA Aerospace Forecasts, Fiscal Years 2015–-*2035.*

Figure 4-2: Historical U.S. Enplanements



Source: FAA Aerospace Forecasts, Fiscal Years 2015–-2035; compiled by WSP | Parsons Brinckerhoff
* 2014 data is an FAA Estimate.

The economic impacts to the airlines following the events of 9/11 and the economic recession of 2008 resulted in major changes to the airline industry. These factors are discussed below.

- **Economic Cycles:** There is a strong relationship between growth in enplanements and the U.S. gross domestic product. This trend clearly indicates that the airline industry and commercial passenger traffic are significantly impacted by upturns and downturns in the U.S. economy. The economic downturn subsequent to the economic recession beginning in 2008 had a profound effect on the level of air traffic in the U.S.

Economic conditions have also spurred numerous airline mergers and acquisitions over the past decade. Table 4-2 presents an overview of the mergers and acquisitions that have occurred in the U.S. airline industry since 2000.

Table 4-2: U.S. Mainline Carriers (2000–2015)

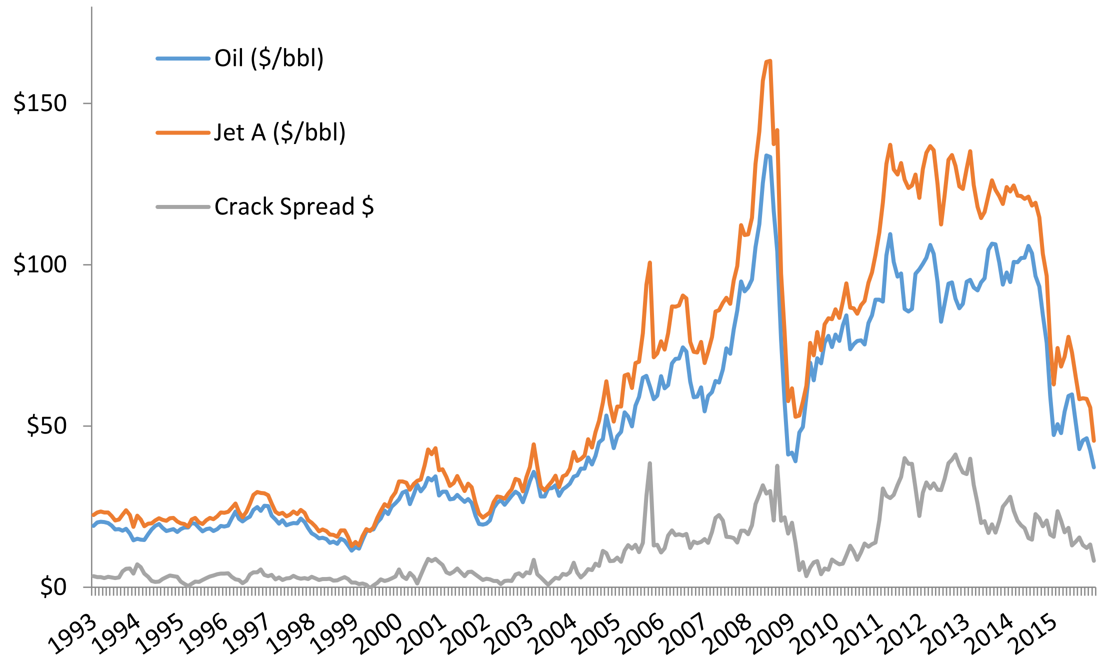
Airline	Airline Acquired	Acquired By	Currently Operating	Current Operating Name
American Airlines	TWA – 2001	U.S. Airways – 2013	Yes	American Airlines
Continental Airlines	–	United – 2011	No	United Airlines
Delta Air Lines	Northwest – 2008	–	Yes	Delta Air Lines
Northwest Airlines	–	Delta – 2008	No	Delta Air Lines
Trans World Airlines (TWA)	–	American – 2001	No	American Airlines
United Airlines	Continental – 2011	–	Yes	United Airlines
U.S. Airways	American – 2013	–	No	American Airlines

Source: Compiled by WSP | Parsons Brinckerhoff

- **Fuel Prices**: Despite a continuing increase in passenger demand, the cost of fuel continues to disrupt the financial stability of commercial airlines and their ability to maintain profitability. Figure 4-3 presents the pricing trends of crude oil and jet fuel (referred to as Jet A). Since 1991, there have been three major spikes in the price of oil. In the 1990s, the price fluctuated between $20 and $30 per barrel increasing to $35 per barrel briefly after 9/11. Oil prices continued to steadily climb until late 2005 when Hurricane Katrina hit the U.S. Gulf Coast, sending oil prices to nearly $70 per barrel. Leading up to the collapse of the financial markets in the Fall 2008, the price of oil climbed to an all-time high of around $140 per barrel. After the collapse and onset of the ensuing recession, oil prices fell to below $40 per barrel. Since that time, oil prices made a fairly steady recovery and as of mid-2014 were in the range of $90 to $100 per barrel. However, at the end of 2014, oil prices declined rapidly averaging around $50 per barrel throughout 2015. In addition, the difference between crude and jet fuel cost per barrel, known as the "crack spread," increased as well, from a historical average of $5 to around $20 in early 2015.

  The uncertainty related to fuel prices can have an adverse effect on commercial aviation if these fluctuations result in an increase in airfares. Additionally, airlines have "right-"sized aircraft to the market being served based on the demand as well as all but eliminated the use of 50-seat regional jets, which have one of the highest cost-per-seat-mile to operate.

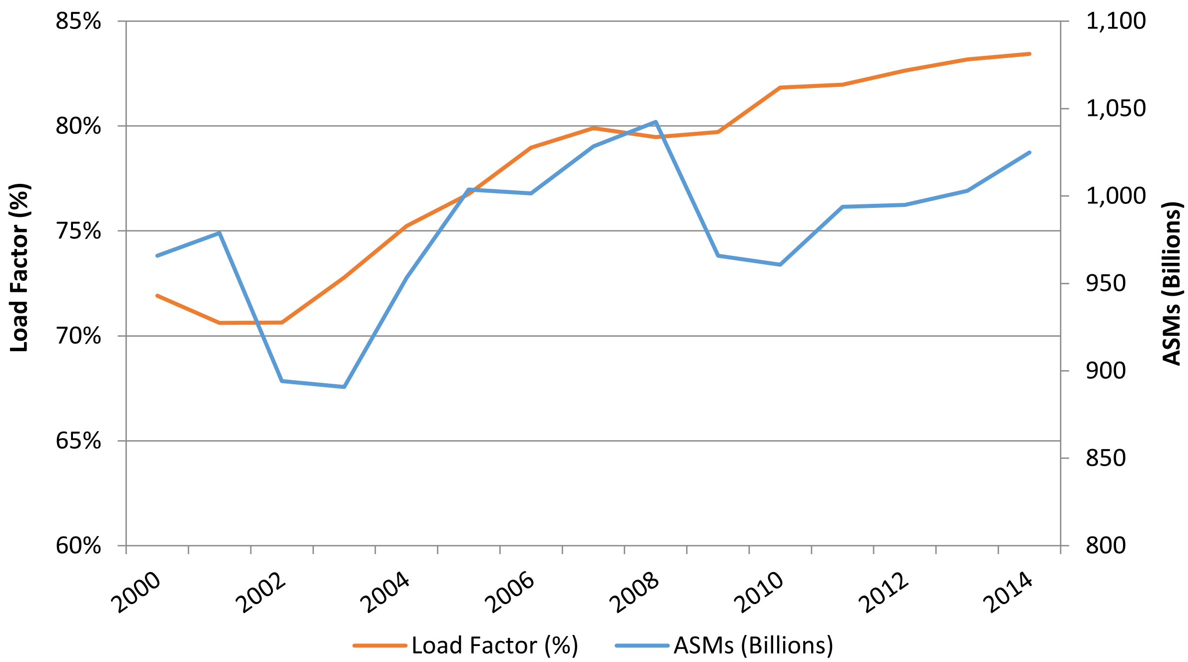
Figure 4-3: Monthly Average U.S. Oil and Jet A Prices



Source: U.S. Energy Information Administration; compiled by WSP | Parsons Brinckerhoff

- **Airline Capacity and Load Factors:** One way to evaluate the revenue drivers of the airline industry is to look at airline capacity and load factors. Airline capacity is often measured by available seat miles (ASM), which is a measure of an airline flight's passenger carrying capacity. It is equal to the number of seats available multiplied by the number of miles flown. Load factors are the percentage of available seats that are occupied. Throughout the late 1990s and early 2000s, load factors were approximately 70 percent. However, beginning in 2002, the U.S. domestic load factor increased, reaching more than 80 percent by 2010 and 84 percent in 2014. Capacity (ASMs) increased in the early 2000s in the aftermath of 9/11 and then remained relatively stable from 2009 through 2012. In 2013 and 2014, ASMs increased approximately 1 percent and 2 percent, respectively, over prior year levels. Figure 4-4 presents historical ASMs and load factors for the U.S. commercial carriers. The load factors experienced in recent years are unprecedented and have resulted in a decrease in commercial aircraft operations across the country.

Figure 4-4: Historical U.S. Commercial Carrier Capacity and Load Factors



Source: FAA Aerospace Forecasts, Fiscal Years 2015–2035; Compiled by WSP | Parsons Brinckerhoff
2014 data is an FAA Estimate

Anticipated Commercial Trends

> *The FAA projects that total domestic passenger enplanements on large U.S. carriers and regional/commuter carriers combined will increase from approximately 668.4 million in 2014 to approximately 951.0 million in 2035, representing an average annual growth rate of approximately 1.7 %*

The preceding descriptions of historical commercial airline trends are the background upon which the FAA has developed forecasts of future levels of commercial passenger activity. The forecasts of commercial passenger activity presented in the FAA Aerospace Forecasts indicate anticipated growth over the study period in both domestic and international passenger activity at U.S. airports. The following paragraphs summarize the FAA forecasts of future commercial airline passenger activity.

Based on the FAA 2014 forecast of slight economic recovery in 2013 and steady economic expansion in the U.S. for the remainder of the forecast period, commercial passenger enplanements in the U.S. are anticipated to experience sustained growth throughout the forecast period. The FAA projects that total domestic passenger enplanements on large U.S. carriers and regional/commuter carriers combined will increase from approximately 668.4 million in 2014 to approximately 951.0 million in 2035, representing an average annual growth rate of approximately 1.7 percent.

The international passenger activity from the *FAA Aerospace Forecasts* are based on the assumption that the world economy (based on international gross domestic products [GDP]) will grow at a pace that exceeds the U.S. GDP growth over the forecast period. Based on this assumption, international passenger enplanements on U.S. carriers are projected to increase from approximately 88.0 million in 2014 to approximately 185.5 million in 2035. This growth represents a relatively robust forecasted average annual growth rate of approximately 3.6 percent. The strongest growth in total international passenger traffic on U.S carriers is anticipated to be experienced in the Latin American and Pacific markets, which are forecast to grow at an average annual rate of approximately 4.0 percent and 3.5 percent, respectively. The average annual growth rate in the European market is projected at approximately 2.5 percent between 2014 and 2035.

The strongest growth in total international passenger traffic on U.S carriers is anticipated to be experienced in the Latin American and Pacific markets, which are forecast to grow at an average annual rate of approximately 4.0 percent and 3.5 percent, respectively. The average annual growth rate in the European market is projected at approximately 2.5

Table 4-3[2] presents a summary of historical passenger enplanement levels at U.S. airports and the FAA domestic and international passenger enplanement forecasts on U.S. carriers (large air carriers and regional/commuter carriers) from 2015 to 2035. Another factor that may influence aviation demand in the future is the potential shortage of pilots. It is anticipated that approximately 18,000 pilots will retire from the big four airlines (American, Delta, Southwest, and United) between 2014 and 2018. These pilots likely will be replaced by pilots currently working for regional airlines (i.e., Republic, SkyWest). The high training costs for becoming a commercial pilot, recently increased number of training hours required to fly for a commercial airliner, as well as low pay, has resulted in less college students working toward becoming pilots. The outcome is regional carriers may see a shortage of pilots, which could result in a lower number of regional operations that may need to be picked up by the mainline carriers or eliminated. The most likely airports to be affected by this would be small and non-hub commercial service airports.

[2] Much of the historical data presented in this chapter begins in 2007, which is the date for the last historical data collected in the previous WASP. In addition, in 2007 historical aviation was at an all-time high for many of the categories presented in this chapter, showing the rate of recovery from the economic crises that began in 2008, where applicable.

Table 4-3: Projection of U.S. Carrier Enplanements (millions)

Fiscal Year	Domestic Enplanements	International Enplanements	Total [1]
Historical			
2007	688.5	75.3	763.8
2008	680.7	78.3	759.1
2009	630.8	73.6	704.4
2010	634.8	77.3	712.1
2011	650.1	81.0	731.1
2012	653.8	82.9	736.7
2013	654.4	85.1	739.5
2014 [2]	668.4	88.0	756.3
Average Annual Growth Rate (2007-2014)	*-0.3%*	*1.7%*	*-0.1%*
Forecast			
2015	685.6	90.2	775.8
2016	696.2	93.4	789.5
2017	708.8	97.0	805.8
2018	720.6	100.5	821.1
2019	729.5	104.6	834.1
2020	742.0	109.1	851.1
2021	752.0	113.3	865.3
2022	762.4	117.5	879.9
2023	774.2	121.9	896.1
2024	784.9	126.2	911.1
2025	796.6	130.8	927.4
2026	809.2	135.5	944.7
2027	823.8	140.4	964.2
2028	839.4	145.5	984.9
2029	855.1	150.7	1,005.8
2030	871.0	156.1	1,027.1
2031	886.4	161.5	1,048.0
2032	902.6	167.1	1,069.7
2033	918.9	173.0	1,091.9
2034	935.3	179.1	1,114.4
2035	951.0	185.5	1,136.5
Average Annual Growth Rate (2014-2035)	*1.7%*	*3.6%*	*2.0%*

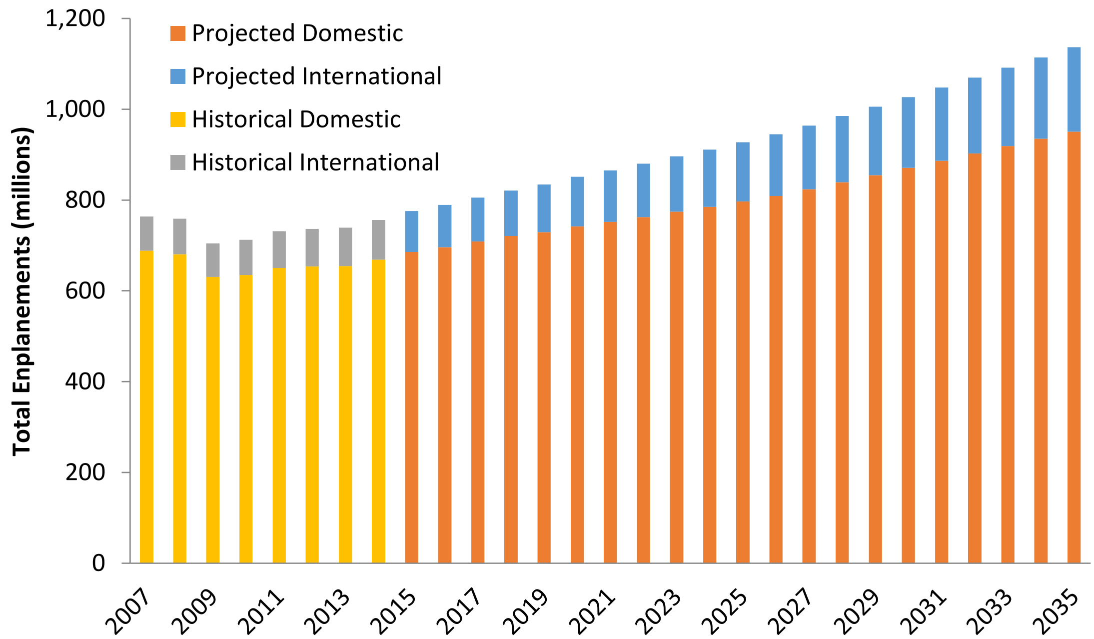
Source: FAA Aerospace Forecasts, Fiscal Years 2015–2035; Compiled by WSP | Parsons Brinckerhoff

[1] Totals may not add up due to individual rounding.

[2] 2014 data is an FAA estimate.

U.S. carrier total passenger enplanement data presented in Table 4-3 is depicted on Figure 4-5.

Figure 4-5: Historical and Projected U.S. Enplanements

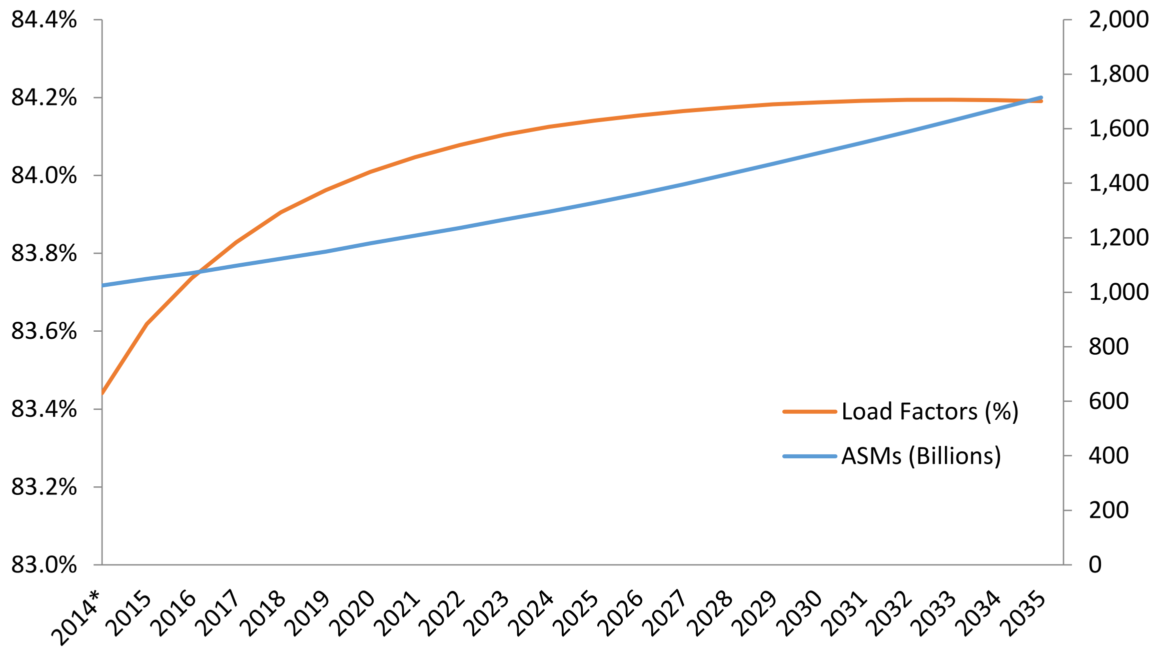


Source: FAA Aerospace Forecasts, Fiscal Years 2015–2035; compiled by WSP | Parsons Brinckerhoff
*2014 data is an FAA Estimate.

As reflected on Figure 4-5, the FAA projects near-term commercial passenger activity for U.S. carriers to be stable and reflect modest but steady growth in both domestic and international enplanements at U.S. airports. Domestic passenger enplanements are projected to increase at an average annual rate of approximately 1.7 percent from 2014 to 2035, which is much greater than the growth experienced at U.S. airports between 2007 and 2014 during the economic recovery. International passenger enplanements are projected to increase at an average annual rate of approximately 3.6 percent over the forecast period, a rate greater than the 2.3-percent average annual growth rate experienced in this category of enplanements between 2007 and 2014.

The FAA also forecasts other factors related to U.S. commercial air carrier passenger activity. According to the *FAA Aerospace Forecasts*, between 2014 and 2035 ASMs are projected to increase from 1,024.8 billion to 1,714.4 billion, average passenger trip length is expected to increase from 1,130.6 miles to 1,270.1 miles, average seats per aircraft mile will increase from 145.2 to 163.8, and the average load factor is expected to increase slightly from 83.4 percent to 84.2 percent. Figure 4-6 presents projected ASMs and load factors through 2035. The sharper projected increase in load factor indicates a flattening or decrease in the number of commercial aircraft operations, which is evidenced by the right-sizing of aircraft to markets and serving some markets with less frequency using larger regional jets (moving from 50-seat aircraft to 70- and 90-seat aircraft). This phenomenon has resulted in cost savings for the air carriers, as they are using more efficient aircraft with less frequencies. For passengers, right-sizing has resulted in higher fares as the supply of seats has decreased. In addition, passengers experience greater inconvenience when the system is backed up due to weather or there is an equipment failure as the lower frequency in flights results in less options to get to their destinations.

Figure 4-6: Projected U.S. Commercial Carrier Capacity and Load Factors



Source: FAA Aerospace Forecasts, Fiscal Years 2015–2035; compiled by WSP | Parsons Brinckerhoff
* 2014 data is an FAA Estimate.

Trends Affecting General Aviation

General aviation includes all civil aviation except scheduled passenger or air cargo operations. It includes personal transportation, business and corporate flights, air taxi (defined as "any common carrier for hire that holds an air taxi operating certificate and primarily operates small aircraft without fixed routes"), and helicopter operations.

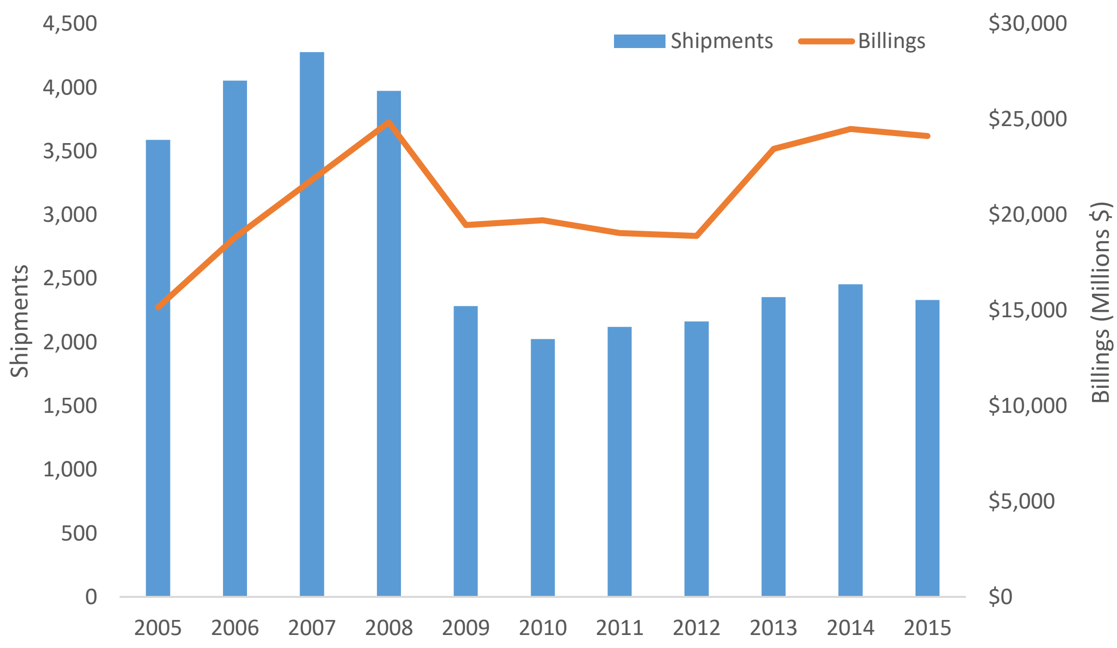
Across the U.S., general aviation aircraft are flown for a wide variety of uses, including business travel, agricultural spraying, flight instruction, emergency airlift, firefighting, recreation, and search and rescue. These aircraft include home-built/experimental, glider, agricultural, military surplus, antique and classic WarBirds, ultra-light airplanes, helicopters, single and multi-engine aircraft, and corporate and private jets.

Specific trends related to general aviation activity, as identified in the *FAA Aerospace Forecasts*, and forecasts developed by the U.S. Department of Transportation and other national groups, are identified in following sections. These anticipated future trends are discussed in terms of the number of aircraft shipments and billings, active aircraft and pilots, changes in the active aircraft fleet mix, and business use of general aviation aircraft.

Aircraft Shipments and Billings

The economic recession that began at the end of 2007 had a marked effect on the general aviation industry. Figure 4-7 presents the historical general aviation aircraft shipments from 2005 to 2015, compared to billings (value of the shipments) for the same time period. According to the General Aviation Manufacturers Association (GAMA), delivery of general aviation aircraft was down nearly 50 percent in 2009 compared to 2008 and was the second year of declining shipments compared to the three previous years, which experienced increases. Since 2009, general aviation aircraft shipments have remained relatively stable.

Figure 4-7: Historical General Aviation Aircraft Shipments and Billings



Source: GAMA; compiled by WSP | Parsons Brinckerhoff

General aviation aircraft billings also showed increases from 2005 to 2008 but decreased in the wake of the recession in 2009. General aviation billings remained relatively stable at approximately $20 billion from 2009 to 2012. However, in 2013 there was an increase of approximately 25 percent over 2012 to $23.4 billion and nearly 5 percent from 2013 to 2014 to $24.5 billion, which is the second highest level of billings on record next to 2008.

The statistics presented by GAMA indicate a decline in the overall general aviation aircraft manufacturing industry. It is important to note that even with the decline in general aviation aircraft manufacturing, the strongest growth appears to be occurring in the jet and turboprop segments of the market. Despite the significant decreases in total shipments during and since the economic recession, the combined share of jet and turboprop aircraft has increased from 40 percent in 2001 to nearly 55 percent in 2015. The growth in these segments can be attributed to increased business use of aircraft and the demand of corporations for safe, efficient, high-performance aircraft. These high-performance aircraft require airport facilities to be developed to a relatively higher and more demanding standard.

Active Pilots

In 2014, the four largest segments of the pilot population were student pilots, private pilots, commercial pilots, and airline transport pilots. With the exception of private pilots, each group experienced growth from 2007 to 2014. As a result, the total number of active pilots increased to approximately 593,500 pilots in 2014, an increase of 3,100 pilots compared to 2007. One of the strongest average annual growth rates was experienced in the student pilot population, which increased by approximately 5.2 percent during the same period. This increase was primarily due to an increase in the duration of validity for student pilot certificates for pilots under the age of 40 from 36 months to 60 months. According to the FAA, the long-term effects of this change are still undetermined and this category of pilots is projected to decrease at an average annual rate of 0.3 percent through 2024. Also noteworthy is the 6.8-percent average annual growth rate in the number of instrument-rated pilots from 2007 to 2012. Currently, approximately 52 percent of the total active pilot population is instrument-rated—another reflection of the increased sophistication of aircraft and pilots.

The FAA has developed forecasts of the future pilot population, by certificate type, based on historical trends, as well as anticipated future trends. These projections estimate that the total active pilot population in the U.S. will increase from approximately 593,500 in 2014 to 617,000 by 2035, representing an average annual growth rate of approximately 0.2 percent. Table 4-4 presents historical and projected active pilots by certificate type.

As shown in Table 4-4, the largest categories of pilots (student, private, commercial, and airline transport) are anticipated to remain relatively stable over the 20-year forecast period. Figure 4-8 presents the share of each type of pilot as presented in Table 4-4.

Figure 4-9 compares the average annual growth rate projected for each pilot type through 2014 to 2035. As shown in the figure, there is little growth in the number of active pilots, with the highest growth rates being in the sport and other categories.

Table 4-4: Historical and Projected Active Pilots by Certificate Type

Fiscal Year	Student [1]	Sport	Private	Commercial	Airline Transport	Other [2]
Historical						
2007	84,339	2,031	211,096	115,127	143,953	33,803
2008	80,989	2,623	222,596	124,746	146,838	35,954
2009	72,280	3,248	211,619	125,738	144,600	36,800
2010 [1]	119,119	3,682	202,020	123,705	142,198	36,864
2011	118,657	4,066	194,441	120,865	142,511	36,588
2012	119,946	4,493	188,001	116,400	145,590	36,146
2013	120,285	4,824	180,214	108,206	149,824	35,733
2014	120,546	5,157	174,883	104,322	152,933	35,658
Average Annual Growth Rate (2007-2014)	*5.2%*	*14.2%*	*-2.7%*	*-1.4%*	*0.9%*	*0.8%*
Forecast						
2015	119,650	5,600	173,750	104,250	153,000	35,440
2016	119,650	6,000	174,100	104,800	153,200	35,440
2017	119,300	6,450	174,200	105,100	153,400	35,505
2018	119,000	6,850	173,500	105,400	153,600	35,620
2019	118,600	7,300	172,750	105,300	153,800	35,975
2020	118,250	7,700	171,950	105,550	154,300	36,475
2021	117,900	8,100	171,250	105,750	155,100	37,200
2022	117,500	8,550	170,650	106,050	156,000	37,905
2023	117,100	9,000	170,000	106,300	156,800	38,590
2024	116,650	9,450	169,300	106,650	157,400	39,320
2025	116,300	9,900	168,650	107,050	158,100	40,130
2026	115,950	10,350	168,100	107,450	158,900	40,835
2027	115,550	10,850	167,500	107,950	159,900	41,550
2028	115,150	11,350	166,950	108,450	160,800	42,130
2029	114,750	11,900	166,400	109,050	161,800	42,595
2030	114,350	12,450	165,900	109,700	162,900	42,950
2031	113,900	13,050	165,400	110,350	164,000	43,240
2032	113,450	13,650	164,800	111,050	165,100	43,480
2033	113,050	14,300	164,350	111,750	166,300	43,735
2034	112,600	14,950	163,950	112,550	167,400	44,000
2035	112,200	14,950	163,600	113,350	168,600	44,300
Average Annual Growth Rate (2014–2035)	*-0.3%*	*5.2%*	*-0.3%*	*0.4%*	*0.5%*	*1.0%*

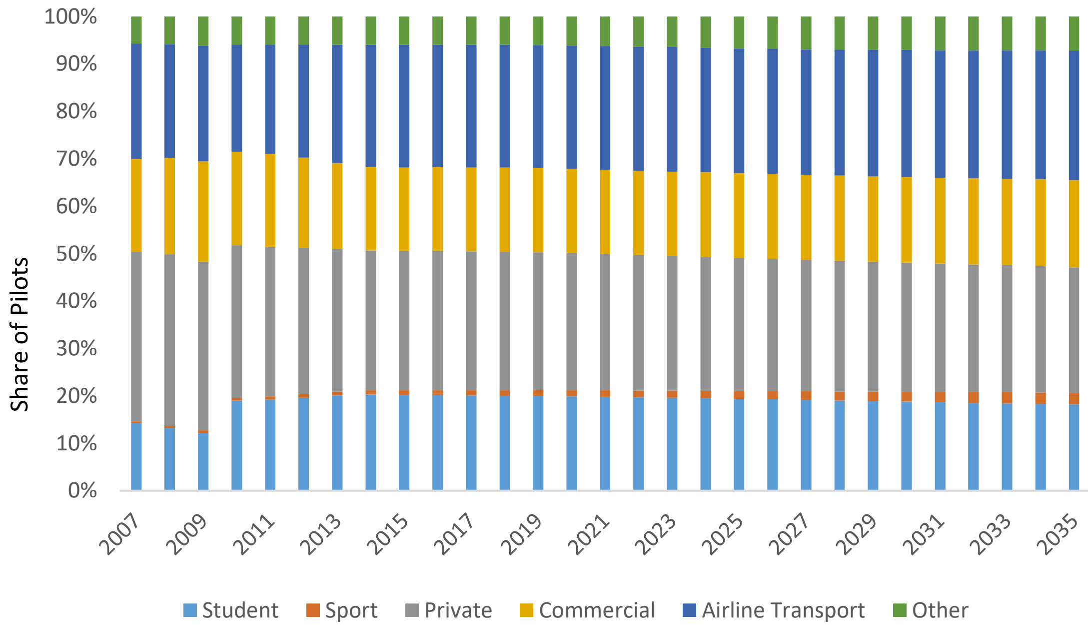
Sources: FAA Civil Airman Statistics; FAA Aerospace Forecasts, Fiscal Years 2015–2035; compiled by WSP | Parsons Brinckerhoff

[1] In July 2010, the FAA issued a rule that increased the duration of validity for student pilot certificates for pilots under the age of 40 from 36 to 60 months. This resulted in the increase in active student pilots to 119,119 from 72,280 at the end of 2009.

[2] Includes pilots with recreational, rotorcraft-only, and glider-only certificates.

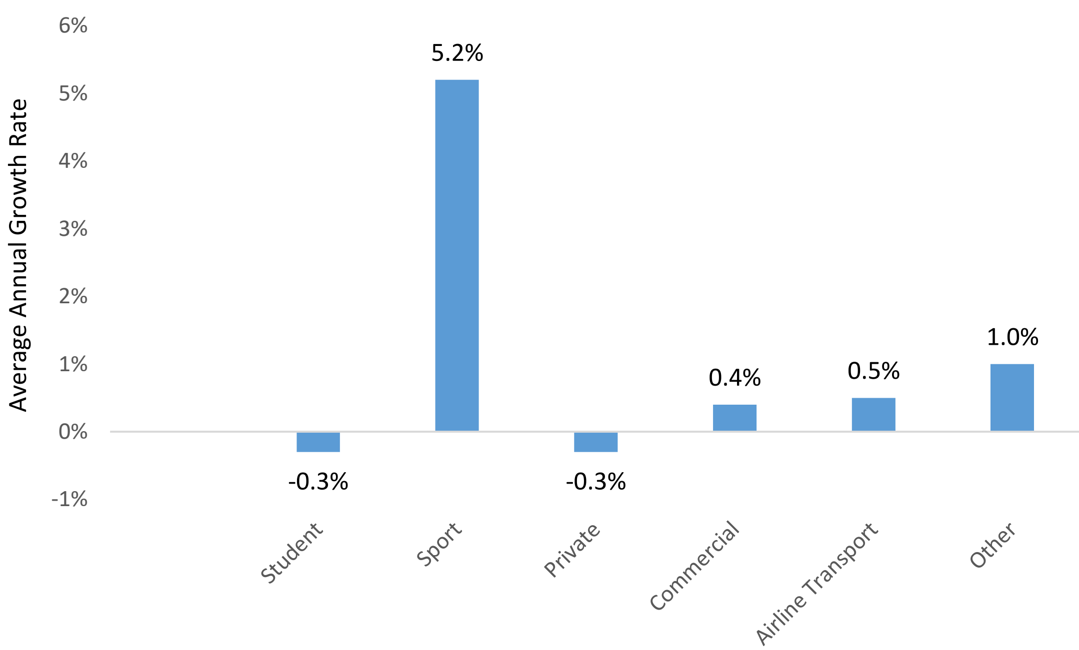
[3] Totals may not add up due to individual rounding.

Figure 4-8: Active Pilots Share by Aircraft Certificate Type (2007–2035)



Source: FAA Aerospace Forecasts, Fiscal Years 2015–2035; compiled by WSP | Parsons Brinckerhoff

Figure 4-9: Projected Growth of Active Pilots (2014–2035)



Source: FAA Aerospace Forecasts, Fiscal Years 2015–2035; compiled by WSP | Parsons Brinckerhoff

General Aviation Aircraft Fleet

The FAA uses the economic forecasts and trends in general aviation aircraft deliveries to develop its forecast of active general aviation aircraft. Table 4-5 presents the number of historical and FAA-projected general aviation aircraft. As shown in the table, the total number of active fixed-wing piston aircraft decreased since 2004, while the number of fixed-wing turbine aircraft has increased. From 2004 to 2014, the number of fixed-wing piston and fixed-wing turbine aircraft fluctuated from approximately 173,400 in 2004 to a high of approximately 187,000 in 2007 to an estimated 146,100 in 2014, representing an overall decrease from 2004 to 2014 of nearly 16 percent.

Table 4-5: Historical and Projected General Aviation Fleet Mix

Aircraft Type	2004	2014 [1]	2035	Average Annual Growth Rate 2014–2035
Single-engine piston	146,613	123,440	108,810	-0.6%
Multi-engine piston	18,469	13,215	12,135	-0.4%
Turbine	8,379	9,485	12,970	1.5%
Jet	9,298	11,750	20,815	2.8%
Rotorcraft	7,821	10,085	17,110	2.5%
Other [2]	28,739	30,885	42,420	1.5%
Total [3]	*219,319*	*198,860*	*214,260*	*0.4%*

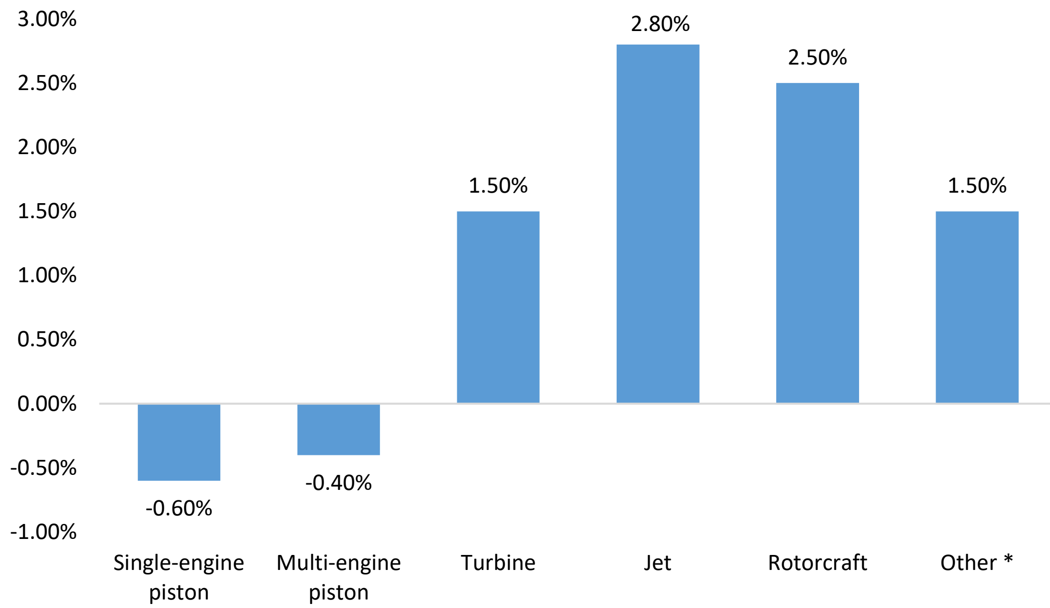
Sources: FAA Aerospace Forecasts, Fiscal Years 2015–2035; compiled by WSP | Parsons Brinckerhoff
[1] 2014 data is an FAA estimate.
[2] Includes aircraft classified by the FAA as sport and experimental.
[3] Totals may not add up due to individual rounding.

As shown in Table 4-5, the total active aircraft fleet is forecast to experience an average annual growth rate of well below 1 percent. One of the most important trends identified in these forecasts is the relatively strong growth anticipated in active jet aircraft. This trend illustrates a trend in the general aviation community toward higher performing, more demanding aircraft. This trend will impact the types of activities occurring at general aviation airports and the types of facilities that may be required at those airports. In addition, rotorcraft are projected to increase at an average annual growth rate of 2.5 percent and both turbine aircraft and other aircraft projected to increase at an average annual growth rate of 1.5 percent.

Figure 4-10 compares the projected average annual growth rate for each type of aircraft in the fleet mix over the period 2014 through 2035, and Figure 4-11 presents the trend in general aviation aircraft fleet mix. Figure 4-10 illustrates the extent to which the growth in jet aircraft are projected to significantly outpace growth in all other components of the aircraft fleet. As shown, the categories with the highest growth rates are jet and rotorcraft aircraft, with growth rates of 2.8 percent and 2.5 percent, respectively. As also shown, the number of active single- and multi-engine piston aircraft is anticipated to decrease over the forecast period.

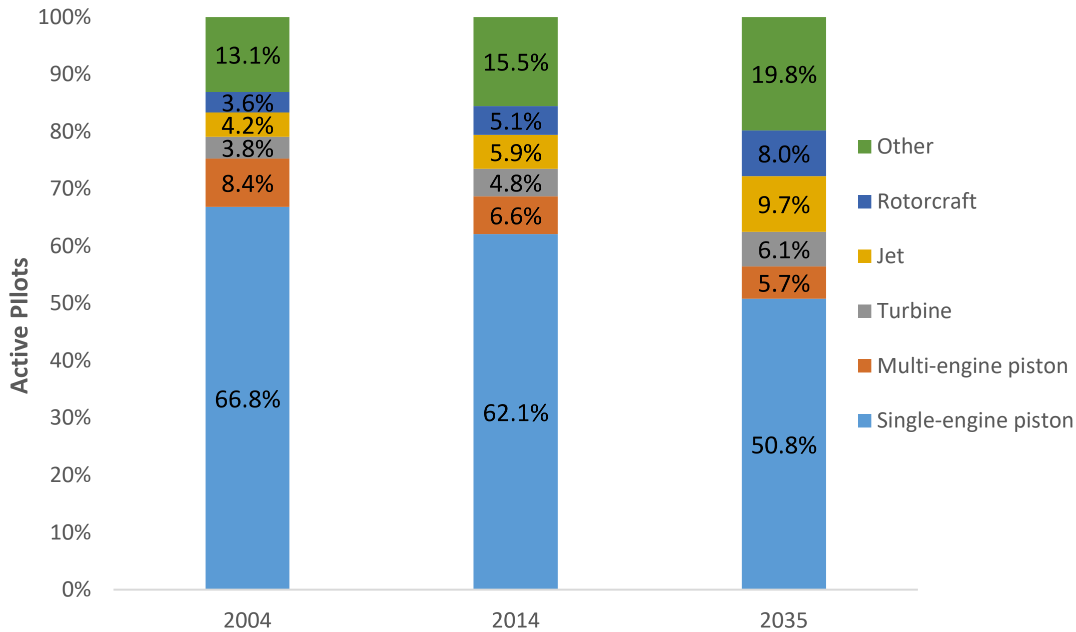
It is also useful to examine the existing and anticipated active aircraft fleet in terms of the percentage of the total fleet that each aircraft class represents or the aircraft fleet mix. Figure 4-11 presents a comparison of the existing general aviation fleet mix for 2004 and 2014 with the projected general aviation fleet mix for 2035.

Figure 4-10: Projected Growth of General Aviation Aircraft (2014 –2035)



Source: FAA Aerospace Forecasts, Fiscal Years 2015–2035; Compiled by WSP | Parsons Brinckerhoff
* Includes aircraft classified by the FAA as sport and experimental.

Figure 4-11: Aircraft Fleet Mix by Aircraft Type



Source: FAA Aerospace Forecasts, Fiscal Years 2015–2035; compiled by WSP | Parsons Brinckerhoff

As shown on Figure 4-11, the majority of the active aircraft in the current fleet (2014) is single-engine piston aircraft. It is anticipated that the percentage of single-engine piston aircraft will decline from approximately 62.1 percent (2014) to 50.8 percent (2035) of the active fleet, as older aircraft are retired and replaced. The share of jets, rotorcraft, and other aircraft are expected to increase during the projection periods, which is a continuation of the trend from 2004 to 2014.

Forecast data developed by the FAA indicates that each component of the general aviation aircraft fleet mix will either remain relatively steady (multi-engine piston and turbine) or grow in terms of total number of active aircraft. Data depicted in the previous tables and figures indicates that jet, rotorcraft, and other aircraft will be the components of the general aviation aircraft fleet mix that will see the largest growth in share of the active fleet over the forecast period.

Jet aircraft are anticipated to grow from approximately 6 percent of the active general aviation fleet mix in 2014 to approximately 10 percent of the active fleet by 2035, indicating the relative increase in sophistication that is anticipated in the active aircraft fleet and pilot population. As with the single-engine piston aircraft, this is a continuation of the trend from 2004 to 2014. The “other” category of aircraft is also forecast to become a larger component of the active fleet, primarily because of expected growth in experimental aircraft, from approximately 16 percent of the fleet to 20 percent of the fleet by 2035.

Current and forecasted trends affecting general aviation can be summarized as follows:

- The number of annual general aviation aircraft shipments has stabilized from the decline due to the Great Recession of 2007.
- The overall number of general aviation licensed pilots will stabilize; relatively strong growth is expected in the number of sport and “other” pilots.

- Moderate growth is expected in the number of active aircraft.
- Jet aircraft are expected to see even more growth from 2014 to 2035, continuing historical trends from 2004 to 2014.

4.2.2 Washington State Aviation Trends

Data regarding historical activity levels at Washington airports is presented in the following sections. Airport activity data typically provides a good indication of the total amounts of activity occurring at an airport as well as recent increases or declines in activity levels at Washington facilities. Data will be presented for the following components of airport activity:

- Enplanements
- Commercial aircraft operations
- Based aircraft
- Non-commercial and general aviation aircraft operations

Enplanements, based aircraft, and aircraft operations data from the public-use airports included in the WASP are reported annually to the FAA. The data reported to the FAA includes information from public-use airports that are a part of the National Plan of Integrated Airport Systems (NPIAS).[3] The FAA publishes the information and provides projections of activity for each airport in its TAF. For consistency with the national trends presented earlier in this chapter, historical data presented in this section is extracted from the 2015 FAA TAF rather than using the data collected for this Study. However, the data collected as part of the survey was used as the base to develop the aviation demand forecasts. This section presents historical comparisons of public-use airports in Washington as presented in subsequent sections.

A summary of the findings related to a comparison of U.S. trends with the trends in Washington are as follows:

- Enplanements at Washington's commercial service airports increased at an average annual growth rate that was greater than the U.S. and the FAA's Northwest Mountain Region between 2004 and 2014.
- Air carrier and air taxi/commuter aircraft operations decreased at an average annual rate of 2.1 percent compared to an average annual decrease of 2.3 percent for the U.S. between 2007 and 2014. These rates of decrease are both higher than the respective rates of decrease for enplanements during the same time period, indicating a trend toward higher aircraft load factors and increased seats per departure.
- Recent trends in based aircraft indicate decreases both in Washington and the U.S., primarily due to the economic recession.
- Combined non-commercial and general aviation aircraft operations in Washington decreased at virtually the same average annual rate as general aviation operations in the U.S. from 2007 to 2014.

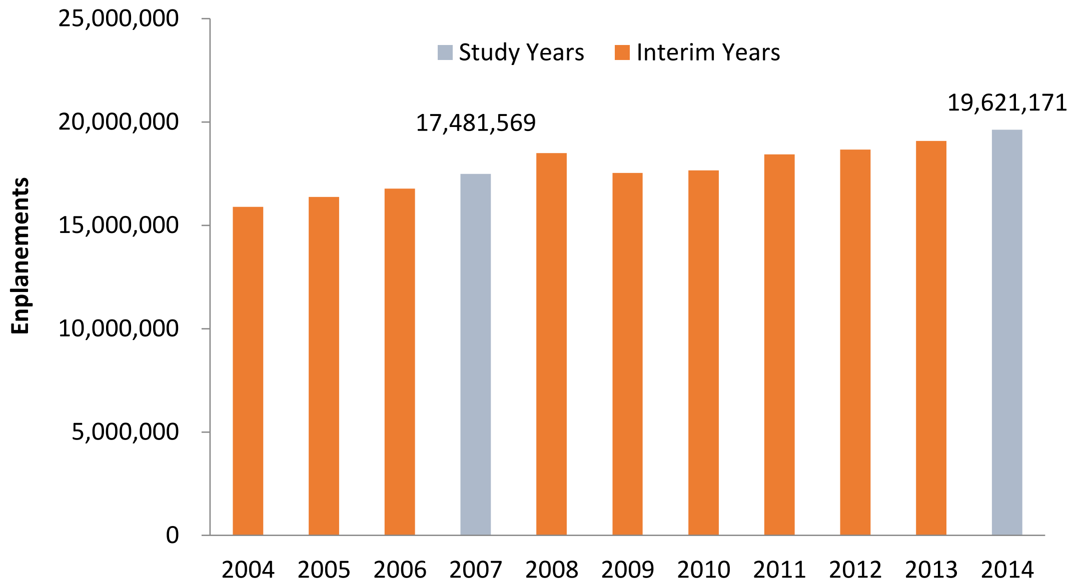
Enplanements

Figure 4-12 presents historical enplanement data for Washington's NPIAS airports. An enplanement is a passenger boarding a commercial service flight. The number of enplanements is largely reflective of the population, employment, and income of an airport's primary market area. In addition, enplanement levels

[3] The NPIAS identifies nearly 3,400 existing and proposed airports that are significant to national air transportation and thus eligible to receive Federal grants under the Airport Improvement Program (AIP).

can also be influenced by decisions by the air carriers to use an airport facility as a hub for connecting passengers.

Figure 4-12: Historical Enplanements at Washington State Airports



Source: 2015 FAA TAF; compiled by WSP | Parsons Brinckerhoff

Of the 64 NPIAS airports in Washington State, there are 10 airports that are considered commercial service or primary airports. Total enplanements for all NPIAS airports were approximately 17.5 million in 2007 (the year of the last WASP), increasing to 19.6 million in 2014. Enplanements at Washington's NPIAS airports have increased at average annual growth rate of 1.7 percent from 2007 to 2014.

Table 4-6 presents a comparison of the enplanements for Washington, the FAA's Northwest Mountain Region, and the U.S. from 2004 to 2014. As shown in the table, Washington's share of the Northwest Mountain Region's enplanements has ranged from 26.4 percent (2007) to 28.1 percent (2014). During the same time period, Washington's share of U.S. enplanements has increased from a low of 2.3 percent in 2006 to the current high of 2.6 percent. Washington's enplanement growth has also outpaced both the FAA's Northwest Mountain Region and the U.S. with an average annual growth rate of 2.1 percent compared to 2.0 percent and 1.7 percent, respectively, for the FAA's Northwest Mountain Region and the U.S.

Table 4-6: Comparison of Washington State Enplanements to Northwest Mountain Region and U.S.

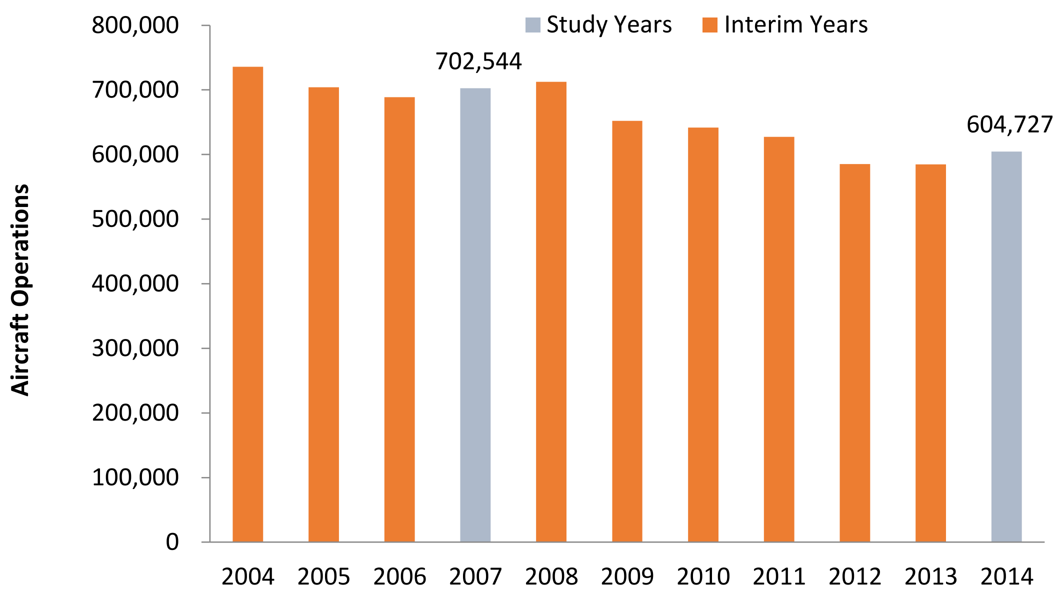
Fiscal Year	Washington	% Change	Northwest Mountain Region	% Change	WA share of NWM Region	U.S. System (in millions)	% Change	WA Share of U.S. System
2004	15,898,945		57,352,050		27.72%	641.2		2.48%
2005	16,374,531	3.0%	60,896,618	6.2%	26.89%	689.0	7.5%	2.38%
2006	16,778,067	2.5%	63,436,986	4.2%	26.45%	737.0	7.0%	2.28%
2007	17,481,569	4.2%	66,185,320	4.3%	26.41%	763.8	3.6%	2.29%
2008	18,497,508	5.8%	67,655,054	2.2%	27.34%	759.1	-0.6%	2.44%
2009	17,530,971	-5.2%	64,247,237	-5.0%	27.29%	704.4	-7.2%	2.49%
2010	17,658,548	0.7%	65,451,243	1.9%	26.98%	712.1	1.1%	2.48%
2011	18,432,030	4.4%	67,510,844	3.1%	27.30%	731.1	2.7%	2.52%
2012	18,664,260	1.3%	67,863,588	0.5%	27.50%	736.7	0.8%	2.53%
2013	19,085,989	2.3%	68,249,733	0.6%	27.96%	739.5	0.4%	2.58%
2014	19,621,171	2.8%	69,874,233	2.4%	28.08%	756.3	2.3%	2.59%
Average Annual Growth Rate (2004-2014)	*2.1%*		*2.0%*			*1.7%*		

Sources: 2015 FAA TAF; FAA Aerospace Forecasts, Fiscal Years 2015–2035; compiled by WSP | Parsons Brinckerhoff

Air Carrier and Air Carrier/Air Taxi Aircraft Operations

Figure 4-13 and Table 4-7: Washington State Air Carrier and Air Taxi/Commuter Aircraft Operations presents a comparison of 2007 and 2014 air carrier and commuter/air taxi operations at the NPIAS airports in Washington, according to the 2015 FAA TAF. As shown in the figure, these aircraft operations have decreased from approximately 702,500 in 2007 to 604,700 estimated in 2014—an average annual decrease of 2.1 percent compared to an annual decrease of 2.3 percent estimated in the *FAA Aerospace Forecasts* for the nation. The decrease in air carrier/air taxi operations is greater than the decrease in enplanements primarily due to the decreases in ASMs during the same time period. This is primarily the result of the right-sizing of aircraft in over-serviced markets and the reduction of frequencies due to the shifting from 50-seat regional jets to 70- and 90-seat regional jets.

Figure 4-13: Historical Air Carrier and Air Taxi/Commuter Operations in Washington State



Source: 2015 FAA TAF; compiled by WSP | Parsons Brinckerhoff

Table 4-7: Washington State Air Carrier and Air Taxi/Commuter Aircraft Operations

Fiscal Year	Aircraft Operations	% Change
2004	735,943	0.7%
2005	704,358	-4.3%
2006	689,052	-2.2%
2007	702,544	2.0%
2008	712,401	1.4%
2009	652,417	-8.4%
2010	641,912	-1.6%
2011	627,192	-2.3%
2012	585,213	-6.7%
2013	584,951	-0.0%
2014	604,727	3.4%
Average Annual Growth Rate (2004-2014)	*-1.9%*	

Sources: 2015 FAA TAF; FAA Aerospace Forecasts, Fiscal Years 2015–2035; compiled by WSP | Parsons Brinckerhoff

Based Aircraft

Figure 4-14 and Table 4-8 present based aircraft data for Washington's airports from 2004 to 2014. Based aircraft are general aviation aircraft that are permanently stored at an airport, either in aircraft storage hangar units or tied down. Because commercial aircraft are typically not permanently based, they are not included in based aircraft statistics. Based aircraft numbers are primarily general aviation aircraft at airports and frequently fluctuate due to a number of factors, including pilot preferences and availability of aircraft storage hangar units. The FAA recently implemented a based-aircraft website to allow airport operators/managers to report actual based aircraft numbers. This process has helped bring the reported based aircraft numbers into NPIAS reporting developed by the FAA.

According to the 2015 FAA TAF, the total number of based aircraft at Washington airports was 7,121 in 2007, the year of the last WASP. Over the seven-year period ending in 2014, total based aircraft in the state has decreased by 20 percent to 5,700. From 2004 to 2014, the number of total based aircraft has decreased approximately at an average annual rate of 1.3 percent, this compares to average annual decreases of approximately 0.4 percent and 1.0 percent for the FAA's Western Region and the U.S., respectively.

Figure 4-14: Historical Commercial Based Aircraft in Washington State

Source: 2015 FAA TAF; compiled by WSP | Parsons Brinckerhoff

Table 4-8: Washington State Based Aircraft

Fiscal Year	Aircraft Operations	% Change
2004	6,467	-0.1%
2005	6,631	2.5%
2006	6,845	3.2%
2007	7,121	4.0%
2008	6,048	-15.1%
2009	6,148	1.7%
2010	5,963	-3.0%
2011	5,637	-5.5%
2012	5,529	-1.9%
2013	5,651	2.2%
2014	5,700	0.9%
Average Annual Growth Rate (2004-2014)	*-1.3%*	

Sources: 2015 FAA TAF; FAA Aerospace Forecasts, Fiscal Years 2015–2035; compiled by WSP | Parsons Brinckerhoff

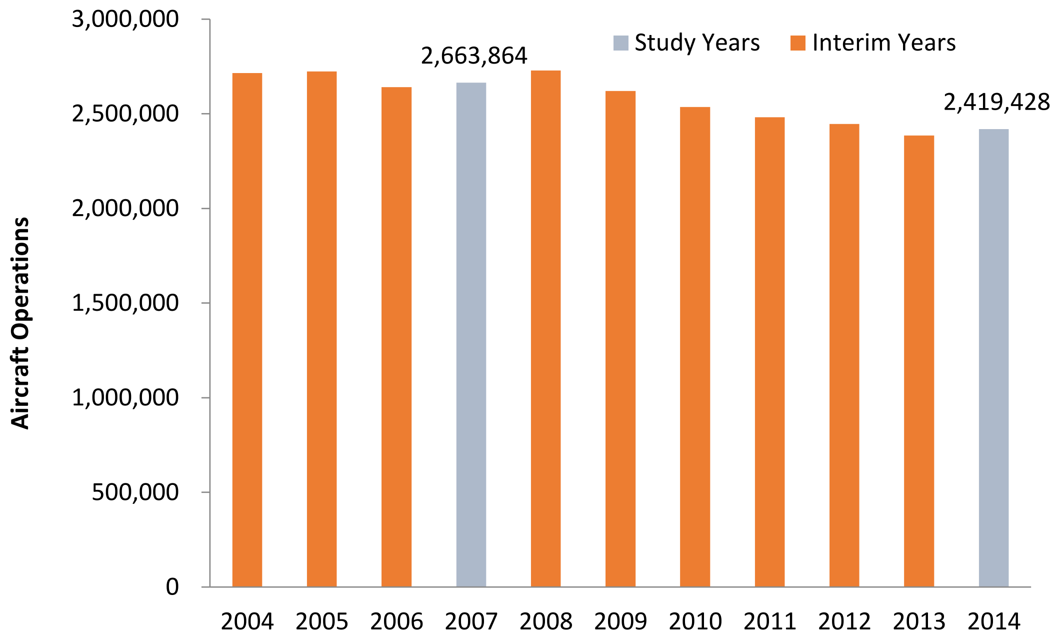
Non-commercial and General Aviation Aircraft Operations

Historical total non-commercial and general aviation operations data for Washington public-use airports is presented on Figure 4-15 **and** Table 4-9: Washington State Non-commercial and General Aviation Aircraft Operations. These consist of primarily general aviation aircraft activity at all Washington public-use airports coupled with comparatively minor amounts of non-scheduled aircraft charter/air taxi aircraft activity at general aviation airports and military aircraft operations at all airports statewide as reported in the 2015 FAA TAF.

Non-commercial and general aviation aircraft operations at WASP airports were approximately 2.7 million in 2007. Over the seven-year period ending in 2014 it is estimated non-commercial and general aviation aircraft operations in the state decreased by 9.2 percent to 2.4 million. On an average annual basis, non-commercial and general aviation aircraft operations have decreased at a rate of approximately 1.4 percent, which is less than the average annual decrease of 3.1 percent for based aircraft during the same time period. Comparatively, combined general aviation and military aircraft operations recorded by the FAA at U.S. towered airports decreased at an average annual rate of 3.4 percent between 2007 and 2014.

A portion of the data used to develop forecasts of non-commercial and general aviation activity was obtained from airports that do not have an air traffic control tower (either FAA operated or contract operated). The methods used to obtain this data are not consistent from one airport to another; therefore, the accuracy of the data for non-towered airports is not consistent with the accuracy of the data from towered airports. For example, some non-towered airports may actually count aircraft operations, while others may just sample data for a specific time period and extrapolate annual data from the sample.

Figure 4-15: Historical Non-commercial and General Aviation Aircraft Operations in Washington State



Source: 2015 FAA TAF; compiled by WSP | Parsons Brinckerhoff

Table 4-9: Washington State Non-commercial and General Aviation Aircraft Operations

Fiscal Year	Aircraft Operations	% Change
2004	2,715,609	-2.3%
2005	2,722,894	0.3%
2006	2,641,280	-3.0%
2007	2,663,864	0.9%
2008	2,729,463	2.5%
2009	2,620,912	-4.0%
2010	2,536,487	-3.2%
2011	2,481,690	-2.2%
2012	2,446,620	-1.4%
2013	2,384,805	-2.5%
2014	2,419,428	1.5%
Average Annual Growth Rate (2004-2014)	*-1.1%*	

Sources: 2015 FAA TAF; FAA Aerospace Forecasts, Fiscal Years 2015–2035; compiled by WSP | Parsons Brinckerhoff

4.2.3 Projections of Washington State Aviation Demand

Developing aviation activity projections for Washington's aviation system is a critical step in assessing the need for and phasing of future development requirements. The methodologies used to prepare aviation demand projections contained in this chapter and the resulting forecasts are discussed in the following sections:

- General forecast methodologies
- Enplanement projections
- Air carrier and air taxi/commuter aircraft operations projections
- Based aircraft projections
- Non-commercial and general aviation aircraft operations projections
- Forecast summary

General Forecast Methodologies

There are several approaches used to develop aviation forecasts. The following bullets outline these various methodologies and discuss the preferred approach for developing the forecasts contained herein.

- **Socioeconomic Trends/Regression Analyses:** This methodology typically uses regression analysis to determine the strength of the relationships between aviation demand and socioeconomic factors (i.e., population, income, employment) and to produce equations that weight the various factors that contribute to aviation demand.

- **Subset's Share of a Total:** This method includes comparing the historical aviation demand in a particular area with the activity during the same time period in a larger region. For example, the activity at a particular airport or subset of airports would be compared to the activity in its region or the entire nation. Trends, if any, are identified and then applied to develop the forecasts.

To develop the forecasts contained herein, various applications of the above described methodologies were used, including the use of already prepared forecasts. The review of historical and projected aviation trends for the nation discussed in previous sections is included to provide a context for the aviation demand forecast presented in the following sections. These methods are appropriate for developing a statewide aviation demand forecast, as they result in projections to determine what facilities are needed for the entirety of Washington State, rather than for one specific airport. Forecasts prepared for individual airports typically use regression analyses to determine if there is a relationship between historical activity and one or more socioeconomic factors, such as population, income, and employment for the market the airport serves.

Enplanement Projections

To prepare the enplanement projections developed for this study, growth rates for individual airports' Master Plans or enplanement growth rates from the 2015 FAA TAF were utilized. These growth rates were applied to the actual 2014 enplanement numbers collected during the data collection/survey phase of this study. In the case of Seattle-Tacoma International Airport (SEA), the actual Master Plan forecasts were used, since the base year is the same as this study (2014). For three other airports (Spokane, Pasco, and Bellingham) that contributed approximately 11 percent of enplanements in 2014, growth rates from the most recent individual airport master plans were used and applied to actual 2014 enplanements as reported in the data collection/survey. For the remaining airports, an individual airport's growth rates from the 2015 FAA TAF were applied to the 2014 enplanements as reported in the data collection/survey. In cases where specific airport information for 2014 was not available, the 2015 FAA TAF data was used.

Table 4-10 presents the enplanement forecasts. As shown in the table, enplanements for Washington State are forecast to increase from approximately 21.3 million in 2014 to 39.0 million in 2034. This reflects an overall increase of approximately 83 percent over 2014 levels (an average increase of nearly 1 million each year) and an average annual growth rate of 3.1 percent, which compares to the *FAA Aerospace Forecasts* long-term growth rate of 2.0 percent for the nation. This outpacing of national growth projected for Washington State is consistent with historical trends (See Table 4-6). The average projected annual growth rate from 2014 to 2034 for enplanements of 3.1 percent compares to the 2015 TAF growth rate of 2.6 percent for Washington during the same time period.

As also shown in Table 4-10, both Spokane International and Tri-Cities Airports are expected to increase in their overall share of enplanements for the state from 6.7 percent and 1.6 percent to 7.6 and 2.9 percent, respectively. These increases in share are essentially taken away from SEA, as the top four airports maintain the 99-percent share they have of total enplanements in 2014. Figure 4-16 presents the air carrier and air taxi/commuter enplanement forecast by study classification.

The enplanement forecasts contained herein are reasonable given their consistency in historical trends and when compared to the forecasts for the FAA's NorthWest Mountain Region and the nation, as well as to the FAA approved forecasts for the individual airports that make up approximately 97 percent of the overall enplanement activity.

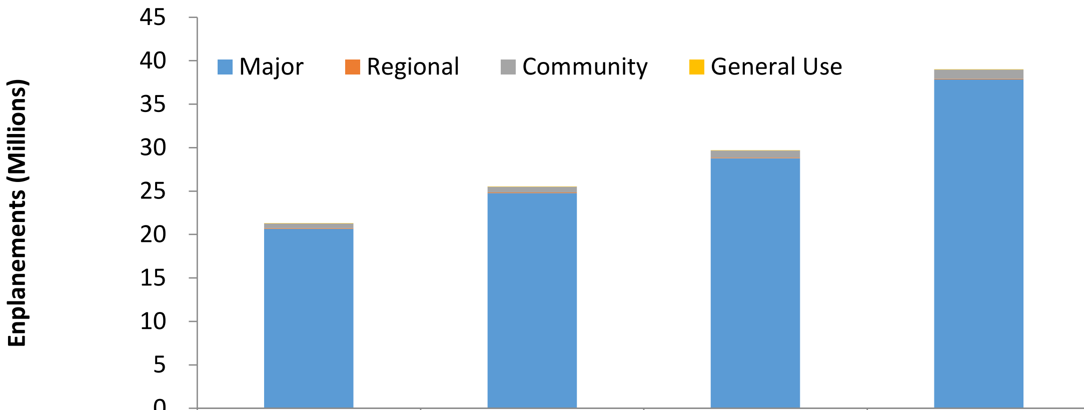
Table 4-10: Projected Enplanements

Airport Name	Air-port Code	Associated City	NPIAS Category[1]	Study Classifi-cation	2014	2019	2024	2034	Total Change 2014–2034	Average Annual Growth Rate	% Share 2014	% Share 2034
Seattle/Tacoma International	SEA	Seattle	P	Major	18,716,615	22,407,600	25,913,700	33,493,432	79%	3.0%	88.0%	85.9%
Spokane International	GEG	Spokane	P	Major	1,434,496	1,716,405	2,054,139	2,943,270	105%	3.7%	6.7%	7.6%
Tri-Cities	PSC	Pasco	P	Major	329,653	449,724	613,529	1,141,861	246%	6.4%	1.6%	2.9%
Bellingham International	BLI	Bellingham	P	Community	557,176	671,224	785,272	1,029,933	85%	3.1%	2.6%	2.6%
Pangborn Memorial	EAT	East Wenatchee	P	Major	56,572	64,012	72,422	92,712	64%	2.5%	0.3%	0.2%
Pullman-Moscow Regional	PUW	Pullman	P	Regional	41,525	55,018	64,078	79,474	91%	3.3%	0.2%	0.2%
Yakima Air Terminal	YKM	Yakima	P	Major	54,921	59,049	63,500	73,401	34%	1.5%	0.3%	0.2%
Walla Walla Regional	ALW	Walla	P	Major	34,689	38,856	43,525	54,615	57%	2.3%	0.2%	0.1%
Boeing Field	BFI	Boeing	P	Major	15,303	17,786	20,676	27,969	83%	3.1%	0.1%	0.1%
Friday Harbor	FHR	Friday Harbor	P	Regional	11,827	13,306	14,975	18,958	60%	2.4%	0.1%	0.0%
Orcas Island	ORS	Eastsound	CS	Community	6,858	7,975	9,290	12,592	84%	3.1%	0.0%	0.0%
William R. Fairchild Int'l	CLM	Port Angeles	CS	Regional	3,604	3,604	3,604	3,604	0%	0.0%	0.0%	0.0%
Kenmore Air Seaplane Base	S60	Seattle	GA	General Use	1,734	1,734	1,734	1,734	0%	0.0%	0.0%	0.0%
Anacortes	74S	Anacortes	GA	Community	927	964	1,001	1,075	16%	0.7%	0.0%	0.0%
Lopez Island	S31	Lopez	GA	Community	454	454	454	454	0%	0.0%	0.0%	0.0%
Grant County International	MWH	Moses Lake	GA	Major	115	115	115	115	0%	0.0%	0.0%	0.0%
Floathaven Seaplane Base	0W7	Bellingham	N/A	General Use	100	100	100	100	0%	0.0%	0.0%	0.0%
Snohomish County/Paine Field	PAE	Everett	R	Major	59	59	59	59	0%	0.0%	0.0%	0.0%
Bowerman Field	HQM	Hoquiam	GA	Regional	4	4	4	4	0%	0.0%	0.0%	0.0%
Bremerton National	PWT	Bremerton	GA	Regional	3	3	3	3	0%	0.0%	0.0%	0.0%
Total					*21,266,635*	*25,507,992*	*29,662,181*	*38,975,365*	*83.3%*	*3.1%*	*100.0%*	*100.0%*
Major					20,642,423	24,753,547	28,781,607	37,827,374	83%	3.1%	97.1%	97.1%
Regional					56,963	71,928	82,657	102,036	79%	3.0%	0.3%	0.3%
Community					565,415	680,617	796,017	1,044,054	85%	3.1%	2.7%	2.7%
General Use					1,834	1,834	1,834	1,834	0%	0.0%	0.0%	0.0%
Total					*21,266,635*	*25,507,926*	*29,662,115*	*38,975,299*	*83.3%*	*3.1%*	*100.0%*	*100.0%*

Sources: Individual airport master plans; WSP | Parsons Brinckerhoff analysis

[1] P = Primary, CS = Commercial Service, GA = General Aviation, R = Reliever, N/A = not applicable

Figure 4-16: Projected Enplanements by Study Classification



	2014	2019	2024	2034
General Use	1,834	1,834	1,834	1,834
Community	565,415	680,617	796,017	1,044,054
Regional	56,963	71,928	82,657	102,036
Major	20,642,423	24,753,547	28,781,607	37,827,374

Source: Individual airport master plans; WSP | Parsons Brinckerhoff analysis

Air Carrier and Air Taxi/Commuter Aircraft Operations Projections

Air carrier and air taxi/commuter aircraft operations projections were also developed using TAF growth rates for the same type of aircraft operations applied to the base 2014 air carrier and air taxi/commuter aircraft operations by facility. With the exception of SEA, the base number for 2014 was established using the data collection/survey data, combined with information from the TAF to obtain correct allocations between air carrier and air taxi/commuter air craft operations and non-air carrier (general aviation and military) aircraft operations. Once the 2014 air carrier and air taxi/commuter operations number was determined, the operations growth rates by facility were applied to develop the forecasts. For SEA, the airport's Master Plan forecast was used, as the base year is the same as this Study.

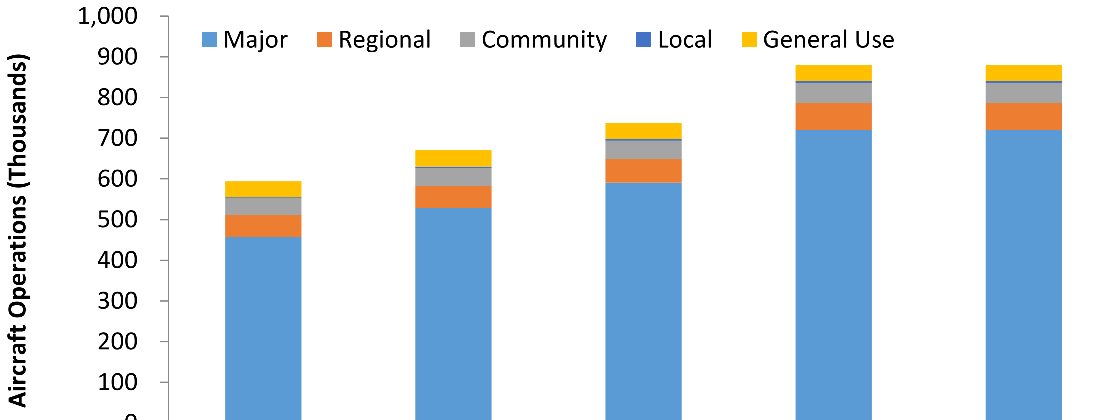
In addition to the facilities presented on Table 4-10, several facilities in Washington State have non-scheduled enplanements (not included in the TAF data) or air taxi aircraft operations for non-scheduled service (in particular air taxi carriers with Part 135 Operating Certificates). The TAF growth rate was used for the aircraft operations at facilities with air taxi operations and no scheduled enplanements, which are summarized at the bottom of the table under the "Other" classifications shown.

Table 4-11 presents the air carrier and air taxi/commuter aircraft operations forecasts. As shown in the table, these aircraft operations for Washington State are forecast to increase from approximately 600,000 in 2014 to 880,000 in 2034. This reflects an overall increase of approximately 48 percent over 2014 levels and an average annual growth rate of 2.0 percent, which compares to the *FAA Aerospace Forecasts* long-term growth rate of 1.5 percent for the nation. The projected trend for Washington State to outpace national growth is consistent with historical growth, as the combined Washington State air carrier and air taxi operations decreased at an average annual rate of approximately 2.0 percent compared to 2.3 percent for the nation. The projected growth rate of 1.5 percent annually from 2014 to 2034 compares to 2.1

percent average annual growth for air carrier and air taxi operations for the same time period for Washington State from the 2015 FAA TAF.

The Major airport classification's share of this category of enplanements is expected to increase during the forecast period from approximately 77 percent to 82 percent of total air carrier and air taxi/commuter operations. Table 4-11 presents the air carrier and air taxi/commuter aircraft operations forecast by study classification.

Figure 4-17: Air Carrier and Air Taxi/Commuter Aircraft Operations by Study Classification



	2014	2019	2024	2029	2034
General Use	39,885	39,820	39,820	39,820	39,820
Local	1,007	3,950	3,950	3,950	3,950
Community	42,734	44,105	45,860	49,729	49,729
Regional	53,223	54,071	57,723	66,121	66,121
Major	457,590	528,453	590,651	719,975	719,975

Source: Individual airport master plans; WSP | Parsons Brinckerhoff analysis

Table 4-11: Projected Air Carrier and Air Taxi/Commuter Aircraft Operations

Airport Name	Airport Code/ Number	Associated City	NPIAS Category[1]	Study Classification	2014	2019	2024	2034	Total Change 2014-2034	Average Annual Growth Rate	% Share 2014	% Share 2039
Seattle/Tacoma International	SEA	Seattle	P	Major	336,238	394,470	444,310	545,961	62%	3.0%	56.6%	62.1%
Spokane International	GEG	Spokane	P	Major	43,491	49,255	53,873	62,939	45%	2.3%	7.3%	7.2%
Boeing Field	BFI	Seattle	P	Major	42,605	48,048	54,188	68,931	62%	3.1%	7.2%	7.8%
Kenmore Air Seaplane Base	S60	Seattle	GA	General Use	35,000	35,000	35,000	35,000	0%	0.0%	5.9%	4.0%
Bellingham International	BLI	Bellingham	P	Community	20,539	21,250	22,732	25,952	26%	1.5%	3.5%	3.0%
Friday Harbor	FHR	Friday Harbor	P	Regional	13,400	14,796	16,335	19,909	49%	2.5%	2.3%	2.3%
Tri-Cities	PSC	Pasco	P	Major	12,170	13,296	14,579	17,728	46%	2.4%	2.0%	2.0%
Grant County International	MWH	Moses Lake	GA	Major	10,307	10,455	10,614	10,985	7%	0.4%	1.7%	1.2%
Lopez Island	S31	Lopez	GA	Community	8,000	8,000	8,000	8,000	0%	0.0%	1.3%	0.9%
Pullman-Moscow Regional	PUW	Pullman	P	Regional	6,100	6,381	6,575	6,864	13%	0.7%	1.0%	0.8%
Snohomish County/Paine Field	PAE	Everett	R	Major	5,982	5,982	5,982	5,982	0%	0.0%	1.0%	0.7%
Yakima Air Terminal	YKM	Yakima	P	Major	4,854	4,934	5,019	5,199	7%	0.4%	0.8%	0.6%
Orcas Island	ORS	Eastsound	CS	Community	3,439	3,566	3,715	4,087	19%	1.1%	0.6%	0.5%
Anacortes	74S	Anacortes	GA	Community	1,727	1,727	1,727	1,727	0%	0.0%	0.3%	0.2%
Walla Walla Regional	ALW	Walla	P	Major	1,685	1,740	1,800	1,933	15%	0.9%	0.3%	0.2%
William R. Fairchild Int'l	CLM	Port Angeles	CS	Regional	388	388	388	388	0%	0.0%	0.1%	0.0%
Pangborn Memorial	EAT	East Wenatchee	P	Major	259	272	286	317	23%	1.3%	0.0%	0.0%
Floathaven Seaplane Base	0W7	Bellingham	N/A	General Use	200	200	200	200	0%	0.0%	0.0%	0.0%
Bremerton National	PWT	Bremerton	GA	Regional	55	65	77	105	91%	4.0%	0.0%	0.0%
Other Regional	12			Regional	33,280	32,440	34,349	38,856	17%	1.1%	5.6%	4.4%
Other Community	4			Community	9,029	9,562	9,686	9,963	10%	0.6%	1.5%	1.1%
Local	3			Local	1,007	3,950	3,950	3,950	292%	7.1%	0.2%	0.4%
Other General Use	2			General Use	4,685	4,620	4,620	4,620	-1%	-0.1%	0.8%	0.5%
Total					*594,438*	*670,398*	*738,004*	*879,595*	*48.0%*	*2.0%*	*100.0%*	*100.0%*
Major					457,590	528,453	590,651	719,975	57%	2.8%	77.0%	81.9%
Regional					53,223	54,071	57,723	66,121	24%	1.5%	9.0%	7.5%
Community					42,734	44,105	45,860	49,729	16%	1.0%	7.2%	5.7%
Local					1,007	3,950	3,950	3,950	292%	7.1%	0.2%	0.4%
General Use					39,885	39,820	39,820	39,820	0%	0.0%	6.7%	4.5%
Total					*594,438*	*670,398*	*738,004*	*879,595*	*48.0%*	*2.0%*	*100.0%*	*100.0%*

Source: WSP | Parsons Brinckerhoff analysis

[1] P = Primary, CS = Commercial Service, GA = General Aviation, R = Reliever, N/A = not applicable

Non-Commercial Aircraft Operations Projections

Non-commercial aircraft operations consist of general aviation and military aircraft operations. The forecast for these types of aircraft operations were developed in a way similar to the air carrier and air taxi/commuter operations presented above. Once the 2014 base number was established using the data collection/survey and TAF information, general aviation and military operations were separated using information related to their share of total aircraft operations from the TAF. Growth rates for general aviation and military aircraft operations were applied to this number to develop the forecast. For the non-NPIAS airports that are not included in the TAF, overall, a combined growth rate for the TAF airports in the same airport classification was used.

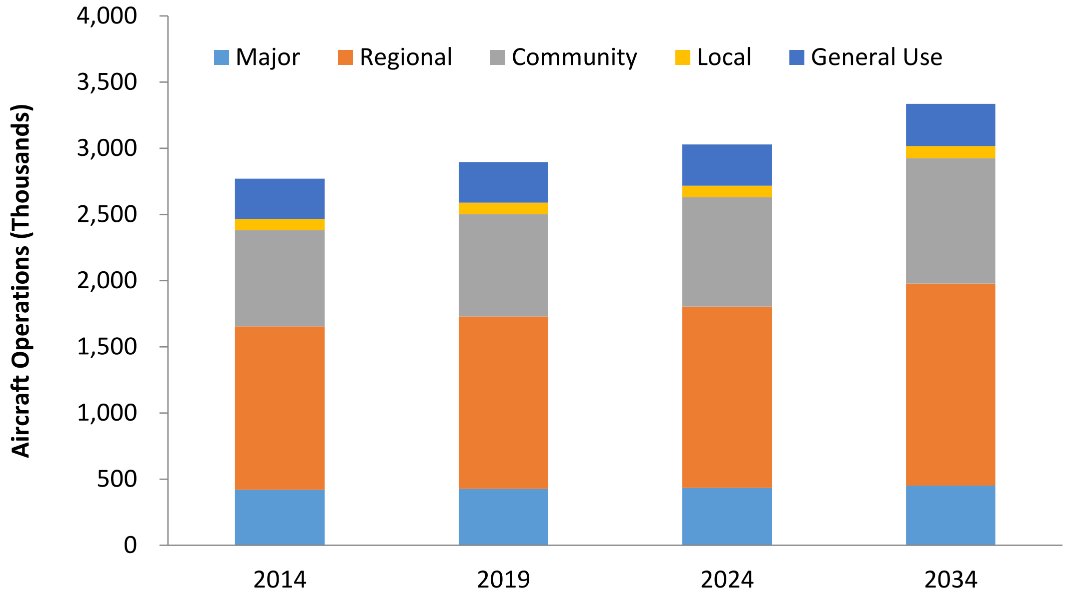
Table 4-12 presents the non-commercial aircraft operations projections for all 135 of the airports in Washington State that are included in this study. These operations are projected to increase from 2.7 million in 2014 to 3.3 million in 2034. This represents an overall increase of nearly 20 percent and an average annual growth rate of 0.7 percent. The average annual growth rate of 0.7 percent compares to the 2015 FAA TAF's growth rate of 1.0 percent for the same time period. Over the forecast period, airports with regional and community classifications are forecast to have a higher share of total non-commercial operations, while the share at airports with major, general use, and local classifications is projected to decrease. Figure 4-18 presents the non-commercial aircraft operations forecast by study classification and Figure 4-19 presents share of non-commercial aircraft operations by classification during the projection period.

Table 4-12: Non-commercial Aircraft Operations Projections

Airport Classification	Number	Study Classification	2014	2019	2024	2034	Total Change 2014–2034	Average Annual Growth Rate	% Share 2014	% Share 2034
NPIAS Major	9	Major	419,921	425,589	433,766	450,953	7%	0.4%	15.2%	13.5%
NPIAS Regional	20	Regional	1,233,720	1,302,511	1,370,314	1,527,361	24%	1.1%	44.5%	45.8%
NPIAS Community	18	Community	452,099	481,232	513,274	588,151	30%	1.3%	16.3%	17.6%
NPIAS Local	14	Local	12,043	12,146	12,255	12,497	4%	0.2%	0.4%	0.4%
NPIAS General Use	3	General Use	138,597	141,107	143,263	148,109	7%	0.3%	5.0%	4.4%
Other Community	17	Community	275,944	293,725	313,283	358,985	30%	1.3%	10.0%	10.8%
Other Local	23	Local	72,681	73,997	75,128	77,669	7%	0.3%	2.6%	2.3%
Other General Use	31	General Use	165,267	166,686	168,178	171,499	4%	0.2%	6.0%	5.1%
Total	*135*		*2,770,273*	*2,896,993*	*3,029,460*	*3,335,224*	*20.4%*	*0.7%*	*100.0%*	*100.0%*
Major	9		419,921	425,589	433,766	450,953	7%	0.4%	15.2%	13.5%
Regional	20		1,233,720	1,302,511	1,370,314	1,527,361	24%	1.1%	44.5%	45.8%
Community	35		728,043	774,957	826,557	947,136	30%	1.3%	26.3%	28.4%
Local	37		84,724	86,143	87,383	90,166	6%	0.3%	3.1%	2.7%
General Use	34		303,864	307,793	311,441	319,608	5%	0.3%	11.0%	9.6%
Total	*135*		*2,770,273*	*2,896,993*	*3,029,460*	*3,335,224*	*20.4%*	*0.7%*	*100.0%*	*100.0%*

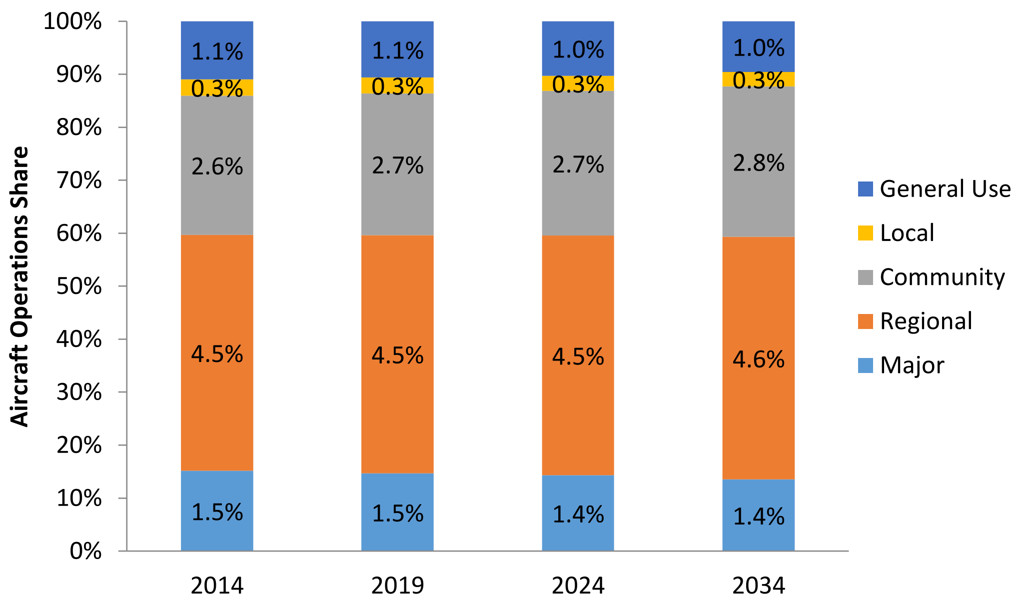
Source: WSP | Parsons Brinckerhoff analysis

Figure 4-18: Non-commercial Aircraft Operations by Study Classification



Source: FAA TAF; WSP | Parsons Brinckerhoff analysis

Figure 4-19: Share of Non-Commercial Aircraft Operations by Study Classification



Source: FAA TAF; WSP | Parsons Brinckerhoff analysis

Based Aircraft Projections

The FAA defines a "based aircraft" as an aircraft that is operational and air worthy that is based at a specific facility for a majority of the year. For airports in the FAA NPIAS, the number of based aircraft is used to determine an airport's NPIAS classification and can factor into eligibility for airport improvement projects and subsequently FAA funding. The based aircraft projections developed for this study were developed in a manner similar to that of general aviation and military aircraft operations. TAF growth rates were applied to the data reported during the survey/data collection process for each individual NPIAS airport. The growth rates by airport classification were applied to the non-NPIAS airports' based aircraft for 2014.

Table 4-13 presents the based aircraft projections. Based aircraft are projected to increase from approximately 7,200 in 2014 to 9,000 in 2034. This represents an overall increase of approximately 25 percent and an average annual growth rate of 1.1 percent. This growth rate compares to the FAA's long-term projected average annual increase in general aviation aircraft of 0.4 percent for the U.S. and the 1.0 percent increase for Washington State from the 2015 FAA TAF.

Table 4-13: Based Aircraft Projections

Airport Classification	Number	2014	2019	2024	2034	Total Change 2014–2034	Average Annual Growth Rate	% Share 2014	% Share 2034
NPIAS Major	9	1,550	1,629	1,710	1,858	20%	0.9%	25.7%	25.0%
NPIAS Regional	20	3,195	3,343	3,502	3,779	18%	0.8%	52.9%	50.8%
NPIAS Community	18	1,166	1,260	1,385	1,665	43%	1.8%	19.3%	22.4%
NPIAS Local	14	76	76	78	78	2%	0.1%	1.3%	1.0%
NPIAS General Use	3	55	56	57	57	3%	0.2%	0.9%	0.8%
Total NPIAS Airports	*64*	*6,042*	*6,364*	*6,732*	*7,435*	*23.1%*	*1.0%*	*100.0%*	*100.0%*
Major	9	1,550	1,629	1,710	1,858	20%	0.9%	21.5%	20.6%
Regional	35	3,195	3,343	3,502	3,779	18%	0.8%	44.3%	41.9%
Community	20	2,106	2,276	2,502	3,006	43%	1.8%	29.2%	33.4%
Local	37	207	207	211	211	2%	0.1%	2.9%	2.3%
General Use	34	151	154	156	156	3%	0.2%	2.1%	1.7%
Total All Airports	*135*	*7,209*	*7,608*	*8,081*	*9,010*	*25.0%*	*1.1%*	*100.0%*	*100.0%*

Source: WSP | Parsons Brinckerhoff analysis

Aviation Demand Forecast Summary

Table 4-14 presents a summary of the elements of aviation demand forecast for this study. The aviation demand forecasts developed using the methodologies described herein are reasonable, in that they are consistent with both historical trends and are similar to the results of the nationally recognized forecasts developed by the FAA in the 2015 FAA TAF and the 2015 FAA TAF; FAA Aerospace Forecasts.

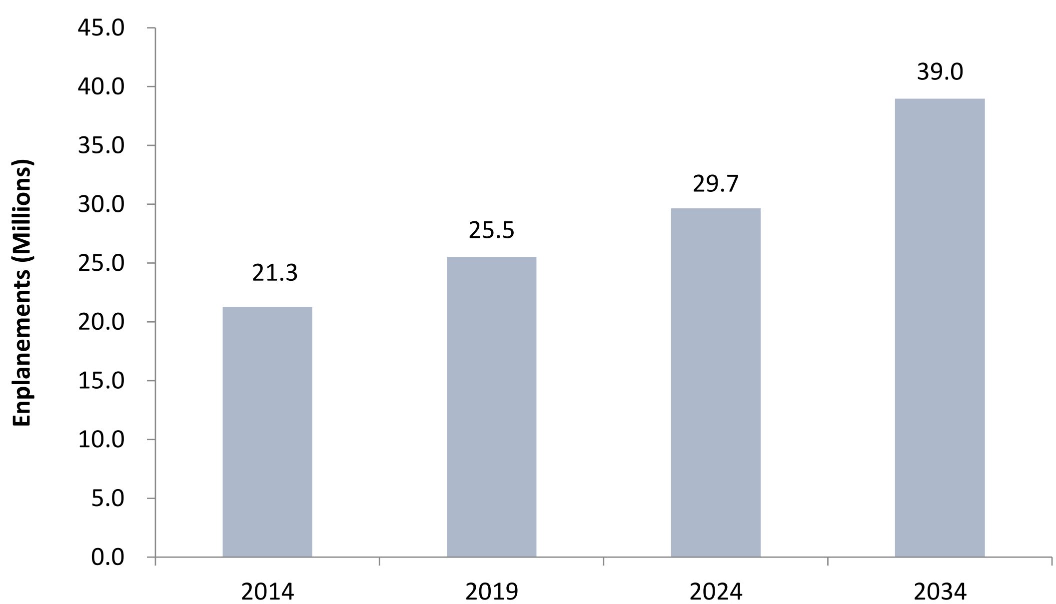
Table 4-14: Forecast Summary

Forecast Element	2014	2019	2024	2034	Total Change 2014–2034	Average Annual Growth Rate	2015 TAF Growth Rate (2014-2034)	2019 (2015 TAF)	Forecast Variance from TAF (%)
Enplanements (millions)	21.3	25.5	29.7	39.0	83 %	3.1%	2.6%	24.3	4.9%
Air Carrier & Air Taxi/Commuter Aircraft Operations	594,438	670,398	738,004	879,595	48 %	2.0%	2.1%	713,391	-6.0%
Non-Commercial Aircraft Operations	2,770,273	2,896,993	3,029,460	3,335,224	20 %	0.9%	1.0%	2,536,10 2	14.2%
Based Aircraft NPIAS Airports	6,042	6,364	6,732	7,435	23 %	1.0%	1.0%	5,999	6.1%
Based Aircraft WASP Airports	7,209	7,608	8,081	9,010	25 %	1.1%	n/a	n/a	n/a

Source: 2015 FAA TAF; WSP | Parsons Brinckerhoff analysis

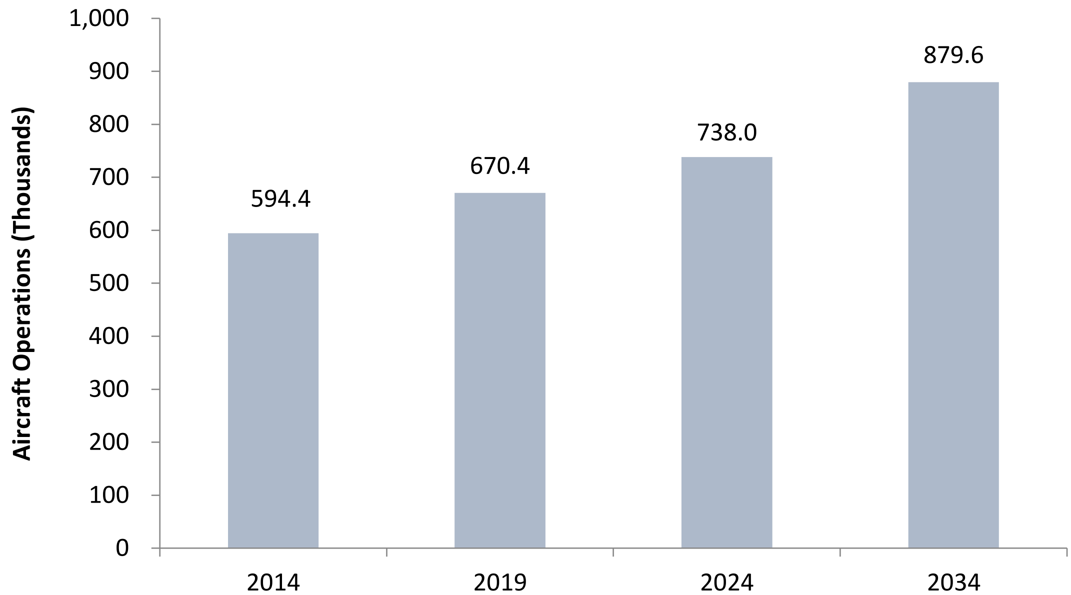
Figure 4-20, Figure 4-21, Figure 4-22, and Figure 4-23 graphically present individual elements of the aviation demand forecast presented in this chapter.

Figure 4-20: Enplanement Projections (in millions)



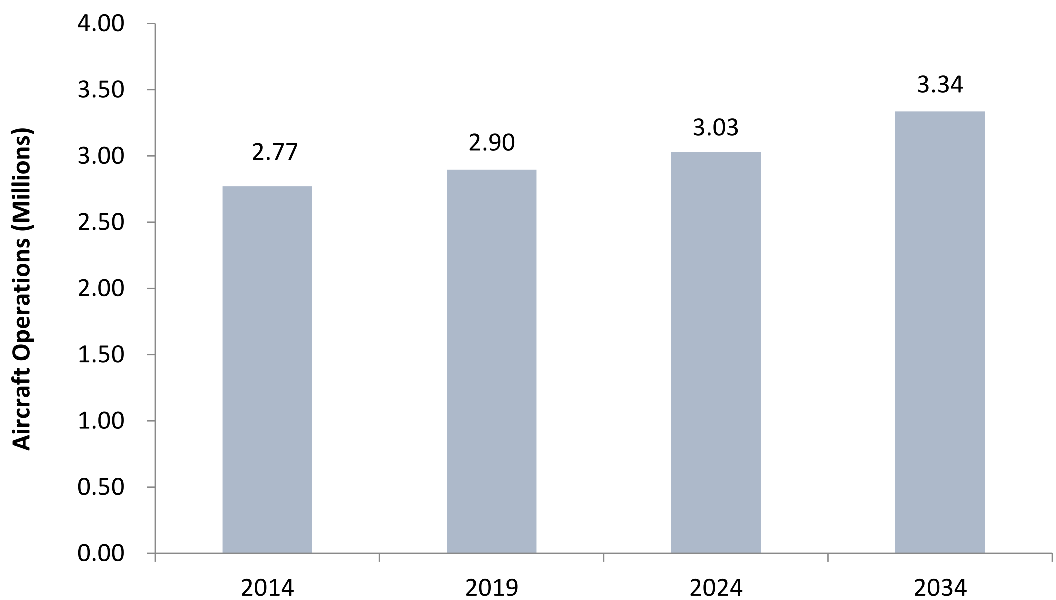
Source: Compiled by WSP | Parsons Brinckerhoff analysis

Figure 4-21: Air Carrier and Air Taxi/Commuter Aircraft Operations Projections (in thousands)



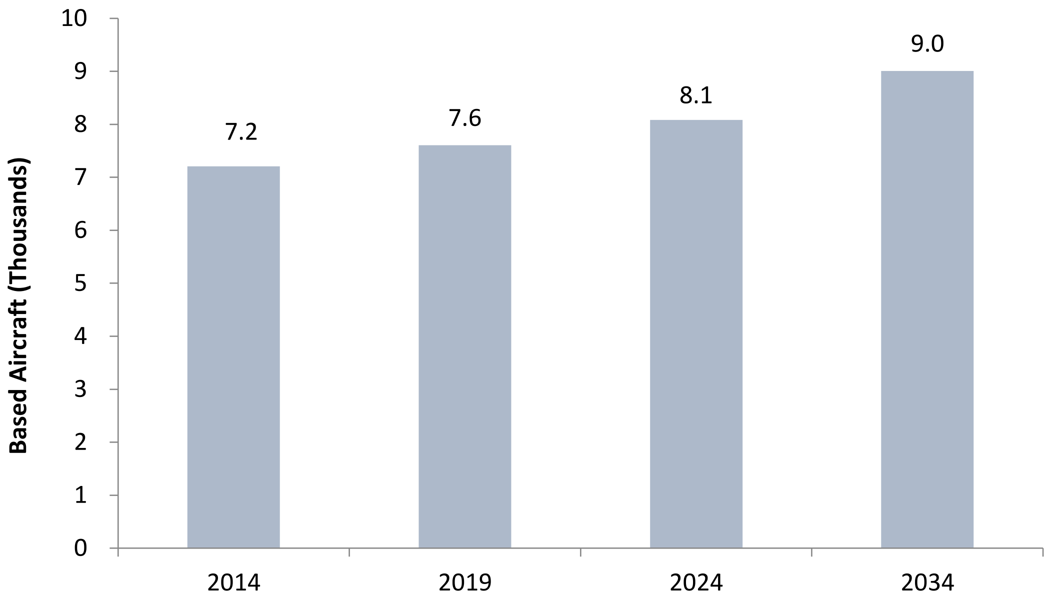
Source: Compiled by WSP | Parsons Brinckerhoff analysis

Figure 4-22: Non-commercial Aircraft Operations Projections (in millions)



Source: Compiled by WSP | Parsons Brinckerhoff analysis

Figure 4-23: Based Aircraft Projections (in thousands)



Source: FAA TAF; compiled by WSP | Parsons Brinckerhoff analysis

4.3 Air Cargo Market Profile and Forecast

This report profiles the air cargo market in Washington State. The information and analysis presented in this report will become the basis for the Washington State Air Cargo Forecast. Problematic to this effort was the lack of reliable historical airport air cargo data. Air cargo data for many Washington State airports does not exist or the data is often incomplete or inconsistent.

To remedy this situation, this reports relies heavily on historical air cargo data published by the U.S. Department of Transportation Bureau of Transportation Statistics in Form 41 T-100 Market data. Historical data for Seattle-Tacoma International Airport was provided by the Port of Seattle. Air cargo tonnages used in this report are in metric tons unless otherwise noted.

4.3.1 Air Cargo Industry Background

Economic growth, international trade, and transport are inextricably linked. Global GDP is forecasted by the World Bank to average 3.2 percent in 2017. The FAA/HIS Global Insight forecast predicts an average world GDP growth at 3.2 percent per year to 2034. With air cargo typically outpacing GDP growth by a factor of two, Boeing predicts that the volume of global air cargo will at least double in two decades.

Air cargo is a $67 billion business, representing 15 percent of total traffic revenue of the airline business and supports approximately 32 million jobs worldwide. Air cargo is an increasingly important component of the U.S. economy. In 2008, air freight accounted for 24 percent of the total U.S. merchandise trade of $3.4 trillion (America's Freight Gateways November 2009, published by U.S.DOT). From 1990 to 2008, the value of inbound and outbound air cargo handled at the U.S. gateway airports grew at an average annual rate of about 8 percent. Overall, U.S. air cargo exports represented 48 percent of the total air trade. In comparison, U.S. maritime exports represented only 29 percent of the total ocean-borne trade.

Air Cargo Carriers

In its simplest form, the air cargo market is made up of freight and mail. Air mail in the U.S. is contracted out by the U.S. Postal Service and travels in the belly hold of commercial passenger aircraft and on freighters operated by contractors. Air freight refers to all cargo other than mail. Air cargo carriers can be divided into a number of components: the passenger airlines, the traditional all-cargo carriers, and the service-oriented integrated/express all-cargo carriers.

Air cargo carriers operate under two distinct business models: the door-to-door model and the airport-to-airport model. Each model is based on distinctly differing characteristics, varies in its deployment of resources, has differing levels of required capitalization, and yields significantly different levels of return on investment. The importance of these business models, and the companies that provide support services, cannot be underemphasized since airports cannot engage in air cargo operations without the support structure in place at or near their airports.

The more traditional air cargo business model is the airport-to-airport service. As the name implies, this model is based on the carriage of freight from an originating airport to a destination airport. Freight is delivered to the originating airport from the shipper's dock by a third party service, typically a freight forwarder, who will then tender it to the airline. At the destination airport, a third party service, typically an agent of the originating freight forwarder will take possession of the freight for delivery to the consignee. This type of airport-to-airport carriage is provided by both the passenger and all-cargo airlines.

The cargo carrying passenger airlines, such as American Airlines and Delta Air Lines, emphasize the use of lower deck, or "belly space," of their scheduled passenger aircraft, while the traditional air cargo airlines, such as Polar Air Cargo, Cargolux, and Nippon Cargo Airlines, have entire fleets dedicated to air cargo and have few limits on cargo size or type. Some passenger carriers, such as Alaska Airlines, China Airlines, and Korean Air, also have dedicated freighter aircraft and others may operate "combis," i.e., aircraft that are designed to carry a combination of both cargo and passengers on the main deck.

The carriers using the door-to-door model are referred to as the integrator/express carriers because they integrate the complete line of services in the air cargo logistics chain from initial pick up from the shipper's dock to final delivery at the consignee's door into one complete package. Unique to the integrator/express carriers is that they typically own and operate their own aircraft, ground transport, and IT systems and essentially provide complete custodial control of the shipment and offer real time shipment tracking. These assets, all under control of one organization, make possible the seamless flow of goods that provide shippers with substantial reductions in their lead times, a critical service element for most of the industries around the world. The two primary integrator/express air cargo carriers are FedEx and UPS. International express traffic has continued to grow faster than the average world air cargo growth rate, expanding 8.9 percent in 2012 and 5.8 percent in 2013.

The distinction between express and general air cargo, however, are beginning to blur. Traditional providers are expanding their time-definite offerings, and express carriers, freight airlines, and postal authorities are consolidating. Ultimately, the air cargo customer benefits from increased service options and lower prices as market pressure brings competing products into the market.

In both airline business models, third party logistics services are provided both in-house and by contract management companies. For the traditional air cargo carrier, the freight forwarder is the primary customer. In the case of the integrator/express carrier, offering supply chain management services are a core competency and a significant part of their business.

The top 10 air cargo airlines in 2014 based on total weight are shown in Table 4-15.

Table 4-15: Top Air Cargo Airlines (2014)

Rank	Airline	2014 Tonnage	Carrier Type	Home Region
1	FedEx Express	16,020	Integrator	North America
2	Emirates SkyCargo	11,240	Pax & Freighters	Middle East
3	UPS Airlines	10,936	Integrator	North America
4	Cathay Pacific Cargo	9,464	Pax & Freighters	Asia
5	Korean Air Cargo	8,079	Pax & Freighters	Asia
6	Lufthansa Cargo	7,054	Pax & Freighters	Europe
7	Singapore Airlines Cargo	6,019	Pax & Freighters	Asia
8	Qatar Airways Cargo	5,997	Freighters	Middle East
9	Cargolux	5,753	Pax & Freighters	Europe
10	China Airlines Cargo	5,266	Pax & Freighters	Asia

Source: http://www.iata.org/publications/Pages/wats-freight-km.aspx*; June 2016*

Important to note from Table 4-15 is that with the exception of FedEx and UPS, the top world air cargo airlines are the international flag combination passenger and freighter operators. Most domestic freight in the U.S. moves by truck rather than by air. This situation limits the amount of air cargo growth that can be expected at non-hub Washington State airports serving the domestic passenger market.

Third Party Logistics Companies

As with the airlines, third party logistics (3PL), or contract logistics management companies, offer a variety of services based on differing business models. Within the air cargo industry, the core of 3PL providers are the freight forwarders, sometimes referred to as indirect carriers. As freight forwarders attempt to compete with the integrator/express airlines for yield and market share, many forwarders are offering value added services to the list of services they have traditionally offered.

The 3PL concept has been evolving for many years, but the basic premise remains unchanged: provide outsourced logistics services, freeing the client to focus on running core operations.

Freight Forwarders

Freight forwarders are 3PL companies that concentrate on originating traffic from shippers. They serve both the shipper and air carrier by consolidating small shipments into larger consignments, palletize or containerize shipments for intermodal movement, issue their own documents for the intermodal haul, take legal responsibility for the goods being moved, provide through rates, perform pickup and delivery service, and render other useful functions to simplify the intermodal process and move freight expeditiously. They rely on the airlines to provide line-haul carriage and, in some cases, other third party providers for customs clearance and final delivery. Under the new TSA security regime, freight forwarders may also provide air cargo screening and inspection as a regulated Certified Cargo Screening Facility.

The basic forwarder's business model is based on obtaining a wholesale rate from the airline by consolidating many small shipments into single containers. By obtaining a lower container rate from the air carrier, the forwarder maximizes the spread between the charges it pays the carriers and the charges it collects on each individual shipment loaded into the container. This spread is its operating margin.

However, not all of an air freight forwarder's terminal locations produce large consolidations. Smaller cities often do not have a large enough market to produce the required volume to build consolidations for a single destination. For this reason, the forwarder will move some individual shipments from smaller cities to a larger city in its system. At the larger airport cities, sometimes known as gateway or hub cities, these small shipments are included into the consolidation being built at that location. The ability to move these smaller shipments in another terminal's larger consolidation is an important advantage for the air freight forwarder's operation.

Many forwarders have large multinational networks, such as Panalpina, Kuehne & Nagel, Expeditors International of Washington, and Schenker, while others specialize in specific local markets, such as Alaska Freight Forwarding and Pacific Alaska Freightways.

Integrated Forwarder

In between the traditional forwarder and the integrator/express carriers are the integrated forwarding companies that are a hybrid of airline and 3PL providers. These types of companies offer pick-up and delivery services using their own fleet of ground vehicles, provide real time shipment tracking, and often control large amounts of air cargo pallet positions with the airlines. The two leaders in this field are DHL Express and TNT. DHL owns 49 percent of Polar Air Cargo Airline and serves over 500 airports around the world. TNT's networks are concentrated in Europe and Asia, but the group is expanding its operations worldwide, including in the Middle East and South America. In recent years, it acquired several road freight companies in China, India, and Brazil.

Fourth Party Logistics Providers/ Lead Logistics Providers

A fourth party logistics provider (4PL)/lead logistics provider (LLP) is typically a non-asset-based logistics consultant. The 4PL provider differs from 3PL providers in that the organization is often a separate entity established as a joint venture or long-term contract between a primary client and one or more partners. 4PL organizations act as a single interface between the shipper/client and multiple logistics service providers. Ideally, all aspects of the client's supply chain are managed by the 4PL organization. Often, many major 3PL providers form a 4PL organization within their existing structure. Primary examples of 4PL providers are UPS Supply Chain Logistics, CEVA Logistics, and Ryder.

Table 4-16 shows the leading global 3PL service providers based on 2012 total gross revenues in 2012.

Table 4-16: Top International Third Party Logistics Service Providers (based on 2012 gross revenues)

Provider	2012 Gross Revenues (millions $)	Provider	2012 Gross Revenues (millions $)
DHL Supply Chain & Global Forwarding	$31,432	Damco	$3,212
Kuehne & Nagel	$22,587	Norbet Denbressangle Group	$2,782
DB Schenker Logistics	$19,732	Kintetsu World Express (KWE)	$2,718
Nippon Express	$17,317	Kerry Logistics Network, Ltd.	$2,575
C.H. Robinson Worldwide	$12,752	Pantos Logistics	$2,546
CEVA Logistics	$8,517	Ryder Supply Chain Solutions	$2,280
DSV Solutions Holding A/S	$8,140	Fiege Logistics	$2,090
Sinotrans	$7,738	Coyote Logistics	$2,000
Panalpina	$7,293	XPO Logistics	$2,000
SDV International Logistics	$7,263	BDP International	$1,900
DACHSER GmbH & KG	$6,627	Wincanton Logistics	$1,695
DACHER	$6,627	Logwin AG	$1,611
Toll Holdings Limited	$6,266	APL Logistics	$1,586
Expeditors International of Washington	$6,080	Total Quality Logistics	$1,621
Geodis	$5,828	Americold Logistics, Inc.	$1,580
UPS Supply Chain Solutions	$5,492	Logwin	$1,611
GEFCO	$5,300	Nissin Corporation	$1,555
JB Hunt	$5,224	Menlo Worldwide Logistics	$1,540
Uti Worldwide	$4,441	GENCO Supply Chain Solutions	$1,509
Agility	$4,415	BLG Logistics Group	$1,470
NYK Logistics /Yusen Air & Sea Services	$4,042	Transplace	$1,400
IMPERIAL Logistics	$3,923	FedEx Supply Chain Services	$1,387
Hellmann Worldwide Logistics	$3,433	Landstar	$1,301
Unyson Logistic	$3,374	OHL	$1,290

Source: Armstrong & Associates, Inc. , A&A's Top Global Third-Party Logistics

There are a lot of both multinational and regional air freight forwarders with a physical presence in Washington State, including Hellmann's, UPS Supply Chain Logistics, Panalpina, Kuehne & Nagel, Schenkers/Bax Global, and Expeditors International of Washington.

To be discussed in a later section, the future for air cargo growth in Washington relies to a significant extent on perception of the international forwarder community toward Seattle as a cost effective and efficient place to do business.

Air Truckers

Trucking is an important component of the air cargo industry. As with the all-cargo airlines, air truckers provide a variety of services. Some air truckers specialize in local pickup and delivery, while others provide nationwide long-haul service. Air trucking companies, such as Jet Airways of the U.S., are registered airlines and do not operate any aircraft. Rather, they provide regularly scheduled service between North American city pairs using air waybills. This service is referred to as road feeder service. Currently, more than 1,000 city pairs in the U.S. and Canada are served by road feeder service.

Many foreign flag air carriers use road feeder service as a means to expand their operational capability in the U.S. This allows the air carrier to actually fly to a limited number of gateways but provide service to many other cities using a combination of scheduled air and truck service. The air carriers publish schedules showing the arrival and departure times of both airplanes and road feeder truck service for the cities they serve. At the present time, the fastest growing segment of air cargo within the U.S. is the trucking of air shipments between airports.

4.3.2 North American West Coast and Regional Air Cargo Activity

Washington State, the Pacific Northwest, and the North American West Coast air cargo markets are well served by a combination of passenger carriers offering both lower deck and full freighter capacity, by the integrated/express and traditional all-cargo carriers providing both door-to-door service and line haul airport-to-airport service, and by an extensive network of freight forwarders, consolidators, customs brokers, and air trucking firms.

Air cargo volumes at most major West Coast gateway airports have declined over the past 14 years, decreasing from approximately 5.7 million tons in 2000 to 4.1 million tons in 2014. This is a decline in growth rate of 1.4 percent per year, much worse than the world average of 9.5 percent GDP growth over the same period. The decline in air cargo volumes in the U.S. is primarily related to modal shift from domestic air to truck. Most of the air cargo growth in recent years is in international shipments at large international gateway airports.

Historical air cargo activity at select West Coast airports is shown below in Table 4-17.

Table 4-17: Select West Coast Historical Air Cargo Activity (metric tons)

Airport	2000	2005	2010	2014	2014 Market share
Los Angeles (LAX)	2,038,784	1,928,894	1,747,629	1,816,629	44.2%
Oakland (OAK)	685,425	675,227	510,947	503,568	12.2%
Ontario (ONT)	464,164	521,853	355,932	430,319	10.5%
San Francisco (SFO)	869,839	584,926	426,725	400,614	9.7%
Seattle (SEA)	455,997	338,663	283,291	327,239	8.0%
Vancouver (YVR)	251,771	223,608	228,387	256,935	6.2%
Portland (PDX)	282,019	263,599	190,117	207,785	5.1%
Seattle (BFI)	145,000	112,758	107,370	109,653	2.7%
Spokane (GEG)	61,009	52,263	43,390	59,567	1.4%
TOTAL	*5,254,008*	*4,701,791*	*3,893,788*	*4,112,309*	*100.0%*

Source: Source: LAX, OAK,SFO, ONT, PDX, YVR: ACI-NA; BFI year 2000 is estimated, years 2005 and 2010 from the KBFI Strategic Plan-BFI, year 2014 from DOT T-100 form; SEA from Port of Seattle records; Spokane from airport records.

As can be seen in Table 4-17, the dominant air cargo airport on the West Coast is Los Angeles International Airport (LAX) with a 44 percent market share. Oakland International (OAK) is a distant second followed closely by Ontario (ONT), San Francisco, and SEA. LAX ranks as the 14th largest air cargo airport in the world and the third largest in the U.S. behind Memphis International Airport (the primary hub for FedEx), Louisville International (the primary hub for UPS), and Miami International.

LAX dominates the West Coast in air cargo due to a number of factors. The most significant reasons include the size of the local Southern California market, number of wide-body aircraft, both passenger and freighter, in service, the variety of destinations served, the frequency of departures and arrivals, the large investment in infrastructure and facilities, and the network of air freight forwarders that has developed in the immediate vicinity of the airport. Secondary reasons why the Southern California air cargo market dominates the West Coast include the large presence of warehouse and logistics company operators located in the Inland Empire of San Bernardino and Riverside Counties.

The air cargo markets at ONT, OAK, BFI, and GEG are dominated by the integrator/express airlines. ONT is the West Coast hub for UPS and OAK is the West Coast hub for FedEx. BFI is the UPS and DHL gateway airport for Western Washington and GEG is a transload hub for the Pacific Northwest for both UPS and FedEx. SEA is the Western Washington gateway for FedEx.

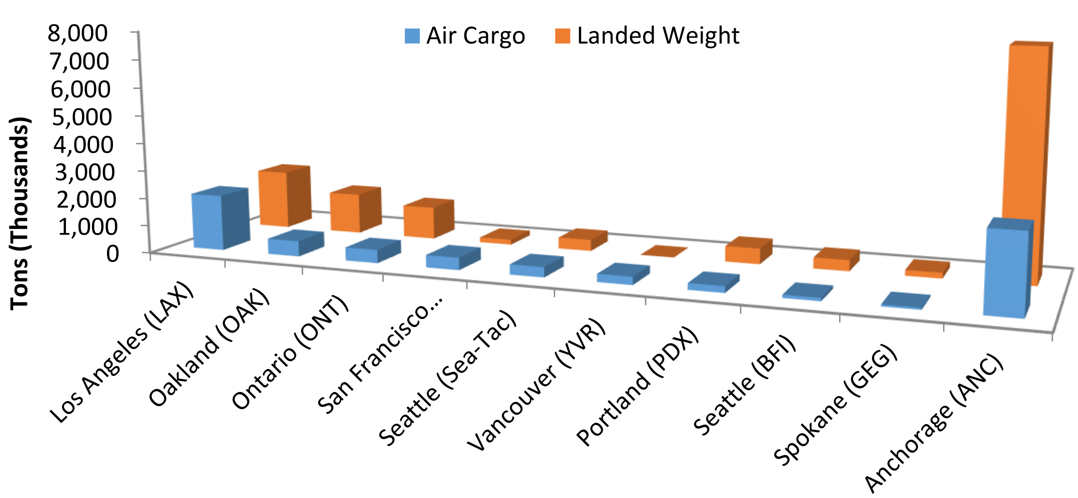
Ted Stevens Anchorage International Airport (not included in Table 4-17), ranks third in air cargo in the U.S. according to Airports Council International. It is unique in that it has a very small local market but serves as a technical stop and transfer hub for air cargo carriers serving the trans-Pacific market and represents an important market of air cargo from Washington State.

West Coast Air Cargo Freighter Market

There is a significant variation in the role various North American West Coast airports have in their use by the air cargo airlines. As with passenger traffic, some airports function as international cargo gateways, others as hubs to large hub and spoke networks, and others as origin and destination points.

To provide a more complete picture of the U.S. West Coast air cargo airport network, a review of the all-cargo-freighter landed weight at each major West Coast airport was performed. Air-cargo landed weight is a statistic collected by the FAA to determine air cargo airports of significance in the U.S. and to allocate air cargo Airport Improvement Program (AIP) funds. Air-cargo landed weight is the certified maximum gross landed weight of an all-cargo aircraft that lands at airport regardless of its payload. As such, the cargo aircraft landed weight for a particular airport represents the theoretical freighter capacity of that airport. Air cargo freighter landed weights compared with metric tons of enplaned and deplaned air cargo for select airports for calendar year 2014 is shown on Figure 4-24.

Figure 4-24: Freighter Aircraft Landed Weight and Cargo Tonnages (2014)



Source: ACI-NA North American Traffic Report; FAA AIP Records; compiled by Keiser Phillips Associates

As can be seen on Figure 4-24, Ted Stevens Anchorage International Airport, in its role as a tech stop for transpacific freighters and a hub for FedEx, UPS, and Polar Air Cargo airlines, has a significant amount of all-cargo freighter traffic compared to other West Coast airports. Both OAK, the west coast hub for FedEx, and ONT, the west coast hub for UPS, also have a significant amount of freighter traffic compared to actual enplaned and deplaned cargo. This gives these airport an advantage in receiving AIP funding.

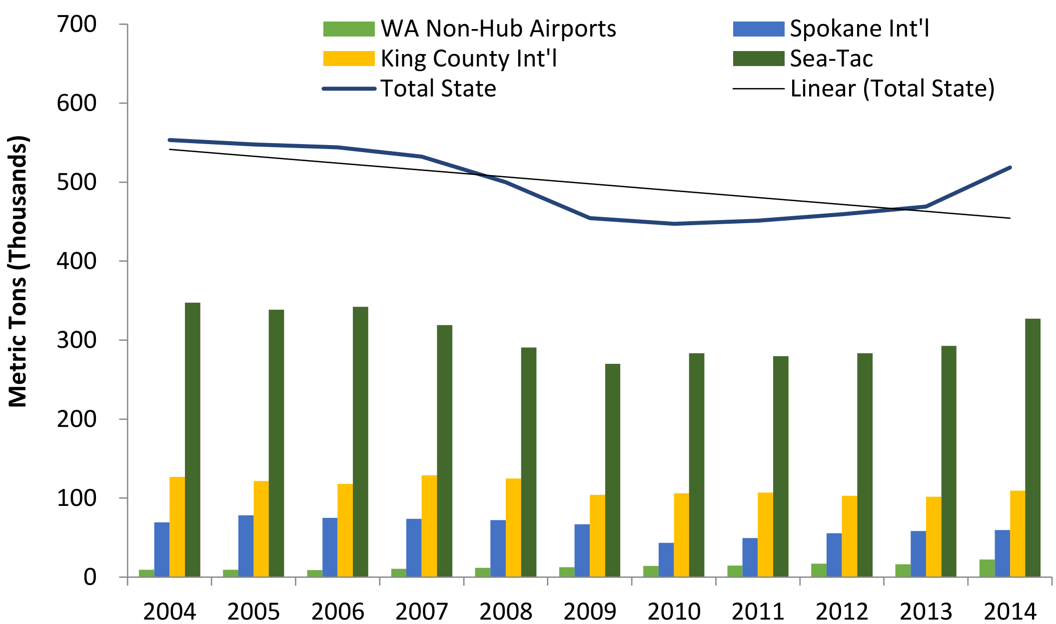
FedEx is also the largest air cargo carrier by tons at LAX. No landed weight data is available for Vancouver International Airport. SEA landed weight increased 15 percent in 2014 over 2013, while Portland International Airport's decreased 1 percent. BFI saw a 7-percent increase in 2014 over 2013 and GEG saw an 11-percent decrease over the previous year. Snohomish County Airport, the only other airport in the state with recorded air cargo aircraft landed weight, saw a phenomenal one-year 57-percent increase in 2014.

4.3.3 Washington State Air Cargo

Air cargo in Washington State is primarily generated by activity at SEA, BFI, and GEG. Non-hub and small commercial passenger airports within the state account for only 4 percent of the total air cargo volumes moved in 2014.

The trend of air cargo activity for Washington State is shown on Figure 4-25. Reflecting trends in general economy, as well as systemic changes in the air cargo industry, air cargo volumes in Washington State have fluctuated over the past 10 years from a high of 553,415 metric tons in 2004 to a low of 454,419 tons during the economic crisis of 2008/2009. The trend lines in the following charts reflect a 10-year downward trend, however, the financial recovery following the Great Recession indicate steady, slow growth.

Figure 4-25: Washington State Air Cargo Trends (2004–2014)

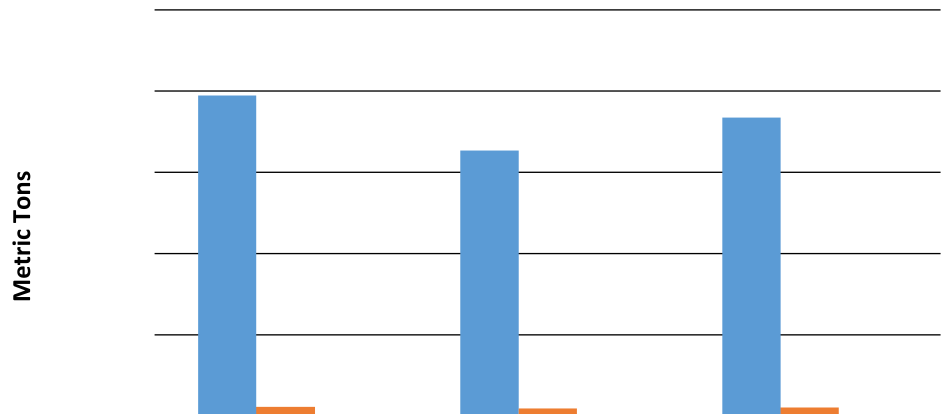


Source: Individual airport records; inventory data; compiled by Keiser Phillips Associates

Growing slowly, but faster than the general economy, air cargo volumes in the state slowly increased 3.8 percent per year from 2009 to 524,782 tons in 2014. Most of the growth in air cargo within the state is driven by the increase in international wide-body aircraft air service at SEA.

Figure 4-26 compares Washington State air cargo trends with U.S. trends. As can be seen in this figure, Washington has maintained a fairly consistent market share of 2.8 percent of the national air cargo market.

Figure 4-26: U.S. and Washington State Air Cargo Tonnage Trends



	2004	2009	2014
Total US Air Cargo	19,723,924	16,345,595	18,363,604
WA Air Cargo	553,381	454,419	518,688
% WA State	2.81%	2.78%	2.82%

Source: Individual airport records; inventory data; compiled by Keiser Phillips Associates

Airports in Washington State that handled one metric ton or more of air cargo in 2014 are presented in Table 4-18. Of the top 20 airports in the state for air cargo, Snohomish County Paine Field experienced the most increase in air cargo, while Walla Walla Regional experienced the greatest decrease. Reflecting an important trend in U.S. air cargo activity, international air cargo at SEA increased 7.7 percent per year over the past five years.

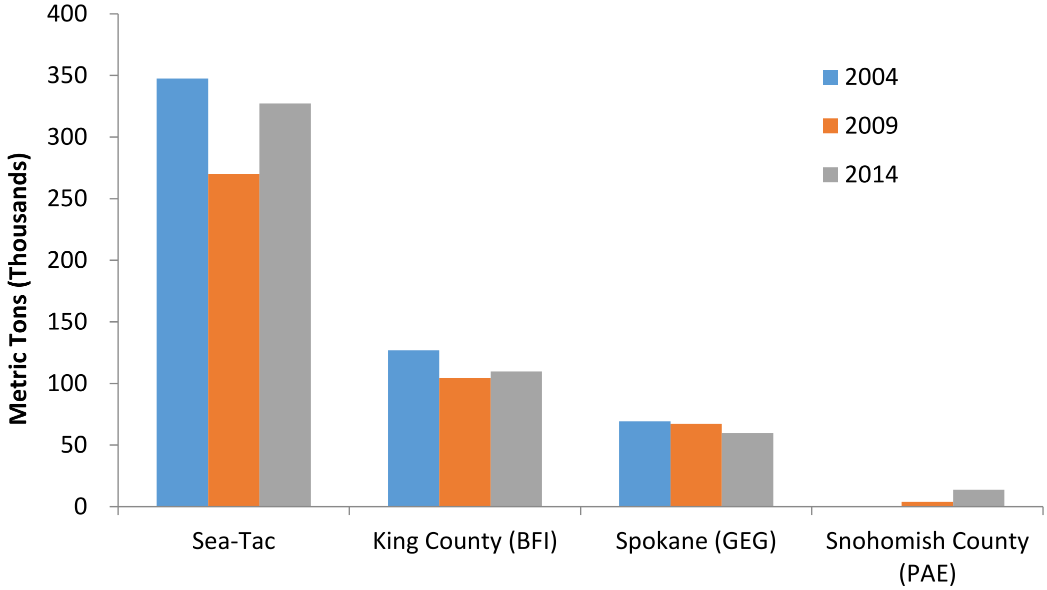
Table 4-18: Washington State Air Cargo Airports (metric tons)

Airport	2004	2014	2004-2014 Average Annual Growth	2009-2014 Average Annual Growth	2014 Market Share
Seattle-Tacoma International	347,574	327,239	-0.6%	3.9%	63.1%
King County International	126,984	109,653	-1.5%	1.0%	21.1%
Spokane International	69,363	59,567	-1.5%	-2.4%	11.5%
Snohomish County	53	13,639	74.2%	28.4%	2.6%
Tri Cities	2,962	2,855	-0.4%	-3.2%	0.6%
Yakima Air Terminal	2,251	1,917	2.4%	1.1%	0.4%
Bellingham International	1,205	1,095	-1.0%	1.9%	0.2%
Pangborn Memorial	672	711	0.6%	2.2%	0.1%
William R. Fairchild International	522	627	1.9%	3.3%	0.1%
Orcas Island Airport	236	444	6.5%	12.8%	0.1%
Grant County International	524	365	-3.6%	-2.1%	0.1%
Skagit Regional	0	363	100.0%	8.0%	0.1%
Friday Harbor Airport	88	196	8.3%	12.5%	0.0%
Pullman Moscow Regional	17	7	-8.5%	-2.6%	0.0%
Ephrata Municipal	5	3	-5.0%	100.0%	0.0%
Sequim Valley	0	2	100.0%	100.0%	0.0%
Walla Walla Regional	9	2	-14.0%	-22.2%	0.0%
Friday Harbor Seaplane Base	0	1	100.0%	100.0%	0.0%
Roche Harbor Airport	0	1	100.0%	0.0%	0.0%
Kenmore Air Harbor	0	1	100.0%	0.0%	0.0%
Oak Harbor	560	0	-100.0%	-100.0%	0.0%
Omak Airport	350	0	-100.0%	-100.0%	0.0%

Source: Seattle-Tacoma International Airport data from Port of Seattle, Spokane International Airport data years 2010-2014 from Spokane International Airport –year 2009 from DOT T-100 All Carrier Market data; all other cargo activity from the DOT T-100 All Carrier Market data

As shown on Figure 4-27, the Seattle air cargo market is by far the largest in the State. SEA and BFI combined have an 84-percent share of the total Washington State market. GEG, the third largest cargo airport in the state, represents an 11.5-percent share of the Washington market.

Figure 4-27: Primary Washington State Air Cargo Markets



Source: Individual airport records; inventory data; compiled by Keiser Phillips Associates

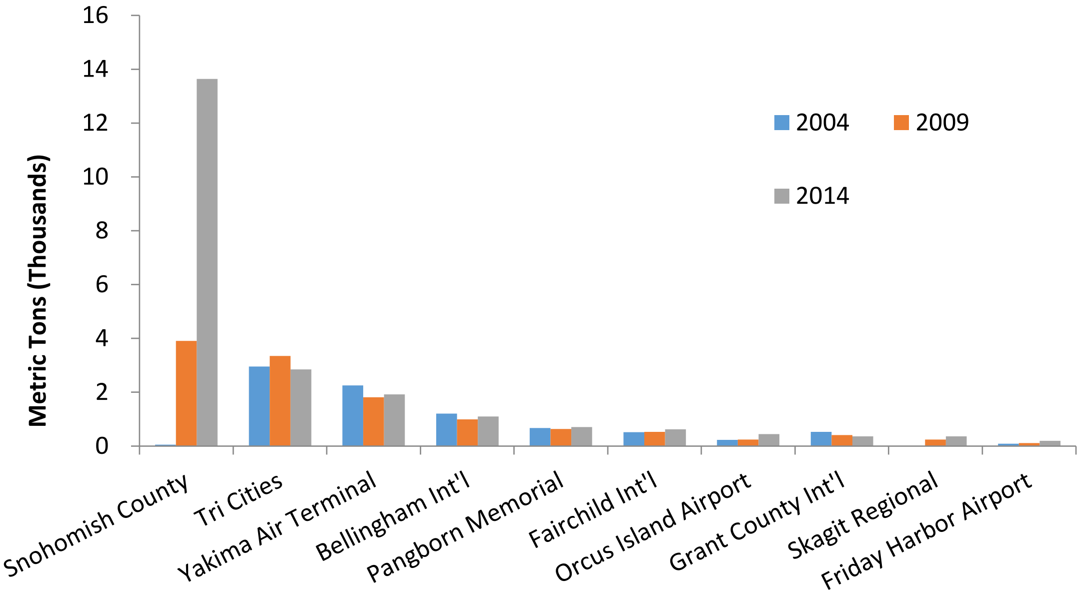
SEA dominates the local Seattle air cargo market with a mix of domestic and international lower-deck cargo (belly cargo), domestic and international freighter cargo, as well as integrator/express cargo generated by FedEx. Air cargo at BFI is generated almost exclusively by the integrator all-cargo carriers. The dominant air cargo carrier at BFI is UPS with an 80-percent market share.

GEG is utilized as an integrator/express cargo hub for the Pacific Northwest. It is dominated by FedEx and UPS with a combined market share of 91 percent. Passenger airlines account for less than 9 percent of the air cargo at GEG.

The air cargo at Snohomish County Paine Field in 2014 was generated by special modified widebody freighters as a part of the Boeing Company's 787 airplane manufacturing and assembly program. Origin and destination cities for cargo generated at Paine Field included Anchorage (a trans-Pacific transload point), Charleston, Nagoya, and Wichita. The general cargo demand in Snohomish County is served through SEA and BFI.

Air cargo activity at other airports in Washington State, shown on Figure 4-28, is generated almost exclusively by FedEx and UPS with very small quantities of enplaned and deplaned by Alaska/Horizon Airlines. Belly cargo capacity at smaller airports in the state is limited due to the regional aircraft utilized to serve these markets.

Figure 4-28: Secondary Washington State Air Cargo Markets



Source: Individual airport records; inventory data; compiled by Keiser Phillips Associates

Due to the lack of wide-body air service, smaller population centers, and the general operational economics of the air cargo business explained previously, Washington State businesses located outside the metropolitan Seattle market are served by air/truck road feeder service from SEA and BFI or directly to/from other major Midwest and West Coast airports, such as Los Angeles, San Francisco, Chicago, or Dallas.

4.3.4 Washington State Air Cargo Hub Airports

This section focuses on the three main air cargo airports within Washington State.

Seattle/Tacoma International Airport

SEA is owned and operated by the Port of Seattle. The Port of Seattle is a special-purpose government established to foster regional economic activity, provide transportation facilities for cargo and passengers by air, water, and land, and to provide a home for the North Pacific fishing industry.

Because there are often competing interests in airport resource utilization between passenger and cargo facilities, it may be informative to review some of the policies that the Port of Seattle has publicly identified as factors that should be considered in understanding the future direction of SEA's growth as related to air cargo.

The Port of Seattle's Mission Statement according to the Port's website is

> *The Port of Seattle is a public agency that creates jobs by advancing trade and commerce, promoting industrial growth, and stimulating economic development."*

The Port of Seattle's Vision is

> *Over the next 25 years we will add 100,000 jobs through economic growth led by the Port of Seattle, for a total of 300,000 port-related jobs in the region, while reducing our environmental footprint.*

The Port has identified four Strategic Objectives as a part of its "Century Agenda":

- Position the Puget Sound region as a premier international logistics hub
- Advance this region as a leading tourism destination and business gateway
- Use our influence as an institution to promote small business growth and workforce development
- Be the greenest and most energy efficient port in North America

Relevant to this study is that as part of the Port's strategy to "Position the Puget Sound region as a premier international logistics hub," its objective is to "Triple air cargo volume to 750,000 metric tons." To achieve this objective, SEA must double its existing air cargo tonnage and significantly increase the air cargo capacity of the airport.

A preliminary review of the recent *Seattle/Tacoma International Airport Master Plan* indicates that the Master Plan air cargo forecast seems to fall short of the goals identified in the Port's Century Agenda.

Seattle/Tacoma International Airport Air Cargo Activity

In 2014, enplaned and deplaned freight and mail at SEA totaled 327,239 metric tons. Airport historical air cargo activity trends are shown in Table 4-19.

Table 4-19: Historical Air Cargo Trends at Seattle/Tacoma International Airport (metric tons)

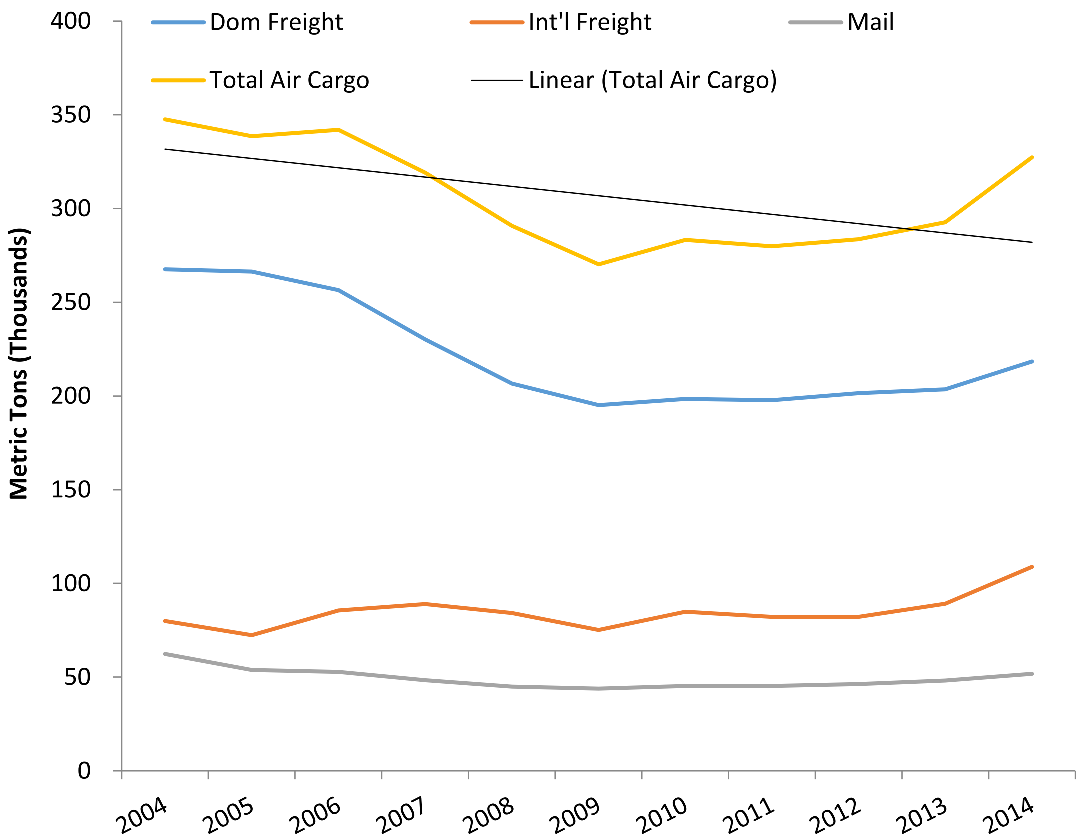
Year	Inbound	Outbound	Total Cargo	% Change
1990	139,650	173,810	313,460	n/a
1991	159,831	187,835	347,666	10.9%
1992	169,751	191,857	361,608	4.0%
1993	181,520	200,022	381,542	5.5%
1994	198,196	211,940	410,136	7.5%
1995	195,120	213,078	408,198	-0.5%
1996	181,502	206,716	388,218	-4.9%
1997	184,263	209,523	393,786	1.4%
1998	207,249	221,078	428,327	8.8%
1999	220,936	223,288	444,224	3.7%
2000	230,530	226,390	456,920	2.9%
2001	199,337	202,198	401,535	-12.1%
2002	185,463	189,290	374,753	-6.7%
2003	175,871	175,547	351,418	-6.2%
2004	173,649	173,868	347,517	-1.1%
2005	175,193	163,469	338,662	-2.6%
2006	173,136	168,904	342,040	1.0%
2007	161,566	157,527	319,093	-6.7%
2008	142,501	148,346	290,847	-8.9%
2009	131,952	138,263	270,215	-7.1%
2010	140,715	142,576	283,291	4.8%
2011	138,337	141,556	279,893	-1.2%
2012	142,235	141,374	283,609	1.3%
2013	152,234	140,475	292,709	3.2%
2014	169,816	157,424	327,240	11.8%

Source: Individual airport records; compiled by Keiser Phillips Associates

As can be seen in Table 4-19, air cargo at SEA steadily has fluctuated significantly from year to year. Since 1990, air cargo at the airport has averaged 0.18 percent per year. Over the past five years, the average annual growth rate has been 3.9 percent.

With the exception of the past few years, inbound and outbound cargo volumes are fairly even indicating a balanced market. Figure 4-29 shows the trends among domestic and international freight and mail. The past three years has seen a marked increase in inbound cargo.

Figure 4-29: Historical Air Cargo Trends at Seattle/Tacoma International Airport



Source: Individual airport records; compiled by Keiser Phillips Associates

The increase of air cargo at SEA over the past few years can be attributed primarily to the increase in international passenger traffic and the increase in seasonal international freighter cherry charters. SEA also received a large boost in air cargo in 2014 due to an eight-month protracted waterfront labor dispute that closed or slowed down most U.S. West Coast seaports. In the month of November 2014, the airport handled four to five additional freighters each week in an effort to move freight for the Christmas holiday buying season. In 2015, air cargo returned to a more sustainable 1.7-percent annual average growth rate reaching 332,636 metric tons.

Seattle/Tacoma International Airport Air Cargo by Type

SEA has both domestic and international passenger air service. The domestic passenger carriers servicing SEA include Alaska Airlines, American Airlines, Delta Air Lines, Frontier, Hawaiian, JetBlue Airways, Southwest Airlines, Sun Country, United Airlines, and U.S. Airways. International combination carriers include Air Canada, All Nippon Airways, Asiana Airline, British Airways, Condor, Emirates, EVA Airlines, Hainan Airlines, Korean Air, and Lufthansa Airlines.

The passenger aircraft fleet mix at SEA is a combination of regional turbo-props, regional jets, and both small narrow-body and wide-body transport jets. The largest passenger planes used are Boeing 747-400s. Air carriers that also utilize freighter aircraft are sometimes referred to as mixed-use carriers. The two largest air cargo carriers among the passenger airlines are Alaska Airlines and Delta Air Lines.

Similar to passenger service, air cargo freighter service at SEA is provided by both domestic and international airlines utilizing a variety of aircraft. The largest all-cargo airlines operating at SEA are FedEx, Cargolux, China Airlines, and Korean Air.

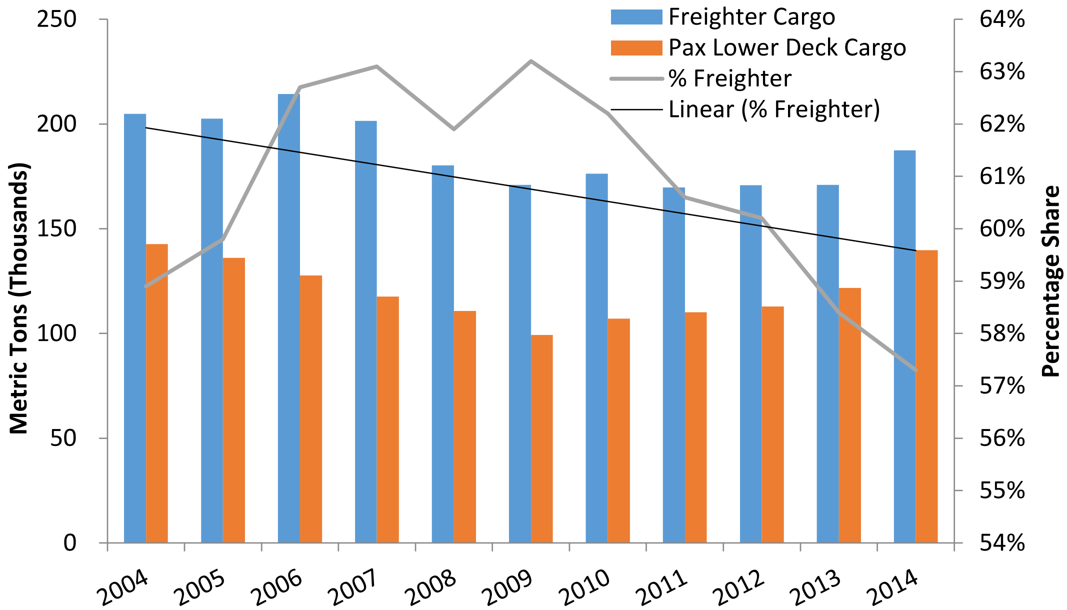
Some airlines, such as Alaska Airlines, Asiana, EVA Air, and Korean Air, operate freighter aircraft in addition to passenger aircraft. Historical lower deck passenger air cargo and freighter air cargo at SEA is presented in Table 4-20 and shown graphically on Figure 4-30.

Table 4-20: Historical Freighter and Belly Cargo at Seattle/Tacoma International Airport (metric tons)

Year	Freighter Cargo	Pax Lower Deck Cargo	% Freighter
2004	204,864	142,710	58.9%
2005	202,548	136,115	59.8%
2006	214,360	127,682	62.7%
2007	201,458	117,637	63.1%
2008	180,157	110,690	61.9%
2009	170,900	99,316	63.2%
2010	176,291	107,000	62.2%
2011	169,732	110,161	60.6%
2012	170,699	112,912	60.2%
2013	170,977	121,732	58.4%
2014	187,475	139,764	57.3%

Source: Individual airport records; compiled by Keiser Phillips

Figure 4-30: Historical Belly and Freighter Cargo at Seattle/Tacoma International Airport



Source: Individual airport records; compiled by Keiser Phillips Associates

As can be determined from Figure 4-30, the passenger belly cargo as a percent of total cargo at SEA has increased significantly since 2009. This is primarily due to increase in wide-body passenger service at SEA over the past five years.

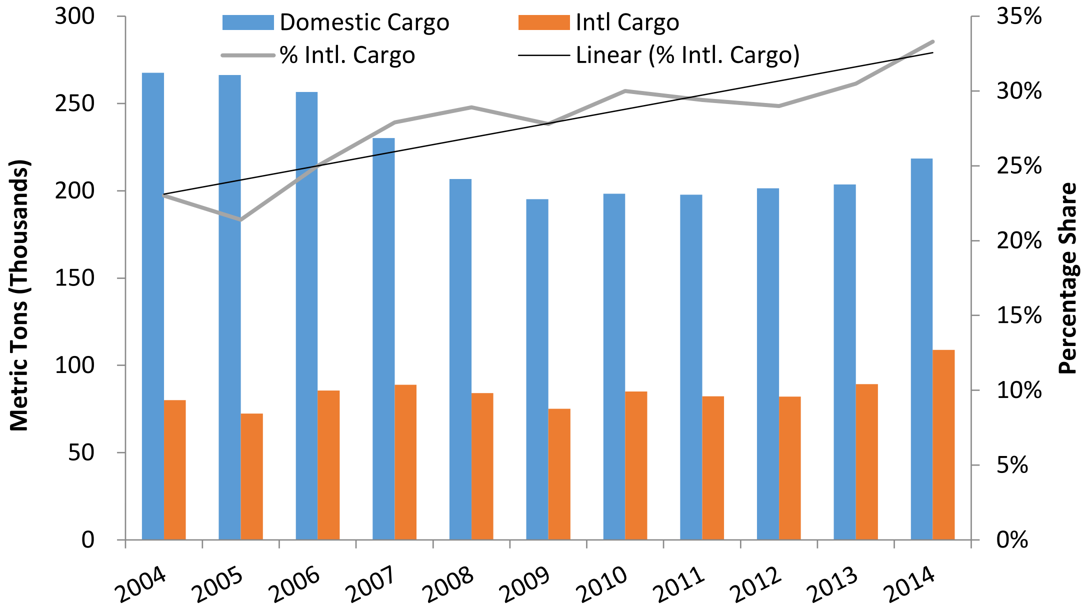
A breakout of domestic and international air cargo is presented in Table 4-21 and shown graphically on Figure 4-31.

Table 4-21: Domestic and International Air Cargo Trends at Seattle/Tacoma International Airport (metric tons)

Year	Domestic Cargo	Intl Cargo	Total Air Cargo	% International Cargo
2004	267,570	80,004	347,574	23.0%
2005	266,281	72,382	338,663	21.4%
2006	256,545	85,497	342,042	25.0%
2007	230,152	88,943	319,095	27.9%
2008	206,694	84,153	290,847	28.9%
2009	195,111	75,105	270,216	27.8%
2010	198,342	84,949	283,291	30.0%
2011	197,687	82,206	279,893	29.4%
2012	201,483	82,128	283,611	29.0%
2013	203,536	89,173	292,709	30.5%
2014	218,410	108,829	327,239	33.3%

Source: Individual airport records; compiled by Keiser Phillips Associates

Figure 4-31: Domestic and International Air Cargo Trends at Seattle/Tacoma International Airport



Source: Individual airport records; compiled by Keiser Phillips Associates

As with the growth in belly cargo at the airport, the growth of international cargo has increased significantly over the past five years corresponding with the increase in international wide-body passenger service.

From 2004 to 2014, international air cargo averaged a 3.12-percent annual growth. Following the economic recession and the growth of wide-body aircraft passenger service at SEA, international air cargo growth has averaged 7.7 percent per year.

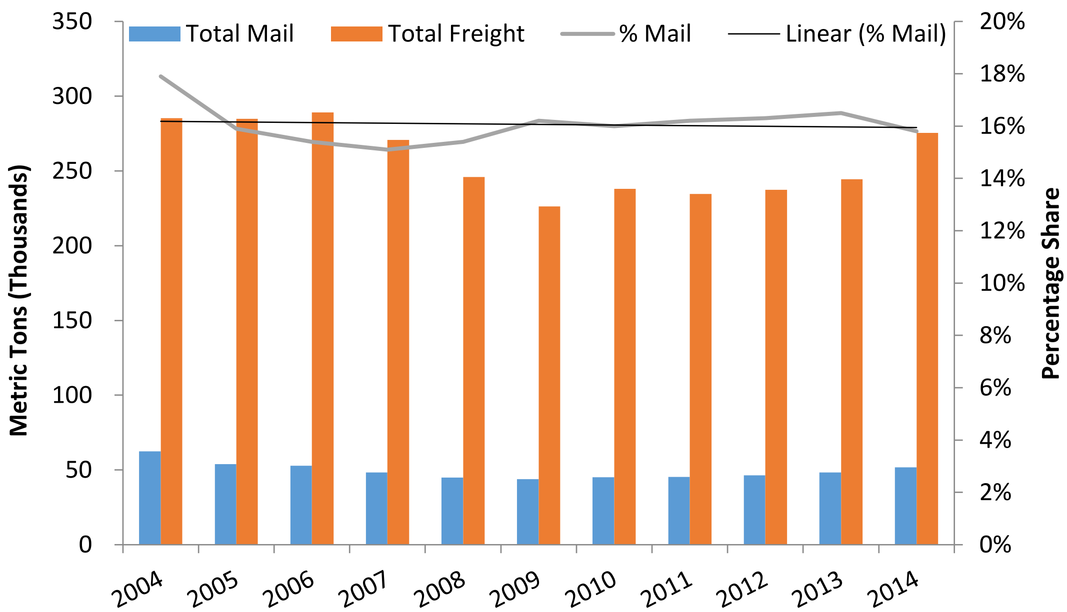
Mail tonnages as a percent of total cargo is fairly steady and is dominated by domestic mail. Air mail totals are presented in Table 4-22 and shown graphically on Figure 4-32.

Table 4-22: Air Mail Trends at Seattle/Tacoma International Airport (metric tons)

Year	Domestic Mail	International Mail	Total Mail	Total Freight	% Mail
2004	62,201	167	62,368	285,206	17.9%
2005	53,734	100	53,834	284,829	15.9%
2006	52,725	120	52,845	289,197	15.4%
2007	48,112	175	48,287	270,808	15.1%
2008	44,811	54	44,865	245,982	15.4%
2009	43,791	74	43,865	226,351	16.2%
2010	45,198	31	45,229	238,062	16.0%
2011	45,164	144	45,308	234,585	16.2%
2012	46,262	38	46,300	237,311	16.3%
2013	47,668	593	48,261	244,448	16.5%
2014	50,681	1,077	51,758	275,481	15.8%

Source: Individual airport records; compiled by Keiser Phillips Associates

Figure 4-32: Air Mail Trends at Seattle/Tacoma International Airport



Source: Individual Airport Records; compiled by Keiser Phillips Associates

The mail is delivered to the airport by the U.S. Postal Service and tendered to the designated terminal handling supplier. The terminal handling supplier scans and containerizes the mail and then delivers the containers of bags to the airlines. The reverse is true for inbound mail. Most of the air mail at SEA is handled by FedEx as domestic shipments.

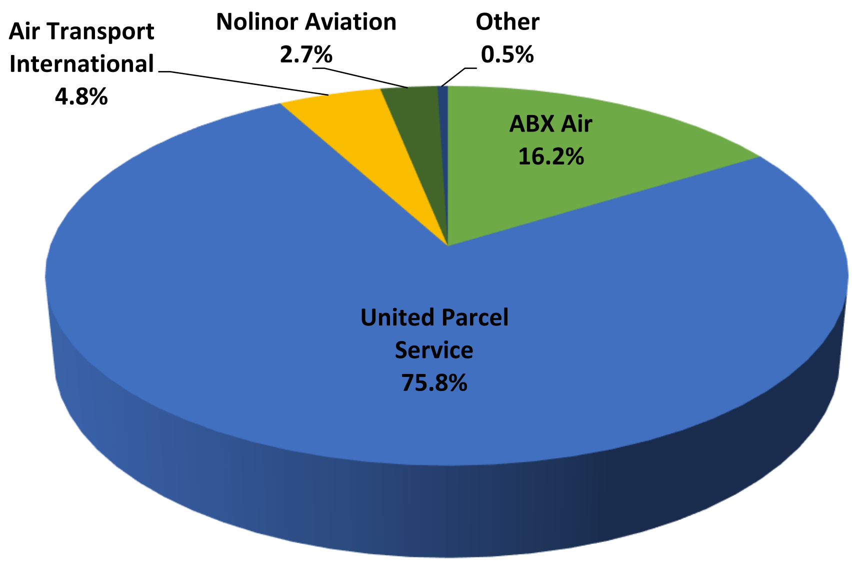
King County International Airport

BFI, locally referred to as "Boeing Field," is a mixed-use general aviation, commercial service, and industrial airport located just south of the SODO (South of Downtown) District in the city of Seattle. The highly constrained airport is bounded on the east by U.S. Interstate 5, to the west by East Marginal Way and the Duwamish Waterway, to the north by the community of Georgetown, and to the south by a cluster of private warehouses and truck terminals.

Due to its inner city location and access to I-5, the airport is attractive to domestic air cargo operators. As mentioned previously, air cargo at BFI is generated almost exclusively by the integrator all-cargo carriers. The dominant air cargo carrier is UPS with an 80-percent market share.

In 2014, enplaned and deplaned air cargo at BFI totaled 109,653 metric tons. The primary air cargo carrier was UPS and the top import and export markets were the carrier's primary hub at Louisville, Kentucky. Other top import markets in 2014 included Ontario, California, Spokane, and Vancouver, British Columbia. The second top export market was Vancouver, followed by Ontario and Spokane. The air cargo market share by air carrier is shown on Figure 4-33.

Figure 4-33: Air Cargo Market Share at King County International Airport for 2014



Source: U.S. DOT T-100 Market Data; compiled by Keiser Phillips Associates

Besides UPS, other all-cargo airlines operating at BFI during 2014 included ABX Air Inc. (operating for DHL), Air Transport International, Ameristar Air Cargo, Atlas Air Inc., Gulf & Caribbean Cargo, Kalitta Charters, Kenmore Air Harbor, Lynden Air Cargo Airlines, Nolinor Aviation, Northern Air Cargo Inc., Everts Air Alaska and Everts Air Cargo, and U.S.A Jet Airlines Inc.

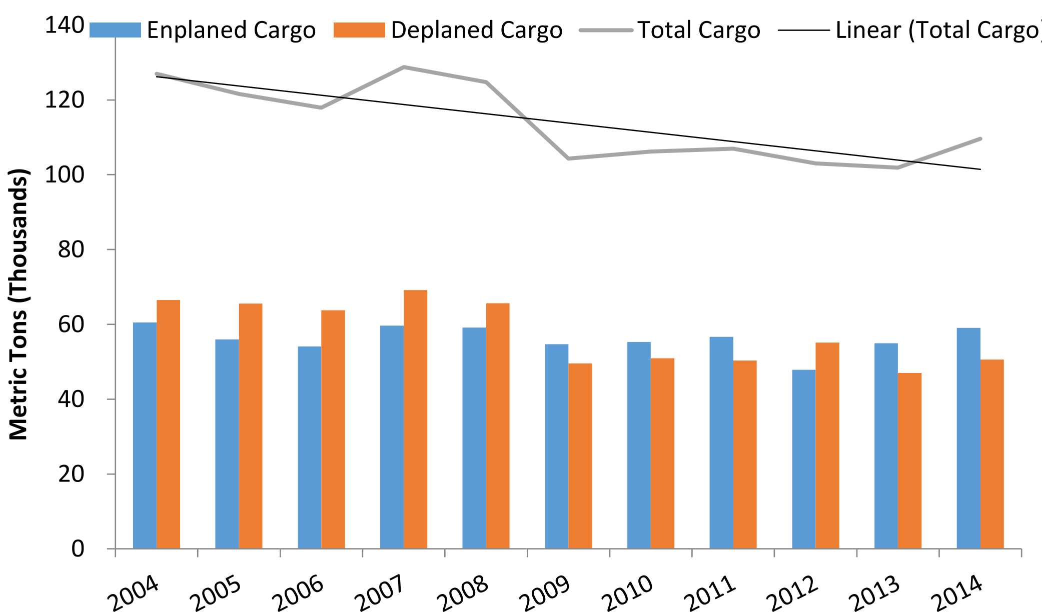
Historical trend of air cargo activity at BFI is presented in Table 4-23 and shown graphically on Figure 4-34.

Table 4-23: Air Cargo Trends at King County International Airport (metric tons)

Year	Enplaned Cargo	Deplaned Cargo	Total Air Cargo	% Change
2004	60,501	66,483	126,984	
2005	56,014	65,563	121,577	-4.3%
2006	54,123	63,775	117,898	-3.0%
2007	59,664	69,113	128,777	9.2%
2008	59,145	65,616	124,761	-3.1%
2009	54,727	49,575	104,302	-16.4%
2010	55,269	50,905	106,174	1.8%
2011	56,619	50,313	106,932	0.7%
2012	47,867	55,147	103,014	-3.7%
2013	54,933	46,951	101,884	-1.1%
2014	59,047	50,606	109,653	7.6%

Source: U.S. DOT T-100 Market Data; compiled by Keiser Phillips Associates

Figure 4-34: Air Cargo Trends at King County International Airport (metric tons)



Source: U.S. DOT T-100 Market Data; compiled by Keiser Phillips Associates

Freighter aircraft types used on a regular basis at BFI include the A300-600, B767-200/300ER, MD11, MD DC-10, and B757-200.

Spokane International Airport

Air cargo service at GEG is provided by the combination passenger/cargo belly carriers, the integrator/express carriers, and small air taxi all-cargo operators. In 2014, the combination carriers accounted for approximately 9 percent of the total enplaned and deplaned cargo tonnages at the airport with the all-cargo carriers handling the remaining 91 percent.

The combination passenger/cargo carriers include Alaska Airlines, Allegiant Air, Delta, Frontier, Horizon, Republic, Shuttle America/UAL, Southwest, Sun Country, United, and U.S. Airways. The largest regularly scheduled passenger planes used are A320s and Boeing 737-8/900s. The largest freighter aircraft used on a regular basis include the A300-600, B767-300, MD 11, and MD DC-10.

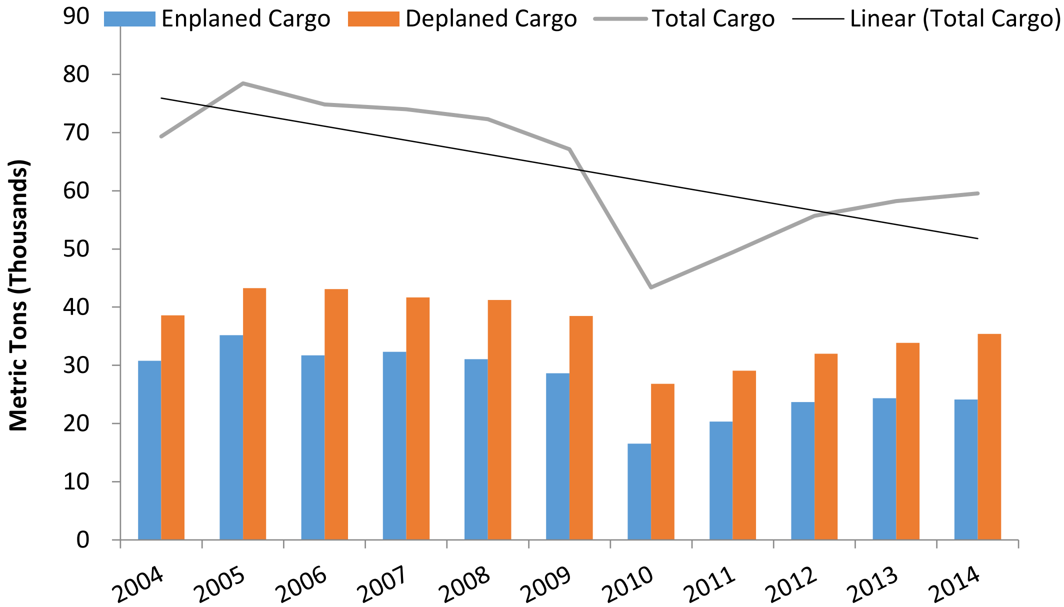
Alaska and Delta had the highest air cargo tonnages in 2014 among the combination carriers. The all-cargo airlines at GEG include FedEx, UPS, Empire, and Airpac. The two dominant cargo carriers are FedEx and UPS. Both FedEx and UPS service the local air cargo market and also utilize GEG as a regional transload hub for aircraft originating and departing to other destinations. FedEx accounted for 58 percent of all air cargo handled by the all-cargo carriers and UPS accounted for 33 percent. A significant portion of the cargo carried by FedEx is U.S. mail. Historical air cargo at GEG is presented in Table 4-24 and shown graphically on Figure 4-35.

Table 4-24: Air Cargo Trends at Spokane International Airport (metric tons)

Year	Enplaned Cargo	Deplaned Cargo	Total Air Cargo	% Change
2004	30,787	38,576	69,363	
2005	35,185	43,275	78,460	13.1%
2006	31,719	43,127	74,846	-4.6%
2007	32,318	41,697	74,015	-1.1%
2008	31,069	41,223	72,292	-2.3%
2009	28,624	38,505	67,129	-7.1%
2010	16,551	26,839	43,390	-35.4%
2011	20,352	29,067	49,419	13.9%
2012	23,711	31,995	55,706	12.7%
2013	24,368	33,850	58,218	4.5%
2014	24,149	35,418	59,567	2.3%

Source: U.S. DOT T-100 Market Data; compiled by Keiser Phillips Associates

Figure 4-35: Air Cargo Trends at Spokane International Airport (metric tons)



Source: Individual Airport Records (2004-2009); U.S. DOT T100 Market Data (2010-2014); compiled by Keiser Phillips Associates

A significant portion of the freighter volume since 1992–93 at GEG has been generated by transload, or sometimes called crossload, operations. A transload typically occurs when a carrier has scheduled one aircraft arriving in Spokane from City A with a final destination to City C; and a second aircraft scheduled to arrive in Spokane from City B with a final destination to City D. At Spokane, the carrier will transload cargo from the aircraft arriving from City A with cargo destined to City D to the aircraft scheduled to City D; while cargo on the aircraft from City B, destined for City C, will be transferred to the aircraft scheduled for City C.

In a typical transload operation, the cargo is physically deplaned from one aircraft and enplaned onto a second aircraft. The transload may take place over a few hours or over the course of a few days. Depending upon a particular carrier's type of operation, if a transload of two or more aircraft is performed simultaneously, then sufficient apron space must be available in close proximity to facilitate the transload operation. If the transload takes place over a few days, then sufficient warehouse space must be available for storage and sorting.

At present, FedEx is currently performing transload operations at Spokane with aircraft, trucks and cargo ultimately to and from Memphis, Oakland, Seattle, Vancouver BC, Reno, and Great Falls. UPS is transloading freight between planes coming to and from Seattle, Portland, Des Moines, and Dallas.

Only a very small portion of the total volume generated in these transload operations originates, or is destined, for the Spokane regional market. Spokane's unique geographical location in Eastern Washington lends itself to this type of hubbing operation taking place at the airport. Both FedEx and UPS have major operations in the Seattle region but are constrained in their ability to expand in that city due to the overcrowded facilities at BFI and SEA. By utilizing GEG, the integrator carriers can maximize the utilization of their aircraft serving the Pacific Northwest and beyond.

Key destinations being served by freighter aircraft to and from GEG include Dallas, Portland, Seattle, Vancouver BC, Memphis, Louisville, Des Moines, Billings, Pendleton, Wenatchee, Sacramento, Missoula, Moses Lake, Lewiston, Yakima, Ontario (California), and Pasco.

Bellingham International Airport

Bellingham International Airport (BLI) is a non-hub commercial service airport located in Whatcom County, approximately 3 miles northwest of the city limits of Bellingham, Washington. The airport is situated approximately 90 miles north of Seattle and 20 miles south of the U.S./Canada Peace Arch Border crossing located in Blaine, Washington.

BLI is typical of Washington State non-hub commercial service airports. Passenger service is provided by airlines using narrow-body 130- to 200-seat aircraft and by small regional air taxis. Air cargo handled at the airport is typically less than 150 pounds.

Aircraft belly cargo service at the airport is provided by Alaska Airlines. Belly cargo is processed through the passenger terminal.

FedEx provides small package express service using air taxi aircraft. Charter service is also provided by local air taxi operators. Approximately 90 percent of the air cargo moving by aircraft through BLI is by FedEx. The FedEx operation provides door-to-door air freight service in the Bellingham market through the use of a fleet of small service vans and to the San Juan Islands by air. Freight is delivered to the FedEx facility in the morning by both over-the-road tractor trailer rigs and by aircraft, typically a Cessna Caravan operated by Empire Airlines. Inbound freight for the Bellingham region is then sorted on site and put on delivery trucks for distribution. Freight destined for the San Juan Islands is placed back on the aircraft to be flown to Friday Harbor.

In the afternoon, the reverse occurs. Outbound freight picked up in the Bellingham region is brought back to the airport by delivery truck, where it is sorted and East Coast priority packages are put on a Cessna 208 Caravan to meet an early evening flight from SEA to Memphis. Most of the West Coast priority packages and deferred delivery packages are loaded onto trucks for over-the-road delivery to the Seattle FedEx station later in the evening.

Other small commercial service airports in Washington, such as Tri Cities, Yakima Air Terminal, Pangborn Memorial, Walla Walla Regional Airport, have similar air cargo profiles as BLI. That is, most air cargo are small packages under 150 pounds in weight and are moved in the belly of narrow-body passenger aircraft by FedEx or UPS feeder aircraft or by air taxi charter service. Cargo ground handling is done on the passenger ramp, in small specialized facilities operated by FedEx or UPS, or on the general aviation ramp.

Other Washington State Cargo Airports

As mentioned previously, air cargo activity at small commercial service airports in Washington State is generated almost exclusively by FedEx and UPS with very small quantities of enplaned and deplaned belly cargo by Alaska/Horizon Airlines. Belly cargo capacity at smaller airports in the state is limited due to the regional aircraft utilized to serve these markets.

Beyond space for FedEx and UPS airport operations, the need for airport air cargo facilities at most non-hub commercial service airports in Washington State is limited. Air cargo tendered at these airports is typically same day express cargo under 150 pounds in weight. Most of these small packages have limited dwell time.

An exception to this profile is Snohomish County Paine Field. The surge in air cargo at Paine Field in 2014 was generated by special modified wide-body freighters as a part of the Boeing Company's 787 airplane manufacturing and assembly program. Origin and destination cities for cargo generated at Paine Field included Anchorage (a trans-Pacific transload point), Charleston, Nagoya, and Wichita. The general cargo demand in Snohomish County is served through SEA and BFI.

Summary

Air cargo in Washington State is primarily generated by activity at SEA, BFI, and GEG. Non-hub and small commercial passenger airports within the state account for only 4 percent of the total air cargo volumes moved in 2014.

Reflecting trends in general economy, as well as systemic changes in the air cargo industry, air cargo volumes in Washington State have fluctuated over the past 10 years from a high of 553,415 metric tons in 2004 to a low of 454,419 metric tons during the economic crisis of 2008/2009.

Growing slowly, but faster than the general economy, air cargo volumes in the state increased 3.8 percent per year from 2009 to 524,782 tons in 2014. Most of the growth in air cargo within the state is driven by the increase in international wide-body aircraft air service at SEA.

Most small airports in the state have experienced a decline in air cargo volumes corresponding to a reduction of passenger service at smaller airports, the downsizing of aircraft serving the smaller markets, and a shift of air cargo to truck.

4.3.5 Washington State Air Cargo Forecast

The forecast of aviation demand is a key element in both the short- and long-term development of air cargo facilities in Washington State. Forecasts provide a basis for determining the type, size, and timing of airside and landside facilities development and consequently influence many phases of the airport planning process.

The focus of this effort is to provide an estimate of air cargo volumes and freighter operations over the long-term, 20-year planning horizon. The base year for this forecast is 2014 and the forecast includes 2019, 2024, and 2034.

It should be noted that data collection, both at the industry level and locally, is problematic. Historical air cargo data is limited and activity by carrier and cargo type is unavailable. A summary of the air cargo forecast is presented in Table 4-25.

Table 4-25: Summary of Air Cargo Forecast for Washington State (metric tons)

Year	Seattle-Tacoma International	King County International	Spokane International	Other Washington Airports	Total Air Cargo
Historical					
2004	347,574	126,984	69,363	9,494	553,415
2009	270,216	104,302	67,129	12,772	454,419
2014	319,490	109,653	59,567	22,229	510,939
Forecast					
2019	351,480	124,063	67,395	23,363	566,301
2024	382,920	140,365	76,251	24,555	624,091
2034	441,770	179,680	97,607	27,124	746,181
Average Annual Growth (2014–2034)	*2.5%*	*2.5%*	*2.5%*	*1.0%*	*2.5%*

Note: Many of the factors influencing future aviation demand cannot necessarily nor readily be quantified. As a result, the forecast process should not be viewed as precise, particularly given the major structural changes that have occurred in the air cargo industry, the uncertain global economy and the security regulations imposed by on-going terrorist threats. Actual future traffic levels addressed here may differ materially from the projections presented herein because of unforeseen or unrealized events.
Source: SAMP Table 6.5 Based on Data provided by the Port of Seattle (Table updated 10/10/17)

Recent Air Cargo Market Trends

This section presents an overview of the factors that can influence the development of air cargo demand forecasts.

Global Economic Trends

Globalization of world markets has expanded trade activity. Global economies are interdependent, and global integration is at a stage that is unprecedented since the late 19th century and early 20th century. In 2015, over $16 billion of goods traveled by air each day, 1/3 of all world trade by value.

U.S. international trade in goods and services grew from more than $288,430 million in January 2009 to more than $398,589 million in January 2016, an average annual growth rate of 4.7 percent.

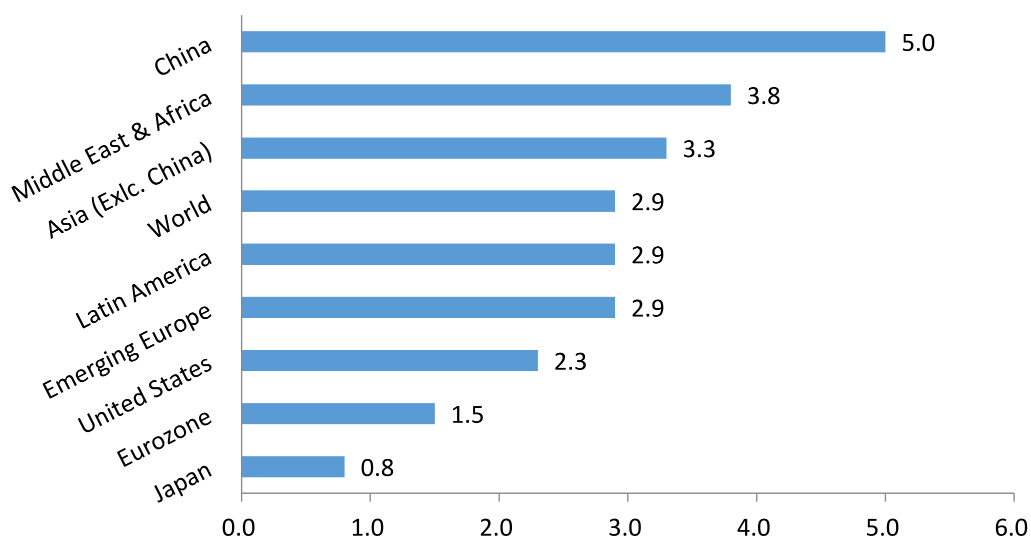
Free trade agreements are playing a significant role in opening up foreign markets to U.S. exporters. Today the U.S. holds free trade agreements with 20 countries. In 2007, trade with countries that the U.S. has free trade agreements with was significantly greater than their relative share of the global economy: although comprising 7.5 percent of global GDP (not including the U.S.), those countries accounted for over 42 percent of U.S. exports.

In 2015, global economic activity remained subdued. Growth in emerging market and developing economies—while still accounting for over 70 percent of global growth—declined for the fifth consecutive year, while a modest recovery continued in advanced economies. Three key transitions continue to influence the global outlook: (1) the gradual slowdown and rebalancing of economic activity in China away from investment and manufacturing toward consumption and services, (2) lower prices for energy and other commodities, and (3) a gradual tightening in monetary policy in the U.S. in the context of a resilient U.S. recovery as several other major advanced economy central banks continue to ease monetary policy.

According to the International Monetary Fund, growth in emerging market and developing economies is projected to increase from 4 percent in 2015—the lowest since the 2008–09 financial crisis—to 4.3 and 4.7 percent in 2016 and 2017, respectively. Price Waterhouse Coppers projects the world economy to grow at an average of just over 3 percent per annum in the period 2014–50, doubling in size by 2037 and nearly tripling by 2050.

IHS Global Insight projects that world economic growth will remain sub-par, below 3 percent a year for the next two years. They forecast world real GDP to grow at 2.9 percent a year between 2016 and 2036. Emerging markets are forecast to grow above the global average but at lower rates than in the early 2000s. Asia (excluding Japan), led by India and China, is projected to have the fastest growth followed by the Middle East and Africa, Latin America, and Eastern Europe. Growth in the more mature economies will be lower than the global trend with the fastest rates in the U.S. followed by Europe. Growth in Japan is projected to be very slow with rates below 1 percent a year reflecting deep structural issues associated with a shrinking and aging population. Figure 4-36 presents the growth rates for the GDP forecast by world region.

Figure 4-36: World GDP Forecast Growth by Region



Source: HIS Global Insight, December 2015 World Forecast; compiled by Keiser Phillips Associates

Historically, air cargo activity has moved in synch with GDP, influenced by fuel price volatility, movement of real yields, and globalization. Over the past five years, however, significant structural changes have occurred in the air cargo industry. Among these changes are air cargo security regulations issued by the U.S. and EU regulators; market maturation of the domestic express market; domestic U.S. modal shift from air to other modes (especially truck); a significant decrease in the cost of oil; growth in international trade from open skies agreements; increased use of mail substitutes; and the emergence of the cross-border e-commerce market.

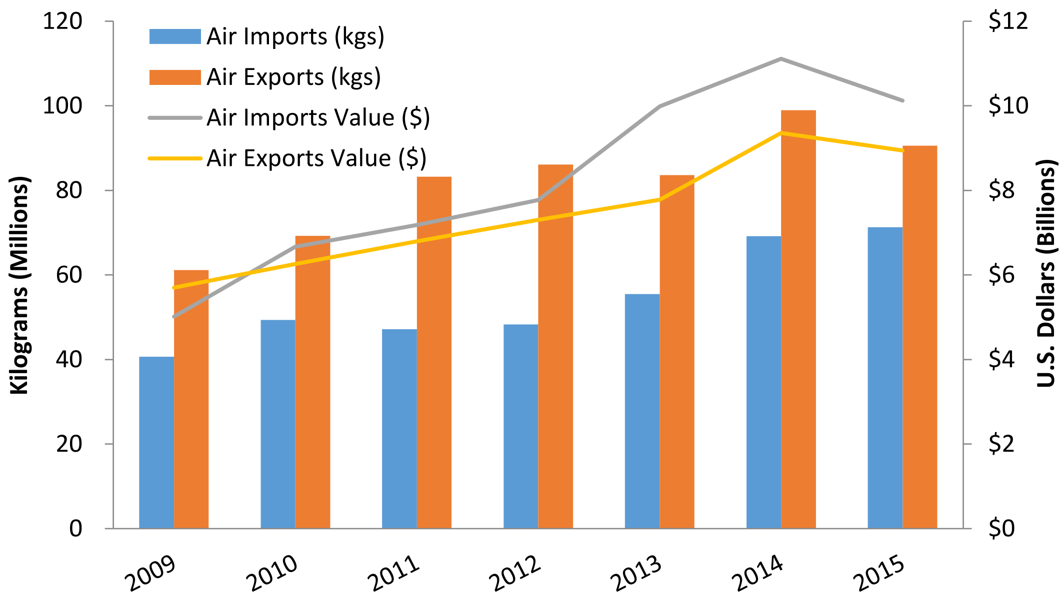
Washington State Economic Trends

According to the February 2016 Washington State Economic and Revenue Forecast, the Washington economy is expanding at a solid pace, although annual Washington exports declined for the first time since 2009. However, according to U.S. Department of Commerce data, state air exports rose dramatically between the same period growing from $5.7 billion in 1997 to $8.9 billion in 2015, a growth rate of 8 percent each year.

The Washington forecast for GDP growth is 2.1 percent and 2.4 percent for 2016 and 2017 and forecasted growth rates for 2018 and 2019 are 2.4 percent and 2.2 percent, respectively.

As shown on Figure 4-37, air exports from Washington State accounted for $8.9 billion in 2015 and air imports to Washington were $10.1 billion with air imports and exports totaling 162,000 metric tons.

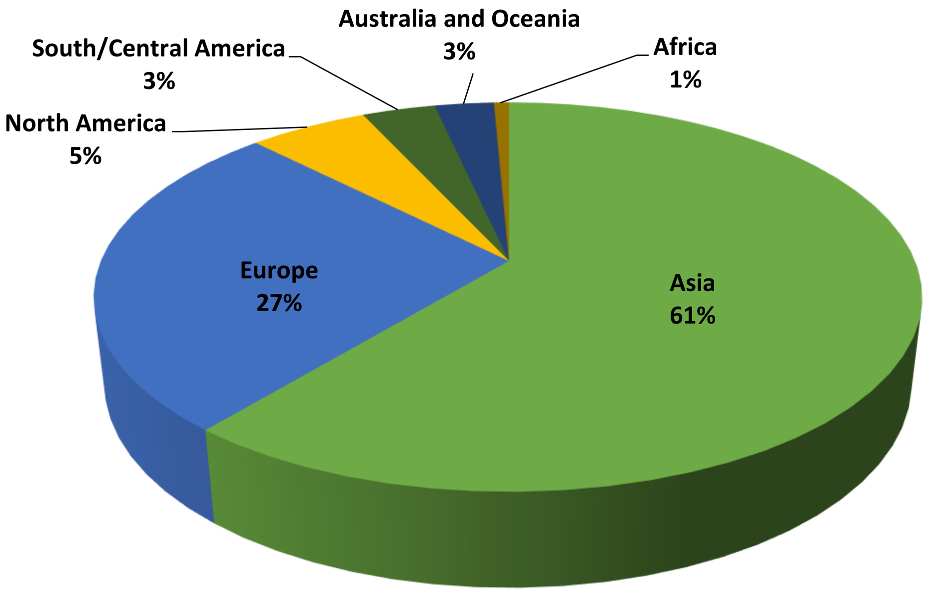
Figure 4-37: Washington State Air Imports and Exports



Source: Compiled by Keiser Phillips Associates

As presented on Figure 4-38, the largest markets for air exports from the state of Washington as measured by weight were Asia, followed by Europe and Canada and Mexico, South America and Australia, and Oceania and Africa.

Figure 4-38: Washington State Air Exports and Import Share by Region (based on weight)



Source: Compiled by Keiser Phillips Associates

World Air Cargo Trends

World air cargo traffic has averaged a 5.2-percent growth per year between 1983 and 2013. The growth rate actually exceeded 6 percent in several years throughout the 1980s, 1990s, and early 2000s. Growth slowed as fuel prices began to rise in 2005 and some shippers began to divert freight to less expensive modes of transport.

The global economic downturn of 2008–2009, the worst economic contraction since the Great Depression, dragged down all modes of freight transport. World air cargo traffic dropped 13 percent over the two years ending in 2009. Traffic jumped 19.4 percent in 2010 and gained a further 0.8 percent in 2011 as global businesses replenished their inventories. The net result of these developments is a world air cargo traffic growth rate of only 2.6 percent for the span of years between 2003 and 2013.

Regional air cargo market shares have changed significantly during the past two decades. Airlines based in Asia, Europe, and North America have accounted for more than 80 percent of the world's air cargo traffic for that entire span of years.

Airlines based in North America led all other world regions with a 35-percent share of the world's air cargo traffic in 1992. This changed during the 1990s and early 2000s as the share flown by airlines based in Asia, including those based in China, grew from 28 percent in 1992 to 39 percent in 2010, reflecting the rapid expansion of Asian export markets. Since 2000, however, carriers based in the Middle East have leveraged their geographic position at the crossroads between Africa, Asia, and Europe. Middle East carriers have quickly expanded their wide-body passenger and freighter fleets, allowing them to increase their share of world air cargo traffic from 4 percent in 2003 to 11 percent in 2013.

In 2015 most major regions experienced weakness in air freight demand. This includes Asia Pacific, where growth was just 2.3 percent in 2015 compared to 2014. For North American carriers, there was a small expansion of 0.1 percent in 2015 overall. These small gains in volumes over the year are explained by the surge in activity in the first quarter of 2015 due to switching towards air cargo because of the U.S. West Coast seaport backlog and recalls in the U.S. for Japanese auto-parts.

The Middle East continued to see strong growth in 2015, with expansion of 11.3 percent.

Over the next five years, it is expected that air cargo demand will continue to come under strain but a stronger recovery in the Eurozone—a key market—can be a source of optimism. The global economy is facing increased uncertainty with three key factors weighing on global outlook: (1) U.S. Federal Reserve looking to normalize monetary policy while other major currencies are likely to ease further, paving the way for further tightening in U.S. bank credit conditions, (2) China's economy embarking on a multi-year rebalancing, and (3) the decade-long commodity super cycle appears to be coming to an end.

According to the *FAA Aerospace Forecasts, FY 2016-FY 2035*, U.S. air carriers flew 35.9 billion revenue ton miles (RTM) in 2015, up 2.2 percent from 2014 with domestic cargo RTMs increasing 3.3 percent to 13.1 billion while international RTMs increased by 1.6 percent to 22.9 billion. Air cargo RTMs flown by all-cargo carriers comprised 78.1 percent of total RTMs in 2015, with passenger carriers flying the remainder. Total RTMs flown by the all-cargo carriers increased 1.8 percent in 2015 while total RTMs flown by passenger carriers grew by 3.6 percent.

Industry Forecasts of Air Cargo Activity

According to most industry analysts, worldwide air cargo is expected to rise between 3 percent and 5.5 percent per year over the next 20 years. This growth relates to an improving world economy and accelerating rates of international trade.

Detailed market analysis in the *2014 Boeing World Air Cargo Forecast* projects annual world air cargo growth of 4.0 percent to 5.5 percent over the next 20 years, approximately double the forecasted economic growth. According to Boeing, Asia will continue to lead the world air cargo industry. The more mature North America and Europe markets will reflect slower and thus lower-than-average traffic growth rates. World airmail is forecast to grow at a consistent 1.0 percent per year.

Regionally, North America air traffic is projected by Boeing to average 2.2 percent growth over the next 10 years and then at 2.1 percent to the 2043 forecast period. Baseline growth in North America-to-Europe air trade is predicted by Boeing to average 2.9 percent per year and Europe-to-North America baseline growth will average 3.3 percent per year. The combined total market baseline growth for the next 20 years is projected to be 3.1 percent, compared with 2.8-percent average growth during the past 20 years.

Asia to North America air cargo traffic flowing in both directions across the Pacific is forecast by Boeing to grow an average of 5.4 percent per year over the next 20 years. The flow from Asia to North America is forecast to grow at an average rate of 5.5 percent per year. The flow from North America to Asia is forecast to grow 5.4 percent per year over the next 20 years.

The total Latin America-to-North America market for air cargo services is forecast by Boeing to grow 5.2 percent per year between 2013 and 2033. North America-to-Africa flows are expected by Boeing to grow 5.2 percent per year through 2033, driven by continued U.S. and Canadian investment in African extractive industries. Africa-to-North America air trade is expected to grow at the nearly identical rate of 5.1 percent per year, as African light manufacturing develops export markets in North America.

Airbus forecasts air cargo to grow 4.4 percent per year over the next 20 years. According to Airbus, Asia Pacific (including India and the People's Republic of China) today represents 36 percent of the world freight traffic and will grow to 42 percent by 2032. Europe/Commonwealth of Independent States and North America combined accounted for 51 percent of the total traffic in 2012; by 2032 its share will be 45 percent. China is the largest driver of air cargo growth; today it represents 15 percent and by 2032 it will be 22 percent of the global market. Due in part to the expanding middle class in emerging countries, traffic from mature to emerging is the second fastest growing segment of the industry. Airbus predicts that the North American domestic market will grow at 2.1 percent per year, while the U.S.-to-China market will grow at 6.4 percent per year. The North America-to-Europe market is projected by Airbus to grow at 4.3 percent per year.

In the *FAA Aerospace Forecasts, FY 2016-FY 2035*, domestic cargo is predicted to increase at an average annual rate of 1.9 percent in 2016 as the U.S. economic recovery continues after posting a 3.3-percent increase in 2015. Between 2016 and 2036, domestic cargo RTMs are forecast by the FAA to increase at an average annual rate of 0.4 percent. International cargo is projected by the FAA to grow at 6 percent for 2016 and for the forecast period (2016–36), international cargo RTMs are forecast to increase an average of 4.7 percent a year based on projected growth in world GDP with the Pacific region having the fastest growth, followed by the Other International, Atlantic, and Latin regions, respectively.

The freight/express segment of domestic air cargo is highly correlated with capital spending; thus, this segment's growth will be tied to growth in the economy. The share of international cargo RTMs flown by all-cargo carriers increased from 49.3 percent in 2000 to 71.8 percent in 2015. Continuing the trend experienced over the past decade, the all-cargo share of international RTMs flown is forecast by the FAA to increase modestly to 78.1 percent by 2036.

Forecast of Air Cargo for Washington

This section presents the cargo forecasts for Washington by individual cargo hub airport, as well as a summary of cargo activity for the state.

Seattle/Tacoma International Airport

A stated goal for the Port of Seattle in its Century Agenda is to more than double the amount of air cargo it handled at SEA by 2036. Recently the Port of Seattle says it has invested $23 million in two major projects to expand SEA's capacity to handle a growing amount of air freight.

As stated previously, air cargo in Washington State is primarily generated by activity at SEA. Over the past 10 years (2004–2014), air cargo at the airport fluctuated up and down, decreasing at an average rate of 0.6 percent annually. Over the past five years (2009–2014) SEA has averaged a 3.9-percent growth rate in total air cargo tonnage. During 2014, the amount of air cargo handled at the airport increased by 11.8 percent.

Reflecting a national trend, most of the recent growth at SEA has been in international air cargo. From 2004 to 2014, international air cargo averaged a 3.12-percent yearly growth rate and, since 2009, international air cargo has averaged a 7.7-percent growth per year.

Considering the emerging role of SEA's role as a trans-Pacific passenger and cargo hub for Delta Air Lines and surge in new international wide-body passenger and cargo service at the airport, it can be expected that international air cargo tonnages will continue to increase at a rapid rate.

The forecast utilized for SEA was taken from the *Draft Final Technical Memorandum, Forecasts of Aviation Activity, Seattle-Tacoma International Airport*, Prepared for Port of Seattle, dated September 2015 and approved by the FAA, as a part of the SAMP. The forecast is presented in Table 4-26.

Table 4-26: Air Cargo Forecast for Seattle-Tacoma International Airport (metric tons)

Year	Domestic	International	Total
Historical			
2004	267,570	80,004	347,574
2009	195,111	75,105	270,216
2014	210,810	108,680	319,490
Forecast			
2019	219,290	132,250	351,540
2024	230,470	152,540	383,010
2034	254,590	187,280	441,870

Source: Leigh Fisher Associates, SAMP; compiled by Keiser Phillips Associates; Information updated on 10/10/17 based on SAMP data provided by the Port of Seattle.

The resulting SAMP air cargo forecast projects air cargo at SEA to grow to 441,870 metric tons by the year 2034. This forecast represents a combined average annual growth rate of 1.5 percent from 2014 to 2034. It should be noted that the SAMP air cargo forecast must be considered extremely conservative considering the growth of international wide-body passenger service at the airport and the Port of Seattle's policy to "Triple air cargo volume to 750,000 metric tons" as a part of its Century Agenda.

King County International Airport

The forecast of demand for BFI is presented in Table 4-27. Air cargo growth at is projected to grow at 2.5 percent per year over the next 20 years. The two key factors that were considered in the projection of air cargo at BFI were the significant presence of the integrator express traffic at the airport and the expectations of above-average domestic air cargo volumes due to the growth of the e-commerce market serviced by the integrator/express airlines.

Table 4-27: Air Cargo Forecast for King County International Airport (metric tons)

Year	Domestic	International	Total
Historical			
2004	60,501	66,483	126,984
2009	54,727	49,575	104,302
2014	59,047	50,606	109,653
Forecast			
2019	66,994	57,069	124,063
2024	75,797	64,568	140,365
2034	97,027	82,653	179,680
Average Annual Growth (2014–2034)	*2.5%*	*2.5%*	*2.5%*

Source: Keiser Phillips Associates

Spokane International Airport

The forecast of demand for GEG is presented in Table 4-28. Air cargo growth is projected to grow at 2.5 percent per year over the next 20 years. Similar to BFI, the two key factors that were considered in the projection of air cargo at GEG were the significant presence of the integrator express traffic at the airport and the expectations of above-average domestic air cargo volumes due to the growth of the e-commerce market serviced by the integrator/express airlines.

Table 4-28: Air Cargo Forecast for Spokane International Airport (metric tons)

Year	Domestic	International	Total
Historical			
2004	30,787	38,576	69,363
2009	28,624	38,505	67,129
2014	24,149	35,418	59,567
Forecast			
2019	27,632	39,763	67,395
2024	31,263	44,988	76,251
2034	40,019	57,588	97,607
Average Annual Growth (2014–2034)	*2.6%*	*2.5%*	*2.5%*

Source: Keiser Phillips Associates

Washington State Non-hub Airports

Air cargo at the state's non-hub airports is projected to grow at an average annual rate of 1 percent per year. The forecast for Washington State's non-hub airports is presented in Table 4-29.

Table 4-29: Air Cargo Forecast for Washington Non-hub Airports (metric tons)

Year	Snohomish County	Tri Cites	Yakima	Bellingham	Pangborn	Walla Walla	Others	Total
Historical								
2014	13,639	2,855	1,917	1,096	711	2	2,009	22,229
Forecast								
2019	14,335	3,000	2,014	1,152	748	2	2,112	23,363
2024	15,067	3,153	2,117	1,211	786	2	2,220	24,555
2034	16,643	3,483	2,338	1,337	868	3	2,452	27,124
Average Annual Growth (2014–2034)	*1.0%*	*1.0%*	*1.0%*	*1.0%*	*1.0%*	*2.0%*	*1.0%*	*1.0%*

Source: Keiser Phillips Associates

Cargo Forecast Summary

The forecast of air cargo for Washington State is presented above in Table 4-25. Air cargo in Washington is projected to grow at an average annual growth rate of 2.5 percent from 2014 to 2034. Most of this growth will be driven by air cargo activity at SEA. Air cargo activity at smaller non-hub airports is projected to increase at 1 percent per year over the planning period.

CHAPTER 5 – CAPACITY ANALYSIS

5.1 Introduction

A capacity analysis was conducted to measure how well the existing facilities and components associated with Washington airports accommodate aviation activity in the state. Existing airport capacity in Washington was first measured against current (2014) levels of aviation demand. Then the existing airport capacity in Washington was measured against forecast levels of aviation demand, identifying potential capacity constraints or shortfalls across the state through 2034.

Three types of airport capacity were examined as part of the capacity analysis:

- **Airfield Capacity:** The ability of an airport's runway system to accommodate takeoffs and landings without experiencing delays.
- **Aircraft Storage and Parking:** The ability of an airport to accommodate storage of based aircraft in tiedowns and hangars.
- **Air Cargo:** The ability of an airport to accommodate processing of air cargo tonnage using existing facilities.

Topics such as terminal capacity, airport parking capacity, TSA screening, baggage handling, off-airport road networks, and similar topics are outside the scope of this study and are addressed in airport master plans or local jurisdiction plans.

A primary issue of the LATS analysis completed in 2009 was capacity, specifically at Sea-Tac. Since the completion of LATS, the number of aircraft operations and enplanements at Sea-Tac have increased. Based on the forecasts completed by Sea-Tac as part of the SAMP, the number of aircraft operations and enplanements are expected to increase throughout the study period (2035). At the time of this writing, Sea-Tac's SAMP is not complete and the future airfield and terminal capacity of Sea-Tac hasn't been determined. Therefore, the WASP references the results and recommendations of LATS regarding airfield and terminal capacity for commercial air service in Washington State. A brief background of the findings of LATS is covered in the next section of this chapter.

In addition to commercial air service capacity issues, a number of other airports across Washington are expected to experience either airfield or aircraft storage capacity constraints by 2034. These airports are shown in Figure 5-1 and identified in the following capacity discussions.

5.1.1 Capacity Background from LATS

This study provides an updated look at Washington State's aviation system and, as such, builds upon work completed in the previous version of the State's system plan, LATS. It is valuable to revisit the analysis and recommendations from prior work to determine if the analysis continues to be relevant and recommendations appropriate or if updated analyses are needed. The results of the LATS analysis and recommendations for capacity are generally consistent with the results of WASP study, further reinforcing the prior recommendations.

As noted in Chapter 1, LATS was initiated through State legislation that directed completion of a system plan and further analysis in key areas of concern including commercial aviation, as well as four Special Emphasis Regions identified in the legislation – Puget Sound, Southwest Washington, Spokane, and Tri-Cities. As part of the legislated mandate, a ten-member Washington State Aviation Planning Council was appointed to develop recommendations for the state air transport system based on the findings in the LATS. As noted in the legislation, the Council was formed to review several key areas as noted below.

> "• Make recommendations based on LATS I and II findings regarding how best to meet statewide commercial and general aviation capacity needs;
>
> • Determine which regions of the state are in need of improvement regarding the matching of existing or projected airport facilities and the long-range capacity needs within the region;
>
> • Make recommendations regarding the placement of future commercial and general aviation airport facilities to meet future aviation needs;
>
> • Include public input in making final recommendations." [1]

The Council provided a summary of their work completed in July 2009 with the publishing of the "Recommendations of the Washington State Aviation Planning Council". This document is available online on the WSDOT Aviation website. The report provided a number of findings and recommendations. Some of the key findings were:

> "• No immediate capacity constraint exists at any airport in Washington State today.
>
> • Airport forecasts generated in 2006 showed that Sea-Tac International Airport was expected to reach capacity by 2024. However, recent trends including higher passenger load factors and an "upgauging" of aircraft size indicate that the airport may now reach its capacity limits by 2030 or beyond.
>
> • Airside capacity expansion at Sea-Tac International is limited due to physical constraints and no new runways are anticipated.
>
> • Airside and landside capacity for scheduled commercial service is available at other airports in the Puget Sound Area: Snohomish County/Paine Field, Olympia Regional, King County International/Boeing Field and Bremerton National airports, depending on the interest of major airlines.
>
> • Aviation capacity must be preserved, protected and, where possible, enhanced through a number of actions designed to improve operations, technology, safety and integration with the State's transportation system and transportation plans.
>
> • Funding to address critical aviation needs is inadequate to meet these needs.

The key Capacity recommendations outlined in the Aviation Planning Council's report include:

> "1. The State of Washington must take a lead role in addressing its long-term aviation system capacity needs from a system-wide and regional perspective.
>
> 2. Washington State shall place a funding and planning priority on maximizing the efficiency and utility of the existing aviation system before creating new airports.

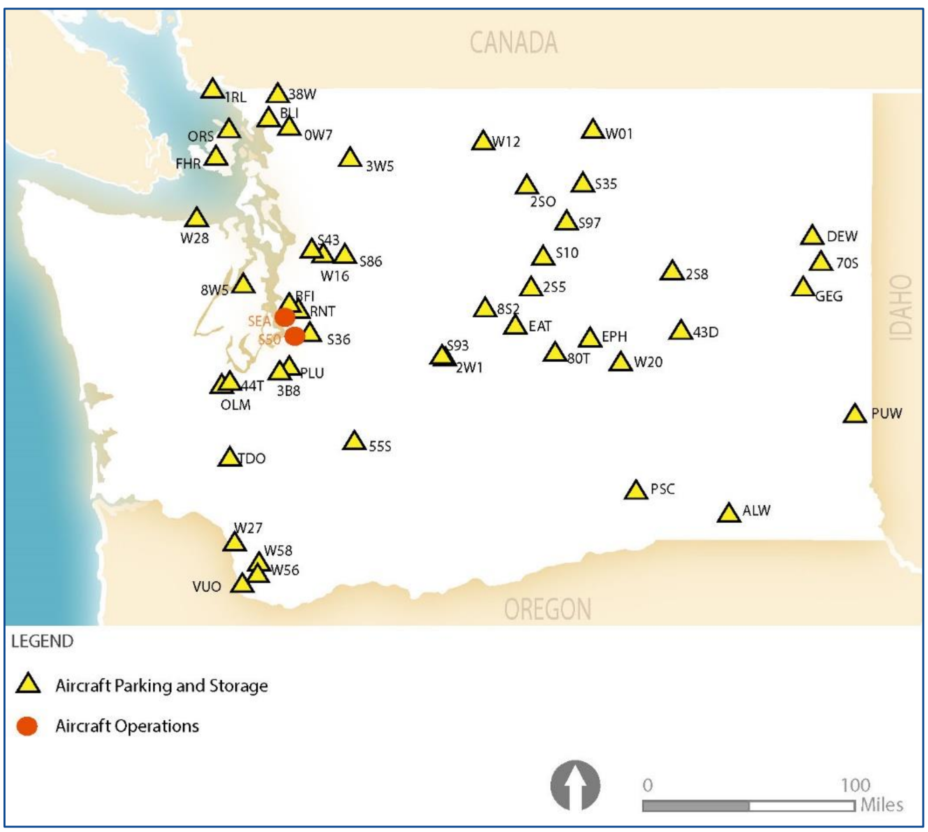
3. If Washington State's existing system cannot provide sufficient aviation capacity to meet existing and future demand and no sponsor has expressed interest, the state will be given the authority to undertake a site selection" [1]

5.2 Airfield Capacity

It is important for the airport system to provide sufficient airfield operational capacity to accommodate current and future demand levels and provide efficient operations throughout the state. By comparing the annual operational demand to an airport's airfield capacity, each airport's current and forecasted demand/capacity ratio is established. This level of evaluation is appropriate for system planning needs, but it is important to note that for most large commercial airports and even some more active general aviation airports, capacity should be evaluated based on hourly conditions and not annual activity.

To examine annual capacity, each airport's annual service volume (ASV) was calculated. ASV is a measure of an airport's ability to process annual operational activity based on airport characteristics, such as airfield configuration and fleet mix. Each airport's ASV was either calculated using the methodologies contained in FAA AC 150/5060-5, *Airport Capacity and Delay*, or obtained from a recent airport master plan. While Seattle-Tacoma International Airport (SEA) was included at this level of analysis as part of the WASP, SEA calculates capacity and demand on an hourly basis (not annual) for its planning purposes in determining needed capacity improvements at the airport.

Figure 5-1: Washington Airports Expected to Approach or Exceed 100-Percent Capacity by 2034



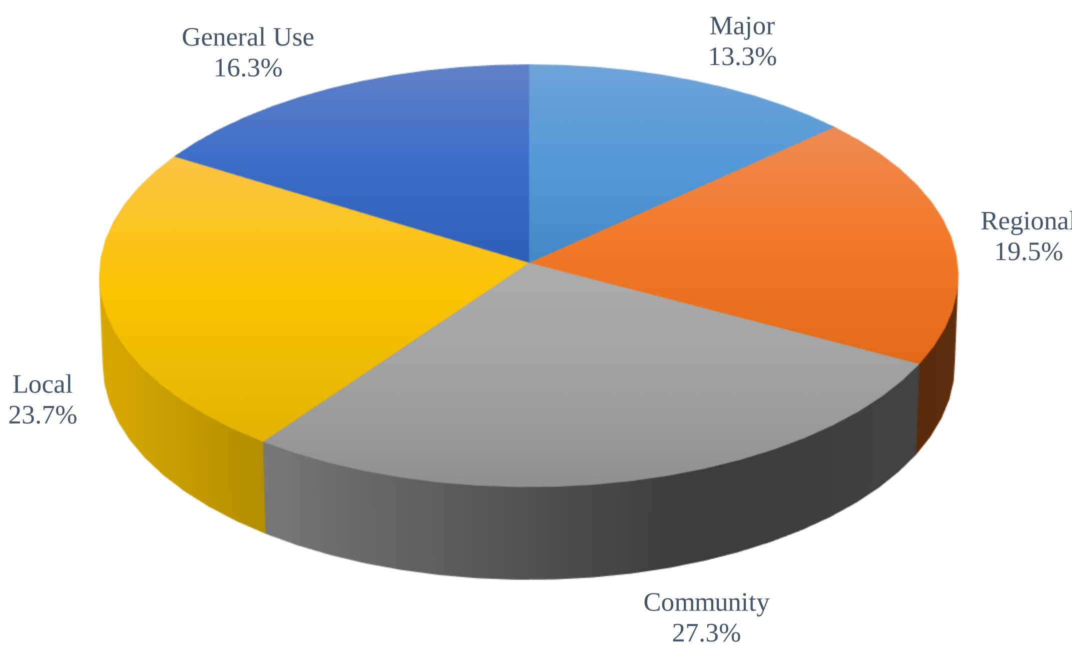
While it is possible for an airport to operate beyond its calculated ASV, aircraft delays will increase as the number of operations rise above the ASV. As delays grow, so do the operating costs of the airlines and aircraft owners, as well as the cost for airport operators. Environmental impacts can also increase, with increased delays leading to increased air and noise pollution due to aircraft waiting to take off or land. Finally, there are potential repercussions for the state airport system capacity as a whole when any airport within the system suffers significant delays.

5.2.1 Serving Current Demand

The public use airports that contribute to statewide operations capacity range widely in size and role. Major and regional airports are typically capable of handling operations by high performance aircraft (airliners, corporate jets, and turboprops), while Community airports typically handle medium- to high-performance aircraft. Local and general use airports accommodate a range of small general aviation aircraft operations (twin- and single-engine aircraft).

A breakdown of 2014 statewide annual service volume operations capacity in Washington by airport service classification is presented in Figure 5-2. Community airports and local airports currently account for the largest portions of state system capacity at 27 percent and 24 percent, respectively. Major and regional airports together represent 33 percent, or approximately one-third of statewide capacity only.

Figure 5-2: 2014 Statewide Annual Service Volume Capacity by Airport Service Classification



Aircraft operations in the state in 2014 utilized approximately 14 percent of overall annual airfield operational capacity. As shown in Table 5-1, the highest utilization was associated with the major and regional airports, where 2014 operations represented 29.5 percent and 27.5 percent, respectively, of overall capacity. Operations at other airport classifications did not exceed 11 percent of overall operations capacity of each category.

Table 5-1: 2014 Operations as Percent of Current Capacity by Airport Service Classification

State Airport Classification	Annual Service Volume	2014 Operations	2014 Operations as % of ASV
Major	3,189,200	940,926	29.5%
Regional	4,675,000	1,286,943	27.5%
Community	6,555,000	707,362	10.8%
Local	5,692,500	212,285	3.7%
General Use	3,910,000	120,766	3.1%
Total System	24,021,700	3,268,282	13.6%

Source: WSP | Parsons Brinckerhoff

While current operations utilize a small percentage of overall state operations capacity, operations and demand are not uniformly distributed among all airports. Airports located in and around the major population and economic centers of Washington, for example, experience the greater demand. Individual airports may face capacity constraints, while other airports have significant excess capacity, a typical dynamic in all states.

The current demand analysis identified three Washington airports where 2014 operations exceeded 60 percent of the airport ASV. The Federal Aviation Administration (FAA) recommends that planning for additional capacity at an airport be initiated when airport operations reach 60 percent of airport capacity. These three airports are listed in Table 5-2. All three airports are located in the highly populated, economically robust Puget Sound region.

Table 5-2: Washington Airports Over 60 Percent Operations Capacity as of 2014

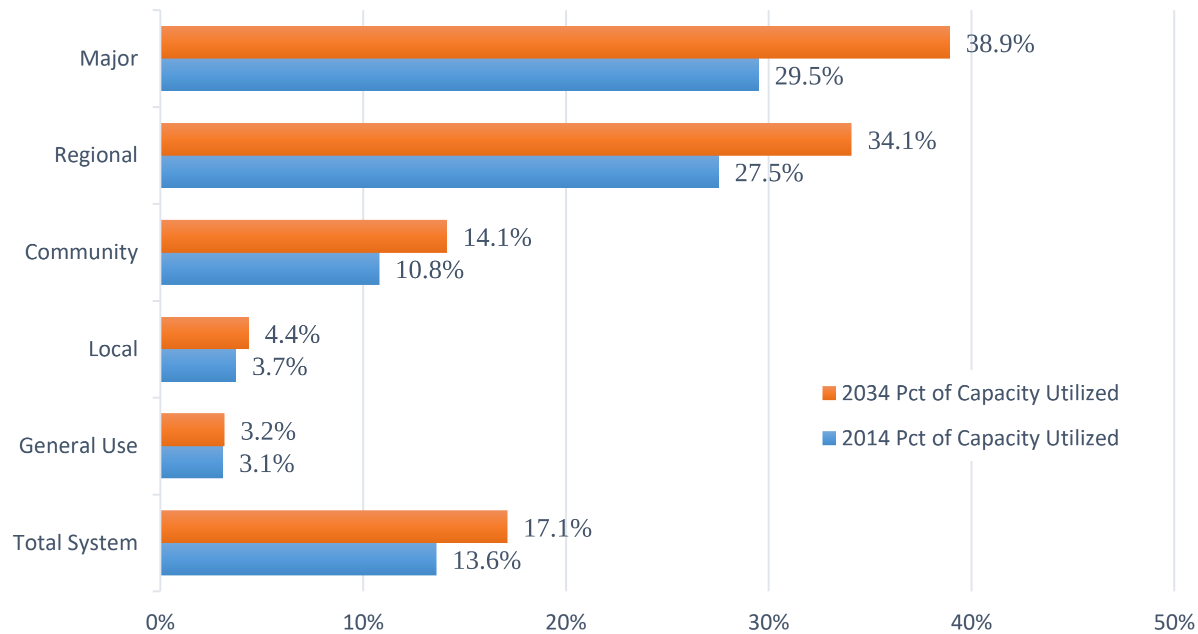
Airport Name	Annual Service Volume	2014 Operations	2014 Operations as % of ASV
Sea-Tac International	533,000	340,078	63.8%
Harvey Field	230,000	141,739	61.6%
Auburn Municipal	230,000	164,539	71.5%

Source: WSP | Parsons Brinckerhoff

5.2.2 Serving Future Demand

Overall aircraft operations demand in Washington is forecast to increase from 13.6 percent of statewide capacity in 2014 to 17.1 percent of statewide capacity in 2034. The greatest operations demand will still be associated with the major and regional airports, as shown in Figure 5-3. By 2034, utilization of overall operations capacity at major and regional airports will reach 39 percent and 34 percent, respectively.

Figure 5-3: 2014 vs. 2034 Aircraft Operations Demand/Capacity Utilization by Service Classification



While future aircraft operations activity remains well below the capacity of the aviation system when viewed from a statewide perspective, capacity constraints affect individual airports where demand is concentrated. Capacity constraints are expected to emerge at six airports in Washington by 2034.

SEA may exceed its airfield operating capacity by 2034 if its current ASV does not change in the future. SEA is currently updating its master plan, including an updated airfield capacity analysis. This analysis was not available at the time of publishing of this report.

Five other airports across the state, as shown in Table 5-3, are expected to reach or exceed 60 percent of operations capacity by 2034—the activity threshold at which planning for adding capacity should commence. The five airports include:

- Auburn Municipal
- Crest Airpark
- Ephrata Municipal
- Harvey Field
- Pierce County | Thun Field

Table 5-3: Airports with Anticipated Constraints in Aircraft Operational Capacity by 2034

Airport Name	ASV	2014 Operations	2014 Utilization	2034 Demand	2034 Utilization
Airports exceeding 100 percent capacity by 2034					
Sea-Tac International[1]	533,000	340,078	63.8%	550,700	103.3%
Airports exceeding 60 percent capacity by 2034					
Auburn Municipal	230,000	164,539	71.5%	220,700	96.0%
Ephrata Municipal	260,000	136,652	52.6%	177,500	68.3%
Harvey Field	230,000	141,739	61.6%	156,500	68.0%
Crest Airpark	230,000	113,880	49.5%	148,200	64.4%
Pierce County | Thun Field	230,000	100,010	43.5%	144,400	62.8%

Source: WSP | Parsons Brinckerhoff

[1] Sea-Tac is currently updating its airport master plan, including an airfield capacity analysis.

The concentration of demand in the Puget Sound region in Washington constitutes the primary capacity issue for the state. Five airports within Puget Sound are expected to either approach or exceed their operation capacity by 2034, including SEA, the busiest airport in the state.

5.3 Aircraft Storage Capacity

Aircraft storage capacity at airports allows for general aviation aircraft to be stored in a location that is both safe and convenient when they are not in use. These general aviation aircraft based in the state are used for a wide variety of purposes, including corporate travel, emergency medical transportation, firefighting capabilities, and search and rescue support. Without adequate aircraft storage at Washington airports, aircraft operators may have difficulty serving particular communities and will not be able to operate in an efficient manner within the state system.

There are generally two types of aircraft storage available at airports: tiedowns and hangars. The decision to utilize either a hangar location or tiedown location is often due to personal preference or cost. Hangar facilities provide an added level of security and protection from the weather but have high leasing costs versus the use of a tiedown position, which have relatively low leasing costs. Larger hangar facilities are often used by corporate aviation to provide a location to base aircraft, conduct business, co-locate additional company services, and provide the regularly scheduled maintenance for aircraft.

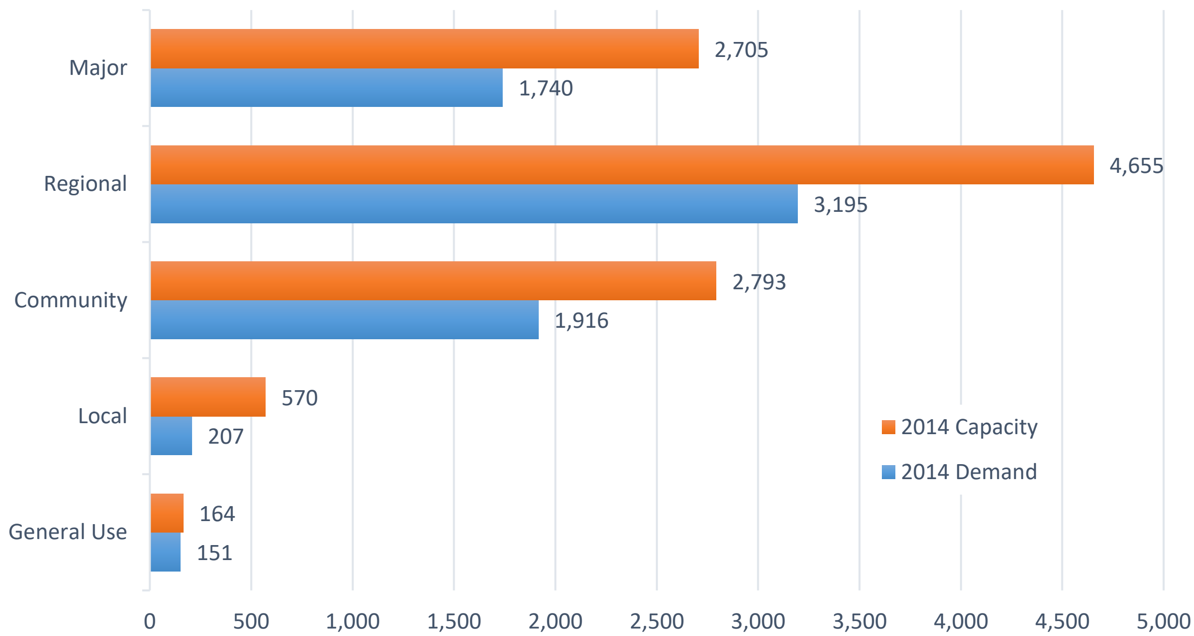
In addition to providing storage for based aircraft at Washington State airports, there is a substantial need for transient storage positions to accommodate visiting aircraft at these same airports. When aircraft fly from one airport to another in the course of completing business in the various communities, maintaining a ramp or apron to park an aircraft for several hours or multiple days is essential for support to aviation users. This is an additional consideration for future airport development.

5.3.1 Serving Current Demand

The existing aircraft storage capacity is comprised of both hangar buildings and aircraft tiedown positions at the public use airports across the state. As of 2014, aircraft storage capacity in Washington State totaled 10,887 positions, of which 3,183 were aircraft tiedown positions and 7,704 were hangar positions.[1]

In 2014, the state airport system as a whole had reached 66 percent of its existing aircraft storage capacity. Aircraft storage at 21 system airports is currently at capacity. Figure 5-4 depicts the 2014 aircraft storage demand and capacity in Washington State by service classification. Figure 5-5 displays the 2014 storage demand and capacity analysis by airport. Table 5-4 displays the current aircraft storage shortfall by airport.

Figure 5-4: 2014 Washington State Aircraft Storage Demand vs. Capacity by Service Classification



[1] For the purposes of the aircraft storage capacity analysis, it was assumed that public and private large hangars identified in the inventory survey contained on average three aircraft storage positions.

Figure 5-5: 2014 Washington State Aircraft Storage Demand vs. Capacity

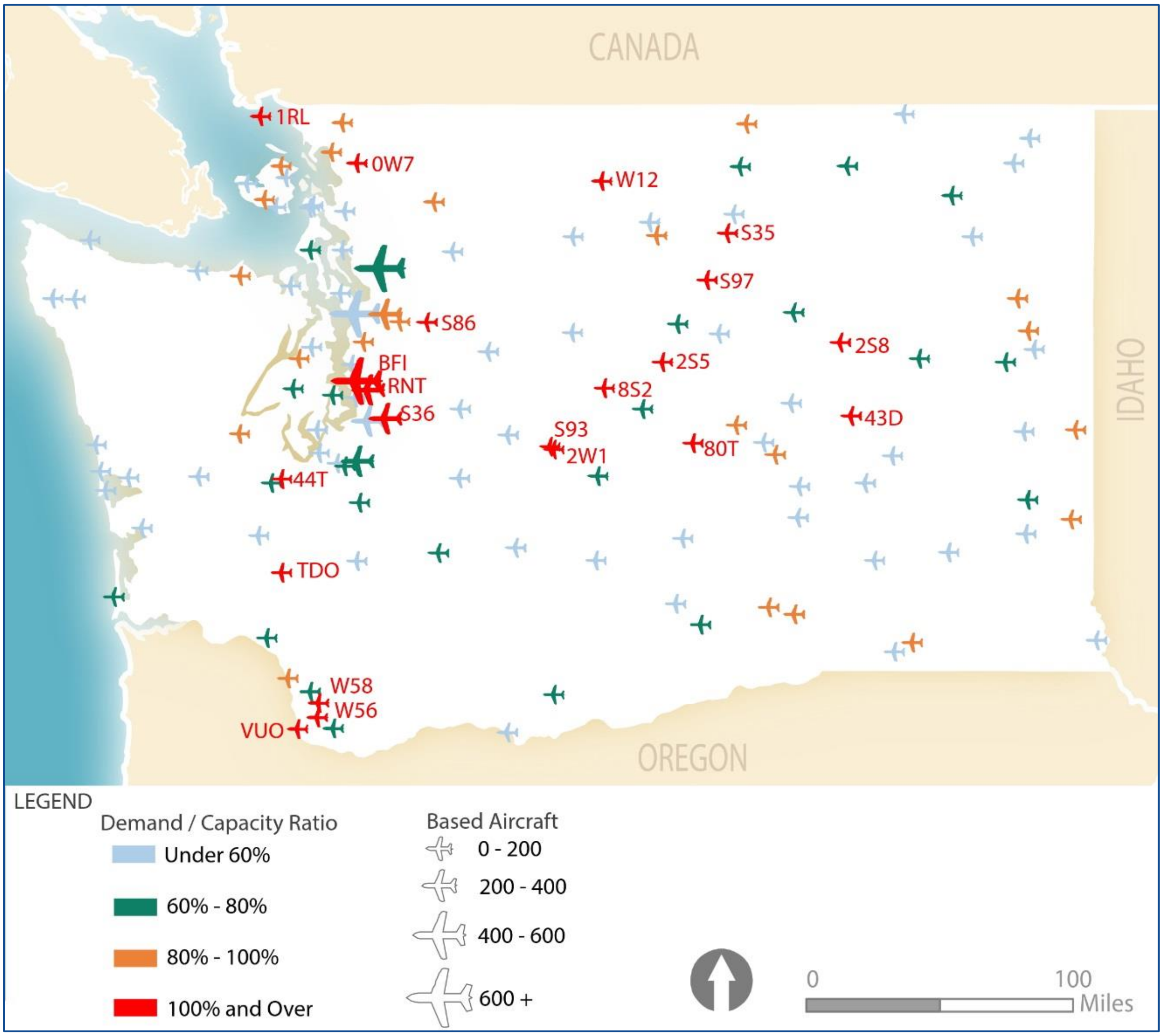


Table 5-4: 2014 Statewide Aircraft Storage Capacity Shortfall, by number of storage positions

Airport Name	Classification	Total 2014 Demand	2014 Capacity	2014 Shortfall
Crest Airpark	Community	332	233	-99
Cashmere Dryden	Community	50	36	-14
Ed Carlson Memorial – South Lewis County	Community	51	42	-9
Point Roberts Airpark	General Use	9	1	-8
Fly For Fun	General Use	12	6	-6
Cedars North Airpark	General Use	8	3	-5
Floathaven SPB	General Use	8	3	-5
Wilbur Municipal	Community	12	7	-5
Lost River	General Use	5	1	-4
Odessa Municipal	Local	11	7	-4
Anderson Field	Community	19	16	-3
Okanogan Legion	Community	18	17	-1
Boeing Field/King County International	Major	418	418	0
Cle Elum Municipal	Local	5	5	0
DeVere Field	Local	5	5	0
Hoskins Field	General Use	8	8	0
Pearson Field	Regional	171	171	0
Quincy Municipal	Local	6	6	0
Renton Municipal	Regional	358	358	0
Sky Harbor	General Use	3	3	0
Waterville	Local	13	13	0

Source: WSP | Parsons Brinckerhoff

5.3.2 Serving Future Demand

Aircraft parking and storage is generally constructed “on demand”; tiedown positions and aircraft hangars are typically only constructed as the demand occurs. Overall storage demand in Washington is forecast to increase by nearly 25 percent by 2034. The greatest increase in demand, on a percent-increase basis, is anticipated to be at community and major airports, increasing by 41.5 percent and 23.7 percent, respectively. Regional airports are anticipated to see increased demand of approximately 18 percent. Local and general use airports are forecast to see the least increase in demand, 2 percent and 3.3 percent, respectively.

Assuming no increase in 2014 aircraft storage capacity numbers, it is anticipated that the overall system would reach a utilization of nearly 83 percent by 2034. While the overall system is projected to have long-term aircraft storage capacity, aircraft storage constraints are expected at individual airports in Washington. Approximately 35 percent (47 of 136) of Washington State airports are expected to have capacity shortfalls by 2034. Figure 5-6 depicts the 2034 aircraft storage demand and capacity in Washington State by service classification. Figure 5-7 displays the 2034 storage analysis by airport. Table 5-5 displays the anticipated aircraft storage shortfall by airport.

Figure 5-6: 2034 Washington State Aircraft Storage Demand vs. Capacity by Service Classification

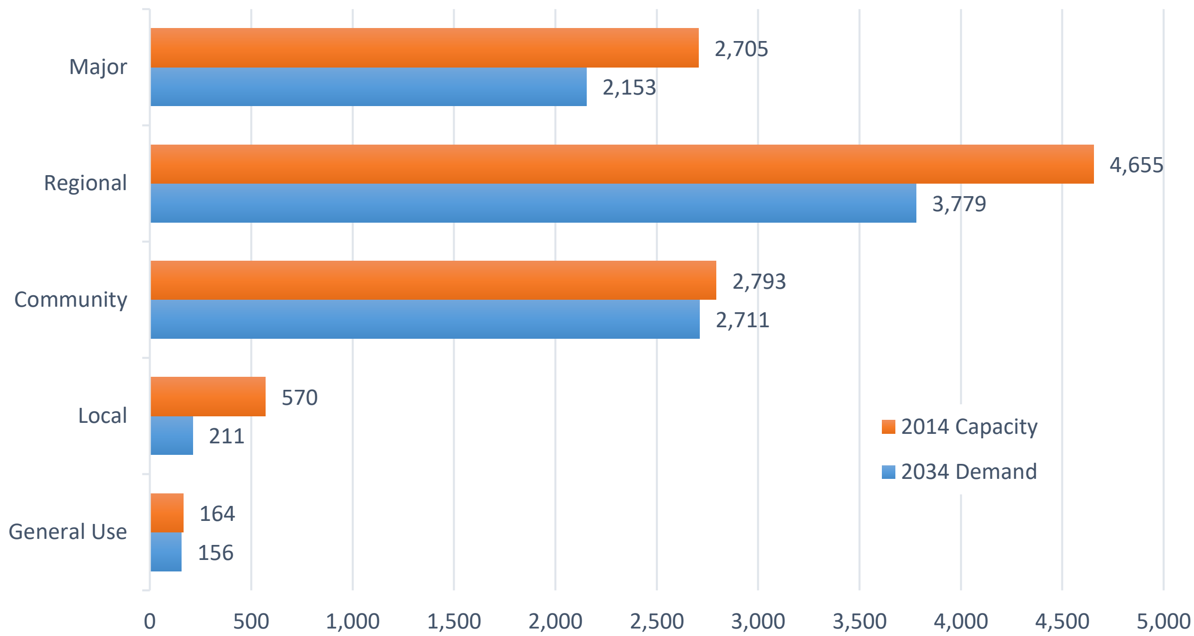


Figure 5-7: 2034 Washington State Aircraft Storage Demand vs. Capacity

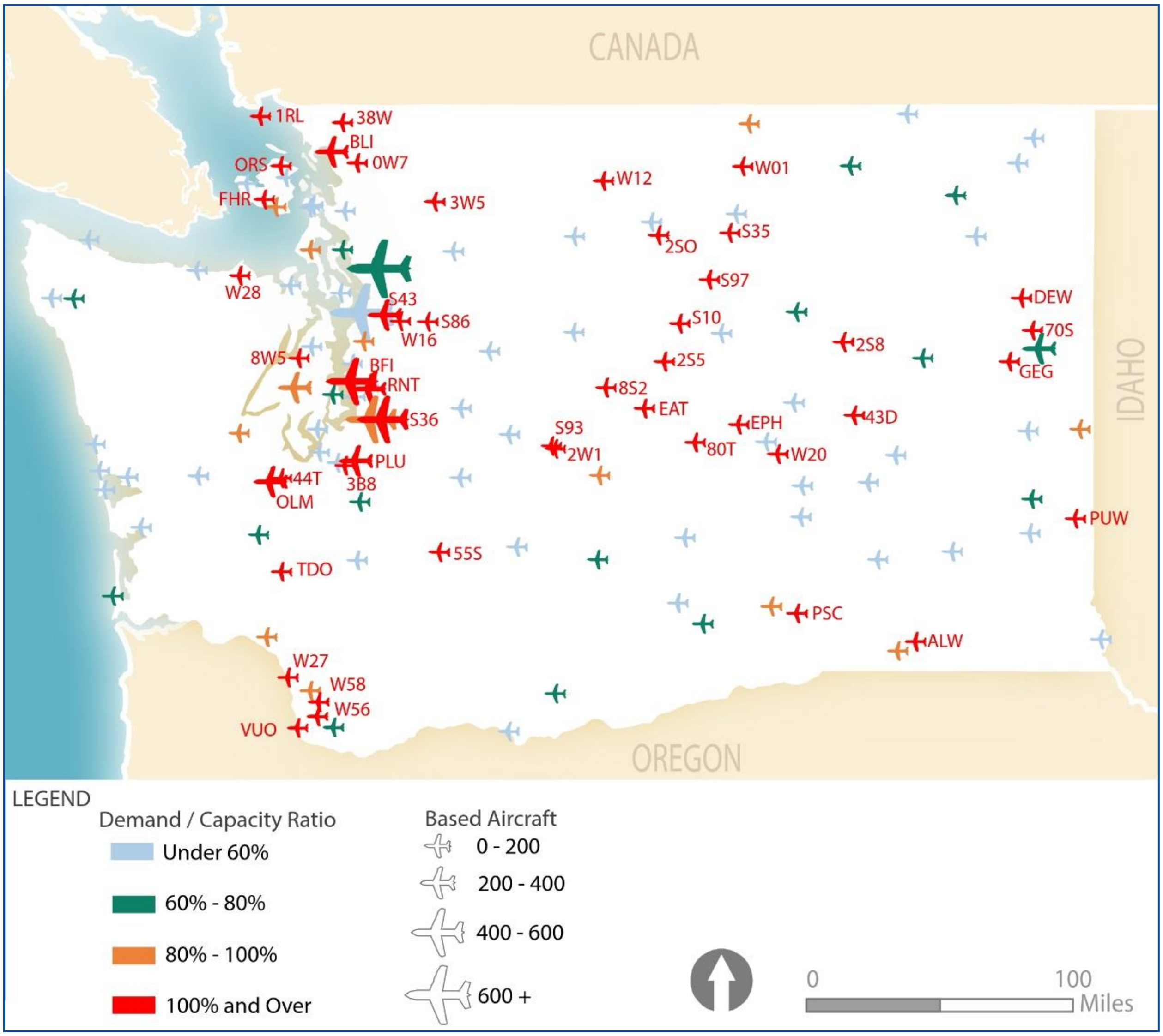


Table 5-5: 2034 Statewide Aircraft Storage Capacity Shortfall, by number of storage positions

Airport Name	Classification	Total 2034 Demand	2014 Capacity	Expected 2034 Shortfall
Crest Airpark	Community	474	233	-241
Bellingham International	Major	295	199	-96
Boeing Field/King County International	Major	499	418	-81
Orcas Island	Community	142	94	-48
Apex Airpark	Community	96	68	-28
Tri-Cities	Major	170	143	-27
Pierce County/Thun Field	Regional	357	337	-20
First Air Field	Community	106	87	-19
Moses Lake Municipal	Community	80	61	-19
Olympia Regional	Regional	206	187	-19
Cashmere Dryden	Community	50	36	-14
Mears Field	Community	66	54	-12
Sequim Valley	Community	50	39	-11
Lynden Municipal	Community	37	27	-10
Walla Walla Regional	Major	145	135	-10
Ed Carlson Memorial – South Lewis County	Community	51	42	-9
Okanogan Legion	Community	26	17	-9
Twisp Municipal	Community	44	35	-9
Point Roberts Airpark	General Use	9	1	-8
Deer Park Municipal	Regional	124	117	-7
Mead Flying Service	Community	30	23	-7
Fly For Fun	General Use	12	6	-6
Woodland State	Community	23	17	-6
Cedars North Airpark	General Use	8	3	-5
Floathaven SPB	General Use	8	3	-5
Friday Harbor	Regional	188	183	-5
Pangborn Memorial	Major	135	130	-5
Renton Municipal	Regional	363	358	-5
Wilbur Municipal	Community	12	7	-5
Lost River	General Use	5	1	-4
Odessa Municipal	Local	11	7	-4
Anderson Field	Community	19	16	-3
Harvey Field	Regional	285	282	-3

Airport Name	Classification	Total 2034 Demand	2014 Capacity	Expected 2034 Shortfall
Pullman-Moscow Regional	Regional	76	74	-2
Shady Acres	Community	50	48	-2
Tonasket Municipal	Community	27	25	-2
Packwood	Local	4	3	-1
Spokane International	Major	75	74	-1
Cle Elum Municipal	Local	5	5	0
DeVere Field	Local	5	5	0
Ephrata Municipal	Regional	80	80	0
Hoskins Field	General Use	8	8	0
Lake Chelan	Community	68	68	0
Pearson Field	Regional	171	171	0
Quincy Municipal	Local	6	6	0
Sky Harbor	General Use	3	3	0
Waterville	Local	13	13	0

Source: WSP | Parsons Brinckerhoff

5.4 Air Cargo Capacity

At the airport level, efficient infrastructure investment translates to the improvement of connectivity, efficiency, cost, and service.

The essential components that are basic to cargo operations include the cargo building for the transfer of cargo from landside to airside, parking and docking to accommodate landside vehicles, and the aircraft ramp for parking aircraft and airside handling of cargo. The cargo building, in addition to acting as a transfer point for cargo passing to and from airside to landside handlers, may also be used for warehousing and storage, container makeup and breakdown, and package sorting operations.

Other facilities related to air cargo may include access roads; truck marshalling areas; aircraft taxilanes and maneuvering areas; and landside offices and warehouse facilities for cargo support groups, such as forwarders, brokers, and national inspection agencies. Configuration and space allotted for access roads, truck marshalling areas, aircraft taxilanes, and aircraft movement areas are site dependent, while landside offices and facilities for cargo support groups are tenant dependent.

5.4.1 Overall Cargo Facilities Planning Concept

Airports and airlines are only a part of a larger eco-system of support services and facilities that comprise the air cargo supply-distribution chain. An airport can be thought of as a key intersection between air logistics and real estate.

Efficient logistics requires strong and visible connectivity made possible through the elimination of as many friction areas as possible. In today's new globally competitive business environment, product obsolescence rates, life cycles, and fast-cycle time inventory models are primary drivers for deciding where to locate today's distribution centers and third-party logistics services. For time-critical deliveries and high-value internationally traded commodities, cost-efficient access to airports and air cargo facilities is increasingly crucial.

Figure 5-8 illustrates a schematic of the relationship between on-airport air cargo activity and second line and off-airport services and facilities.

Figure 5-8: Integrating the Airport with the Community

Due to limited on-airport land availability and higher prices, a significant portion of the air cargo logistics chain activity takes place outside the immediate airport boundaries. However, since transportation costs can be significantly larger than real estate costs, and due to congestion-related uncertainty in travel times, many users of air cargo want to be as close as possible to the airport.

Being close to an airport allows third party logistics providers, particularly freight forwarders, consolidators, and pick-up and delivery services, the ability to dependably offer later drop-off times for shippers to their facilities and provide earlier delivery times to the consignee.

As one moves up the supply chain and closer to the manufacturer, location to the airport becomes less critical.

5.4.2 Washington State Air Cargo Facilities

Air cargo activity in Washington State is highly concentrated primarily occurring at Seattle/Tacoma International Airport (SEA), King County International Airport (BFI), and Spokane International Airport (GEG). Non-hub and small commercial passenger airports within the state account for only 4 percent of the total air cargo volumes moved in 2014. By the year 2034, the market share of air cargo for non-hub airports is expected to shrink to 3.6 percent.

Seattle-Tacoma International Airport

As stated previously, air cargo in Washington State is primarily generated by activity at SEA. Over the past five years (2009–2014) SEA has averaged a 3.9-percent growth rate in total air cargo tonnage. During 2014, the amount of air cargo handled at the airport increased by 11.8 percent.

Based on a Martin Associates 2013 *Economic Impact of the Port of Seattle*, air cargo activity at SEA provides the region a $22.7-billion economic value. It is responsible for 119,685 related jobs, $5.5 billion in wages and salaries, and $520.7 million in state and local taxes. Freighter landing fees at SEA contributed approximately $5.5 million, effectively reducing the cost per enplanement at SEA by $0.29. More importantly, as described in Chapter 2, the air cargo service provided at SEA provides not only Seattle regions, but Washington State and the entire Pacific Northwest with access to both domestic and global markets.

Air cargo facility requirements at Sea-Tac are constrained because of limited amount of land available for development and the significant growth in both passengers and cargo over the past five years. Sea-Tac currently has 14 on-airport cargo warehouses. Thirteen warehouses, interspersed throughout a ramp area on the north end of the airport, primarily serve as “pass-through” facilities. There is also one 58,000-square-foot lower-deck cargo (belly cargo) facility on the southeast side of the airport and 20 cargo area freighter hardstands for widebody aircraft. A capital improvement project, completed in 2015, expanded five cargo aircraft parking areas to accommodate the increasing frequency and use of the Group VI Boeing 747-8 nose load freighters.

Studies conducted as part of Sea-Tac’s 20-year *Sustainable Airport Master Plan* (SAMP) have identified inefficient configuration of existing cargo facilities. As facilities are moved and reconstructed, they will likely be redesign and reconfigured. As previously noted, the Sustainable Airport Master Plan is still in progress, and therefore this WASP study is unable to address or confirm the topics and findings of the SAMP. Readers are encouraged to obtain the most current information on the SAMP from the Port of Seattle Website.

King County International Airport

As a primary gateway for UPS, BFI generates the second largest volume of air cargo in the state of Washington after SEA. In 2014, UPS accounted for 80 percent of the air cargo tonnages at BFI with the next largest air cargo carrier, ABX Air, operating on behalf of DHL, accounting for approximately 12 percent of the 2014 tonnages.

According to the *Draft King County International Airport Master Plan Update* (May 2016), air cargo freight and mail facilities are currently concentrated at three areas along the east side of the airport property. The first area, located in and adjacent to the passenger terminal, is associated with AIRPAC Airlines that leases space in the north end of the terminal building and adjacent apron area. The second cargo area (utilized exclusively by UPS and Ameriflight) is located just south of the terminal and consists primarily of apron area, accommodating parking positions for four large air carrier aircraft and several smaller aircraft, as well as a variety of small storage/office buildings and vehicle parking/cargo transfer areas. The third cargo area is located farther to the southeast (adjacent to the Runway 31R threshold) and consists primarily of apron area, accommodating parking positions for two large air carrier aircraft, as well as a storage/office building and vehicle parking/cargo transfer areas.

Since June 2016, ABX/DHL has moved its air cargo operations from BFI to SEA. The move will reduce the air cargo activity at BFI by about 20 flights per week of Boeing 757 and B767 freighter aircraft.

From a review of the *Draft King County International Airport Master Plan Update (May 2016)* and the *King County International Airport Strategic Plan 2014–2020*, and a comparison of available facilities at the airport, it was determined that there exists sufficient land and runway capacity available to accommodate future air cargo demand at the airport.

Spokane International Airport

Existing air cargo facilities at GEG are located within the terminal area west of Runway 3-21. These facilities include cargo terminals, cargo aircraft apron and weigh scales, administration, freight forwarding and sort building space, landside vehicle access, and parking facilities. Total building space is approximately 61,983 square feet.

A 26,400-square-foot joint-use building accommodating the passenger carriers belly freight is located north of the airport passenger terminal building. The building consists of administrative office space, landside-loading docks, and short-term heated storage areas for each carrier. The building is rectangular in shape with approximate dimensions of 80 feet wide by 330 feet long. A paved area on the immediate southeast side of the building, measuring approximately 80 feet by 320 feet, provides approximately 25,600 square feet for the tugs and dollies transporting belly freight from the passenger terminal and for freight consolidation. A vehicle parking lot, located on the northwest side of the building, measures approximately 125 feet by 320 feet, or 40,000 square feet in area.

Two single-user cargo buildings adjacent to each other are located within the terminal area, northeast of the joint use facility. The larger of the two building is 20,463 square feet, while the smaller is 11,600 square feet with a 3,000-square-foot annex. The area is served by approximately 463,533 square feet of cargo apron.

East of the runways exists over 80 acres of land available for future airside development.

Based on the available resources at GEG, there should not be any issues for the airport to accommodate future air cargo demand.

Non-hub Airports

As mentioned previously, air cargo activity at small commercial service airports in Washington State is generated almost exclusively by FedEx and UPS with very small quantities of enplaned and deplaned belly cargo by Alaska/Horizon Airlines. Belly cargo capacity at smaller airports in the state is limited due to the regional aircraft utilized to serve these markets.

Beyond space for FedEx and UPS airport operations, the need for airport air cargo facilities at most non-hub commercial service airports in Washington State is limited. Air cargo tendered at these airports is typically same day express cargo under 150 pounds in weight. Most of these small packages have limited dwell time.

An exception to this profile is Snohomish County Paine Field. The surge in air cargo at Paine Field in 2014 was generated by special modified widebody freighters as a part of the Boeing Company's 787 airplane manufacturing and assembly program. Origin and destination cities for cargo generated at Paine Field included Anchorage (a trans-Pacific transload point), Charleston, Nagoya, and Wichita. The general cargo demand in Snohomish County is served through SEA and BFI.

5.5 Summary and Findings

SEA dominates the Washington State air cargo market with a mix of domestic and international belly cargo, domestic and international freighter cargo, as well as integrator/express cargo generated by FedEx and DHL.

Air cargo activity at SEA provides the region a $22.7-billion economic value. It is responsible for 119,685 related jobs, $5.5 billion in wages and salaries, and $520.7 million in state and local taxes.

However, the ability of SEA to accommodate and expand air cargo activity, particularly international freighter service, should be closely monitored due to recent, dramatic increases in demand and discussions of expansion of air passenger and maintenance, repair, and overhaul activities.

The analysis found no evidence of constraints to air cargo activity at other Washington system airports.

GEG and BFI are projected to experience moderate growth in air cargo demand and have adequate resources to accommodate future air cargo growth.

Snohomish County, Pasco, Yakima, Bellingham, Wenatchee, Moses Lake, Port Angeles, and Skagit all have relatively small cargo operations and on-site capacity does not seem to be an issue.

CHAPTER 6 – CLASSIFICATIONS AND AIRPORT METRICS

Washington's system of airports supports an array of airport activities, infrastructure, and demand that vary from airport to airport. Airport classifications provide a mechanism to evaluate the system of airports by grouping like airports for purposes of analysis. There are several existing classification systems that exist on the national level, but these systems do not reflect the unique nature of Washington's system, including the high number of airports that are not included in the Federal Aviation Administration's (FAA) system as represented in the National Plan of Integrated Airport Systems (NPIAS). The existing systems were reviewed and a Washington-specific classification system was developed as part of the WASP for use in evaluating system needs and the overall performance of the system.

6.1 FAA Classifications

The FAA utilizes the NPIAS to determine the role and eligibility of funding for airports within the U.S. Of Washington's 136 airports, the FAA has only designated 64 for inclusion in the NPIAS, less than half of the state's system of airports. It is important to note that the FAA updates the NPIAS every two years. The most recent NPIAS (2017-2021) was submitted to Congress on September 30, 2016, well into the progress of the WASP. Therefore, the WASP references the prior 2015-2019 NPIAS.

As depicted in Many of Washington's NPIAS airports are classified by the FAA as GA airports. In 2012, the FAA developed an additional classification system specific to GA airports titled *General Aviation Airports: A National Asset* and referred to as the ASSET Report. In this report, five new categories, which included nonprimary commercial service, relievers, and GA airports, were developed based on several factors focused primarily on the types and levels of existing activity. After the release of the 2012 report, the FAA conducted a second study to further examine its initial airports that were "unclassified." The *2014 ASSET 2: In-Depth Review of 497 Unclassified Airports* report attempted to classify these airports. Of the 497 airports, 212 were classified but 281 remained unclassified. In Washington, 10 airports were initially deemed unclassified, with five of these classified as Basic in ASSET 2. Table 6-2 displays the different categories and their descriptions, as well as the number of Washington airports within each of the classifications.

Table 6-1, airports are classified by the FAA based on the availability and level of commercial service at the airport. For the commercial service airports classified as primary, which include those with more than 10,000 annual passenger boardings, the FAA also uses hub type to further classify airports. Those with less than 10,000 annual passenger boardings are referred to as nonprimary. The airports without commercial service, which are most airports in the U.S., are general aviation (GA) airports; these GA airports are further classified if they are designated as GA reliever airports. A reliever is designated by the FAA to relieve congestion at a nearby commercial service airport. Additionally, an airport may also be considered a cargo service airport if it is served by aircraft providing only cargo services with a total annual landed weight of more than 100 million pounds. All other airports are referred to as GA.

Many of Washington's NPIAS airports are classified by the FAA as GA airports. In 2012, the FAA developed an additional classification system specific to GA airports titled *General Aviation Airports: A*

National Asset and referred to as the ASSET Report. In this report, five new categories, which included nonprimary commercial service, relievers, and GA airports, were developed based on several factors focused primarily on the types and levels of existing activity. After the release of the 2012 report, the FAA conducted a second study to further examine its initial airports that were "unclassified." The *2014 ASSET 2: In-Depth Review of 497 Unclassified Airports* report attempted to classify these airports. Of the 497 airports, 212 were classified but 281 remained unclassified. In Washington, 10 airports were initially deemed unclassified, with five of these classified as Basic in ASSET 2. Table 6-2 displays the different categories and their descriptions, as well as the number of Washington airports within each of the classifications.

Table 6-1. FAA NPIAS Airport Classifications

AIRPORT CLASSIFICATIONS		HUB TYPE: PERCENTAGE OF ANNUAL PASSENGER BOARDINGS	COMMON NAME	WASHINGTON
Commercial Service: Publicly owned airports that have at least 2,500 passenger boardings each calendar year and receive scheduled passenger service	Primary: Have more than 10,000 passenger boardings each year	Large: 1% or more	Large Hub	1
		Medium: At least 0.25%, but less than 1%	Medium Hub	0
		Small: At least 0.05%, but less than 0.25%	Small Hub	2
		Nonhub: More than 10,000, but less than 0.05%	Nonhub Primary	7
	Nonprimary	Nonhub: At least 2,500 and no more than 10,000	Nonprimary Commercial Service	2
Nonprimary (except commercial service)		Not Applicable	Reliever General Aviation	5 47

Source: FAA NPIAS Report 2015-2019

Table 6-2. FAA GA ASSET Airport Classifications

ROLE	DESCRIPTION	WASHINGTON
National	Supports the national and state system by providing communities with access to national and international markets in multiple states and throughout the United States.	1
Regional	Supports regional economies by connecting communities to statewide and interstate markets.	11
Local	Supplements communities by providing access to primarily intrastate and some interstate markets.	20
Basic	Links the community with the national airport system and supports general aviation activities (e.g., emergency services, charter or critical passenger service, cargo operations, flight training and personal flying).	16
Unclassified	Provides access to the aviation system.	5

Source: FAA NPIAS Report 2015-2019

A shortcoming of the NPIAS and ASSET systems is that they do not account for non-NPIAS airports, of which there are numerous airports, seaplane bases, and heliports in Washington State. To be considered eligible for entry into the NPIAS, they must meet entry criteria such as being located at an adequate site, capable of being expanded and improved to provide a safe and efficient airport, and not be located within 20 miles of another NPIAS airport. Additionally, the NPIAS is a nation-wide effort that does not factor in the characteristics and needs of Washington. Section 6.4 discusses the NPIAS and ASSET eligibility in detail as well as evaluates which non-NPIAS airports within the state may be considered eligible for inclusion in the NPIAS.

6.2 WASP Airport Classification Process

Through the review of NPIAS and ASSET classifications, it was determined that Washington needed its own airport classification system that allows for the examination of the entire state airport system in a more consistent and meaningful way. The WASP then examined the prior state classification system developed as part of the 2009 Washington Aviation System Plan. The six classifications from the previous Aviation System Plan are depicted in Table 6-3. The classifications were largely driven by accessibility of the system, while also considering population density and based aircraft within certain driving times, as well as minimum threshold criteria for each classification based on their intended function. These criteria included runway length, based aircraft, or special characteristics such as scheduled passenger service or water landing areas.

Several of these criteria were recognized as being valuable in determining the level of community demand, however, the criteria do not relate to the aviation activities within the state. The WASP examined the criteria and the nomenclature and proposed a new classification process. This process was vetted through the study's Advisory Committee to gain a consensus on the appropriate naming convention and criteria applicable to today's Washington aviation system.

Table 6-3. 2009 WASP Classifications

CLASSIFICATION	# OF AIRPORTS	DESCRIPTION
Commercial Service	16	Accommodates at least 2,500 scheduled passenger boardings per year for at least 3 years
Regional Service	19	Serves large or multiple communities; all NPIAS relievers; 40 based aircraft AND 4,000-foot runway (with exceptions)
Community Service	23	Serves a community; at least 20 based aircraft; paved runway
Local Service	33	Serves a community; fewer than 20 based aircraft; paved runway
Rural Essential	38	Other land-based airport, including residential airparks
Seaplane Bases	9	FAA-identified unless it is commercial service

Source: 2009 Washington Aviation System Plan

The first step in the process was to evaluate the criteria most relevant to determining airport classifications. One specific factor that was determined not to be important to the classification of an airport was whether or not the airport was included in the FAA's NPIAS. The three factors that were determined to be most impactful on the classifications of airports included the following:

- Community demand
- Primary aviation activities
- Critical aircraft

The type and size of the community the airport serves is a driving factor in the success of an airport. Population density ranges dramatically throughout the state and does not allow for precise ranges for classification. The population density within the airport drive times are based on a geographic information system analysis utilizing zip code and U.S. Census tract data.[1] Within the analysis, it is assumed that 20 nautical miles equated to a 30-minute drive time and that the population was dispersed evenly across the zip code.

As the population density has such large ranges, the community is defined in terms of geography, population, and the aviation community for the WASP. Another factor in the community demand for aviation is the number of based aircraft and the surface of the runway, which should support the level of community demand.

The primary aviation activities are important as they indicate the size and type of aircraft that need to be accommodated and services provided relative to the activities. Primary activities at an airport can vary widely and can be based on the infrastructure and amenities available, the local characteristics and needs, and the population density. The impact of each type of activity may not always be quantifiable, but they all provide some level of value to the community. Activities deemed to have a higher impact include air cargo, pilot training, aircraft manufacturing, commercial service, corporate general aviation and business travel, and personal transportation through GA. These activities are more typical in larger communities

[1] Washington State population data – 2010 US Census Data; Washington State retail data – 2007 US Economic Census data; Idaho State population – 2014 ACS 5-Year census tract data; Oregon State population – 2014 ACS 5-Year census tract data.

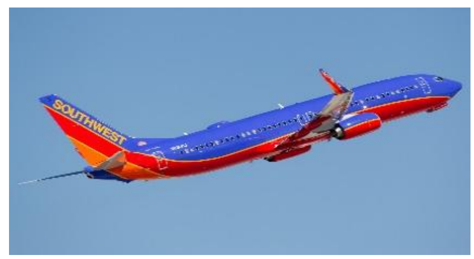
due to the diversity and needs of users for economic viability of the activity. In the case of commercial service, airlines decide which communities to serve unless they are included in the Essential Air Service program of the U.S. Department of Transportation. Airlines consider the population of a community, business activity, and distance from other commercial airports. For air cargo, service is provided at airports based on the flow of goods arriving and departing the airport service area and also consider business activity and distance from other airports where cargo activity is occurring.

Of a lesser impact are more recreational activities, such as skydiving, aerial sightseeing, and aerial photography, as well as scientific research, national security, and agricultural activities. These activities may not require the same infrastructure and population density to support due to their more specialized nature.

Other activities that have an impact to the community include activities related to emergencies such as firefighting, search and rescue, medical air transport, blood tissue and organ transportation, and emergency preparedness and disaster response. Depending on the level of operation, a certain amount of infrastructure may be necessary to support the activity. Medical air transport units may be based at an airport, requiring personal facilities for staff and aircraft storage and fuel. If the airport is just used as a landing site for emergency aviation services when necessary, it may only require a place to land, fuel, and roadway access.

Critical Aircraft is defined by the FAA as the most demanding type of aircraft to conduct at least 500 operations a year at an airport. Based on this aircraft's approach speed to the runway, tail height, and wingspan, an Airport Reference Code (ARC) is assigned and dictates the design standards for the airport. This aircraft is a good indicator of the types of activities that take place or are possible at an airport. It is unlikely airline passengers would be at an airport that is only capable of handling small, light aircraft. Similarly, it is unlikely that these light aircraft are regularly landing at an airport with large commercial jets. Table 6-4 displays the dimensions for the main categories used in the WASP airport classification criteria.

Table 6-4. Airport Reference Code (ARC) Dimensions

ARC	APPROACH SPEED	WINGSPAN	TAIL HEIGHT	EXAMPLE AIRCRAFT
A-I (small)	Less than 91 knots	Less than 49 feet	Less than 20 feet	
B-II	91 to 120 knots	49 to 78 feet	20 to 29 feet	
C-III	121 or greater knots	79 feet or greater	45 feet or greater	

Source: FAA Advisory Circular 150/5300-13A

In addition to evaluating the criteria that are applicable to Washington's aviation classifications, the nomenclature and number of classifications was reviewed. Five airport classifications were identified through work with the Advisory Committee. These classifications include *Major*, *Regional*, *Community*, *Local*, and *General Use*. The naming of these classifications was tied to the size of the community within the airport's service area, whether it is the population, geographic size, or size of aviation community. Table 6-5 presents a summary of the WASP airport classifications, including the naming convention, the associated primary activities, and other factors used in classifying the airports.

Table 6-5. WASP Airport Classifications Summary

CLASSIFICATION	PRIMARY ACTIVITIES	FACTORS TO CLASSIFY AIRPORTS
Major	§ Commercial service § Aircraft or aerospace manufacturing	§ ARC C-III or greater § Primary Activity: commercial service and/or aerospace manufacturing/MRO § Population over 40,000
Regional	§ Corporate GA and travel business	§ ARC B-II or greater § Primary Activity: corporate GA and travel business § Population over 30,000
Community	§ GA-personal transportation/ business and recreational § Pilot training	§ Not metro or regional § Paved primary runway surface § 15 or more based aircraft
Local	§ GA-personal transportation/ recreational § Pilot training § Agriculture	§ Not metro or regional § Paved primary runway surface § Less than 15 based aircraft
General Use	§ GA-personal transportation/ recreational, including backcountry	§ Unpaved primary runway surface (including all seaplane bases)

Source: Parsons Brinckerhoff and Kimley-Horn and Associates

Appendix C, Table C-1 presents a listing of airports by classification, and Table C-2 presents an alphabetical listing of airports by the associated city while denoting the classification. The following provides a more detailed description of each classification.

6.2.1 Major

A *Major* airport services the general population's travel needs through commercial service activities and most likely provides aircraft or aerospace manufacturing. There may be other activities on the airfield such corporate travel, emergency medical, or flight training, but the primary role is commercial travel. As such, the main aircraft will tend to be larger with an ARC C-III or greater and the runways will be paved. The service area population must be a minimum of 40,000 but is more likely between 55,000 and 2.2 million.

There are 10 airports classified as *Major* Airports (all of which are included in the NPIAS) as listed in Table C-1 in Appendix C.

6.2.2 Regional

A *Regional* airport primarily serves as a base for corporate and business travel via general aviation aircraft and commuter passenger service through the airlines. These trips are typically in smaller aircraft, with an ARC of B-II or greater, and may or may not include scheduled commercial airline service. The population must be a minimum of 30,000 but is more likely between 34,000 and 2.1 million.

There are 20 airports classified as *Regional* airports (all of which are included in the NPIAS) as listed in Table C-1 in Appendix C.

6.2.3 Community

A *Community* airport provides a facility for larger scale general aviation activities that are important to aviation, such as business and personal transportation, recreation, and pilot training. There may be fewer corporate flights for business activities than a *Regional* airport, but they will still be active at this type of airport. The typical aircraft serving these activities are ARC A-I (small) to B-II. A *Community* airport serves a population range of 5,000 to 1.8 million. *Community* airports have paved runways and should have a minimum of 15 based aircraft to be included in this classification.

There are 35 airports classified as *Community* airports (18 of which are included in the NPIAS) as listed in Table C-1 in Appendix C.

6.2.4 Local

A *Local* airport primarily serves GA activities such as personal transportation, recreation, pilot training, and agricultural uses. It is like a *Community* airport but has less activity or serves a smaller community. *Community* airports are differentiated by having paved runways with less than 15 based aircraft. The aircraft will be similar in size to a *Community* airport, with an ARC of A-I (small) to B-II. The population served may range from as little as 3,500 to 1 million people.

There are 37 airports classified as *Local* airports (14 of which are included in the NPIAS) as listed in Table C-1 in Appendix C.

6.2.5 General Use

All airports without a paved surface are classified as *General Use*. This classification includes seaplane bases and those airports with turf or other surfaces that are not paved. The same type of aircraft, ARC A-I to B-II, as *Community* and *Local* airport may operate at the airport, but they are primarily for personal transportation and backcountry activities. There are no minimums for population or based aircraft for this classification, but the population can range dramatically from 2,400 to 2.1 million depending on the airport's location.

There are 34 airports classified as *General Use* airports (2 of which are included in the NPIAS) as listed in Table C-1 in Appendix C.

6.3 Airport Metrics

Measuring the system's performance is an important objective of the WASP. In order to measure the system's performance, evaluating each airport's contributions to the system and how each airport impacts the overall system's performance must be determined. The airport classifications allow for the establishment of metrics that are obtainable for the individual airports based on their classification or role and contribution to the system. It is not reasonable to assume that an airport with limited resources and activity should be held to the same standards or performance as an airport with greater resources and significant annual activity. Individual airport metrics can be compiled to evaluate the overall system's performance and determine adequacies, deficiencies, and redundancies.

For the WASP, metrics were developed relative to each system goal category. Some of the metrics are easily quantifiable, such as the pavement condition index (PCI), while others may be actions the airport needs to take, such as analyzing how well the airport meets FAA design standards. Some of the metrics are also important to serve as minimum standards for the system's development, while others are recommended to serve as minimums to strive to achieve.

The following presents the Airport Metrics by goal category, as well as specific metrics associated with each classification.

6.3.1 Aeronautical Airport Safety

Aeronautical and Airport Safety is intended to ensure airports are operating safely and efficiently. The objectives of this goal include attaining and maintaining the WSDOT Performance Objectives and Standards and the FAA Design Standards as well as, more specifically, maintaining safe and clear approaches. Based on this, two metrics derived from FAA Design Standards were established to measure the system's performance of the Aeronautical Airport Safety goal.

The FAA Design Standards facilitate the public interest requirement to develop and maintain a national system of safe, delay-free, and cost-effective airports through publications of advisory circulars and orders. The standards and recommendations represent the most effective national approach for meeting the long-term aviation demand in a manner that is consistent with national policy, with safety being the highest priority. Every effort should be made to bring an obligated airport in line with the existing standards not only for safety purposes but also because federal funding may be dependent on it.

The Obstructions Metric (Table 6-6) includes, at minimum, ensuring the Runway Safety Area (RSA)[2] and the Threshold Siting Surfaces (TSS)[3] are clear of obstructions for all runway ends at all classifications of airports. The target is to ensure that the ultimate approach, whether it is with a runway extension or lower visibility minimums, is also clear so there are no obstructions to the future development. The existing and required dimensions of the RSA and TSS can be found on the airport's Airport Layout Plan (ALP).

Table 6-6. Aeronautical and Airport Safety Metric: Obstructions

CLASSIFICATION	DESCRIPTION	MINIMUM STANDARD	TARGET
I	Major	Clear runway safety area and threshold siting surface for all runway ends	Clear runway safety area and threshold siting surface for all runway ends, and clear obstructions to achieve airport's identified ultimate approach capability
II	Regional	Clear runway safety area and threshold siting surface for primary runway ends	Clear runway safety area and threshold siting surface for all runway ends, and clear obstructions to achieve airport's identified ultimate approach capability
III	Community	Clear runway safety area and threshold siting surface for primary runway ends	Clear runway safety area and threshold siting surface for all runway ends, and clear obstructions to achieve airport's identified ultimate approach capability
IV	Local	Clear runway safety area and threshold siting surface for primary runway ends	Clear runway safety area and threshold siting surface for all runway ends, and clear obstructions to achieve airport's identified ultimate approach capability
V	General Use	Clear runway safety area and threshold siting surface for primary runway ends	Clear runway safety area and threshold siting surface for all runway ends, and clear obstructions to achieve airport's identified ultimate approach capability

[2] The Runway Safety Area is a defined surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot, or excursion from the runway.
[3] The Threshold Siting Surfaces ensure compatibility between nearby objects and the runway's threshold, which is defined as the first part of pavement available and suitable for landing.

The Weather Services Metric (Table 6-7) displays the type of weather systems that should be utilized by the airports based on the classification. Smaller airports, such as *General Use*, *Local*, and *Community*, should ideally have an on-site weather reporting system such as an Automated Weather Observation System (AWOS) or Automated Surface Observation System (ASOS).[4] *Major* and *Regional* airports should have a weather system on-site at a minimum, but ideally also provide an Automated Terminal Information System (ATIS) to pilots. The ATIS provides hourly recorded essential aeronautical information, such as weather, active runways, available approaches, Notices to Airmen, and other pertinent information.

Table 6-7. Aeronautical and Airport Safety Metric: Weather Services

CLASSIFICATION	DESCRIPTION	MINIMUM STANDARD	TARGET
I	Major	On-site weather reporting (AWOS, ASOS)	On-site weather reporting (AWOS, ASOS, ATIS)
II	Regional	On-site weather reporting (AWOS, ASOS)	On-site weather reporting (AWOS, ASOS, ATIS)
III	Community	Not required	On-site weather reporting
IV	Local	Not required	On-site weather reporting
V	General Use	Not required	On-site weather reporting

[4] AWOS are mostly operated, maintained, and controlled by FAA. ASOS are operated and controlled cooperatively by FAA, National Weather Service, and Department of Defense.

The Airfield Geometry Design Standards Metric (Table 6-8) sets the minimum standard for all NPIAS airports to meet FAA airfield geometry design standards. The FAA promotes standards and recommendations to support their policies as promulgated by the United States Code. The FAA-obligated NPIAS airports are required to meet FAA standards and, as appropriate and eligible, can work with FAA to apply for a modification of standard for certain conditions. FAA defines a modification to standard as "any approved nonconformance to FAA standards, other than dimensional standards for Runway Safety Areas (RSAs), applicable to an airport design, construction, or equipment procurement project that is necessary to accommodate an unusual local condition for a specific project on a case-by-case basis while maintaining an acceptable level of safety." The target for NPIAS airports is to meet the FAA design standard for their Airport Reference Code.

In addition, WSDOT plans to develop state standards that best align with the airport classification and the necessary infrastructure associated with the standards. These standards have not yet been established, but if the state standards are greater than FAA standards, all airports would need to comply with state standards. These state standards would be the only ones applicable to the non-NPIAS airports. The target for non-NPIAS airports is to meet the state design standards without modification of standards.

Initially, it is anticipated that WSDOT's state standards will focus on the RSA, widths of runway and taxiways, separation standards, and airspace obstructions. The existing and recommended dimensions of the design standards can be found on the airport's ALP.

Table 6-8. Aeronautical and Airport Safety Metric: Airfield Geometry Design Standards

CLASSIFICATION	DESCRIPTION	MINIMUM STANDARD*	TARGET*
I	Major	Meet FAA/state design standards for Airport Reference Code	Meet FAA/state design standards for Airport Reference Code
II	Regional	Meet FAA/state design standards for Airport Reference Code	Meet FAA/state design standards for Airport Reference Code
III	Community	Meet FAA/state design standards for Airport Reference Code	Meet FAA/state design standards for Airport Reference Code
IV	Local	Meet FAA/state design standards for Airport Reference Code	Meet FAA/state design standards for Airport Reference Code
V	General Use	Meet FAA/state design standards for Airport Reference Code	Meet FAA/state design standards for Airport Reference Code

*Includes Runway Safety Area, runway/taxiway width, runway/taxiway separation standards

6.3.2 Economic Development and Vitality

Economic Development and Vitality ensures the airport is advancing the business opportunities of the airport and its surrounding community. The objectives include supporting and increasing the opportunity of the transportation of goods and passengers utilizing air service, enhancing collaboration between the airport and its community to maintain and support economic growth and development, and increasing tenant revenues by promoting on-airport businesses and aerospace manufacturing jobs.

Table 6-9 sets the recommended minimum and target for the Collaboration with Government Agencies on Economic Opportunities Metric for all classifications of airports in the WASP. The recommended minimum includes collaborating with state and local agencies, such as the local chamber of commerce, economic development commission, or tourism bureau. The target is to have a documented plan and monitor these efforts. Table 6-10 displays a similar metric for Partner with Industry to Support Activities. As with the collaboration on economic opportunities metric, the recommended minimum is to collaborate with businesses to support activities and the target is to document and monitor the efforts for all classifications of airports.

Table 6-9. Economic Development and Vitality Metric: Collaboration with Government Agencies on Economic Opportunities

CLASSIFICATION	DESCRIPTION	RECOMMENDED MINIMUM	TARGET
I	Major	Collaborate with state & local agencies to document economic and qualitative contributions of aviation	Documented plan for collaboration efforts; track and monitor efforts and results
II	Regional	Collaborate with state & local agencies to document economic and qualitative contributions of aviation	Documented plan for collaboration efforts; track and monitor efforts and results
III	Community	Collaborate with state & local agencies to document economic and qualitative contributions of aviation	Documented plan for collaboration efforts; track and monitor efforts and results
IV	Local	Collaborate with state & local agencies to document economic and qualitative contributions of aviation	Documented plan for collaboration efforts; track and monitor efforts and results
V	General Use	Collaborate with state & local agencies to document economic and qualitative contributions of aviation	Documented plan for collaboration efforts; track and monitor efforts and results

Table 6-10. Economic Development and Vitality Metric: Partner with Industry to Support Activities

CLASSIFICATION	DESCRIPTION	RECOMMENDED MINIMUM	TARGET
I	Major	Collaboration with businesses to support airport activities	Documented plan for collaboration efforts; track and monitor efforts and results
II	Regional	Collaboration with businesses to support airport activities	Documented plan for collaboration efforts; track and monitor efforts and results
III	Community	Collaboration with businesses to support airport activities	Documented plan for collaboration efforts; track and monitor efforts and results
IV	Local	Collaboration with businesses to support airport activities	Documented plan for collaboration efforts; track and monitor efforts and results
V	General Use	Collaboration with businesses to support airport activities	Documented plan for collaboration efforts; track and monitor efforts and results

The Air Cargo Activity Report Metric (Table 6-11) provides recommended minimums and targets regarding tracking activity, managing air cargo support services and facilities, and collaborating with other agencies to expand air cargo opportunities based on the classification of airport. A *Major* airport is targeted to collaborate with WSDOT on facility and policy needs related to air cargo, outside agencies for connections to off-airport activity such as an airport logistic park, and track and report cargo activity statistics. Smaller *Community* and *Local* airports should be tracking the activity and discussing needs with WSDOT.

Table 6-11. Economic Development and Vitality Metric: Cargo Activity Reporting

CLASSIFICATION	DESCRIPTION	RECOMMENDED MINIMUM	TARGET
I	Major	Track and annually report air cargo/freight activity (such as number of operations, tonnage, type of freight carried) to WSDOT; manage off-airport resources for air cargo support services (such as cross-dock trucking, warehouse, etc.); examine feasibility of establishing airport logistics parks	Collaborate with WSDOT on air cargo facility and policy needs, and investment strategies, identified as a result of reported activity; collaborate with regional planning and economic development agencies on off-airport resource development
II	Regional	Track and annually report air cargo/freight activity (such as number of operations, tonnage, type of freight carried) to WSDOT; identify off-airport resources for air cargo support services	Collaborate with WSDOT on air cargo facility and policy needs, and investment strategies, identified as a result of reported activity; collaborate with regional planning and economic development agencies on off-airport resource development
III	Community	Track and report air cargo/freight activity (such as number of operations, tonnage, type of freight carried) to WSDOT	Collaborate with WSDOT on air cargo facility and policy needs, and investment strategies, identified as a result of reported activity
IV	Local	Track and report air cargo/freight activity (such as number of operations, tonnage, type of freight carried) to WSDOT	Collaborate with WSDOT on air cargo facility and policy needs, and investment strategies, identified as a result of reported activity
V	General Use	Track and report air cargo/freight activity (such as number of operations, tonnage, type of freight carried) to WSDOT	Collaborate with WSDOT on air cargo facility and policy needs, and investment strategies, identified as a result of reported activity

6.3.3 Education, Outreach, and Community Engagement

Education, Outreach, and Community Engagement is intended to promote aviation and its importance, impact, and activities. The objectives include promoting aviation education to enhance safety and community support, increasing community knowledge of the aviation systems to communicate airport benefit and contribution to local communities and economies, and promoting aviation activities matched to community needs.

The Aviation Outreach and Engagement Metric (Table 6-12) recommends, at a minimum, airports in all classifications have a documented plan to engage the local and aviation community and tourism boards in how to advocate for the airport while supporting the community. The target would be to implement the plan's methods and be able to measure the engagement. Engagement may be in the form of hosting public events, maintaining a website or actively participating on social media, supporting educational programs, or soliciting feedback from the community to ensure its needs are being met.

Table 6-12. Education, Outreach, and Community Engagement Metric: Aviation Outreach and Engagement

CLASSIFICATION	DESCRIPTION	RECOMMENDED MINIMUM	TARGET
I	Major	Documented plan to engage local community, aviation groups, and tourism boards, advocating the airport and supporting the community (host events, websites, educational programs, solicit feedback, etc.)	Implemented methods that provide positive, measurable engagement with the community
II	Regional	Documented plan to engage local community, aviation groups, and tourism boards, advocating the airport and supporting the community (host events, websites, educational programs, solicit feedback, etc.)	Implemented methods that provide positive, measurable engagement with the community
III	Community	Documented plan to engage local community, aviation groups, and tourism boards, advocating the airport and supporting the community (host events, websites, educational programs, solicit feedback, etc.)	Implemented methods that provide positive, measurable engagement with the community
IV	Local	Develop plan to engage local community	Implemented plan that provides positive engagement with the community
V	General Use	Documented plan to engage local community, aviation groups, and tourism boards, advocating the airport and supporting the community (host events, websites, educational programs, solicit feedback, etc.)	Implemented plan that provides positive engagement with the community

6.3.4 Infrastructure Improvement, Preservation, and Capacity

Infrastructure Improvement, Preservation, and Capacity is focused on ensuring the existing system is maintained and improved to handle the current and forecasted capacity. The objectives include providing access for aircraft during all weather conditions, maintaining the facilities to established classification levels, and planning to meet emerging requirements in technology and infrastructure, such as NextGen.

The Physical Condition of Infrastructure Metric (Table 6-13) is based on the industry standard Pavement Condition Index (PCI). Pavement can be assessed following the ASTM Standard D5340, *Standard Test Method for Airport Pavement Condition Index Surveys*. PCI values range from 0 (failed) to 100 (excellent).

Table 6-13. Infrastructure Improvement, Preservation, and Capacity Metric: Physical Condition of Infrastructure

CLASSIFICATION	DESCRIPTION	MINIMUM STANDARD*	TARGET*
I	Major	Runways PCI >70 (AC) or >60 (PCC)	Runways PCI >70 (AC) or >60 (PCC); taxiways PCI>65 (AC) or >55 (PCC); other pavements PCI >60 (AC) or >50 (PCC)
II	Regional	Runways PCI >65 (AC) or >55 (PCC)	Runways PCI >65 (AC) or >55 (PCC); taxiways and other pavements PCI>60 (AC) or >50 (PCC)
III	Community	Runways PCI >65 (AC) or >55 (PCC)	Runways PCI >65 (AC) or >55 (PCC); taxiways and other pavements PCI>60 (AC) or >50 (PCC)
IV	Local	Runways PCI >65 (AC) or >55 (PCC)	Runways PCI >65 (AC) or >55 (PCC); taxiways and other pavements PCI>60 (AC) or >50 (PCC)
V	General Use	Not applicable	Not applicable

*AC = asphalt concrete; PCC = Portland cement concrete

Figure 6-1 provides examples of pavement in poor and good condition. Pavement condition is a major safety component at an airport as it directly impacts the capability of the runway surface to provide a suitable environment for maintaining aircraft directional control. Pavement in poor condition can damage aircraft through prop strikes or foreign object debris being swept up from the ground into an aircraft. It is also important to maintain pavement regularly as repairs become costlier the longer maintenance is deferred. As *General Use* airports are unpaved surfaces, this Metric does not apply to them. *Local*, *Community*, and *Regional* airports should have a PCI of 55 or greater if using Portland cement concrete (PCC) or 65 or greater if using asphalt concrete (AC). *Major* airports have a higher standard of 60 or greater for PCC and 70 or greater for AC. The Target PCIs for runways, taxiways, and other pavement areas are shown in Table 6-13.

Figure 6-1. Example of Pavement Conditions

PAVEMENT IN POOR CONDITION	PAVEMENT IN GOOD CONDITION

Airport Capacity Metric (Table 6-14) recommends that all classifications of airports have the ability to meet their current storage requirements. *Community*, *Regional*, and *Major* airports should ensure they are not exceeding 80 percent of their current airfield capacity. Airfield capacity can be defined as either a measure of maximum sustainable throughput or as the number of aircraft operations that can be accommodated with a specified maximum average delay. Airfield capacity is determined based on the available airfield system and a range of airport characteristics, including the types and numbers of aircraft operations.

Targets for airport capacity include providing storage for future aircraft based on forecasts for all classifications and not exceeding 60 percent of the airfield capacity for *Community*, *Regional*, and *Major* airports.

Table 6-14. Infrastructure Improvement, Preservation, and Capacity Metric: Airport Capacity

CLASSIFICATION	DESCRIPTION	RECOMMENDED MINIMUM*	TARGET*
I	Major	Airfield capacity <80% and sufficient aircraft storage capacity	Airfield capacity <60% and land for future aircraft storage capacity
II	Regional	Airfield capacity <80% and sufficient aircraft storage capacity	Airfield capacity <60% and land for future aircraft storage capacity
III	Community	Airfield capacity <80% and sufficient aircraft storage capacity	Airfield capacity <60% and land for future aircraft storage capacity
IV	Local	Sufficient aircraft storage capacity	Land for future aircraft storage capacity
V	General Use	Sufficient aircraft storage capacity	Area for future aircraft storage capacity

* Airfield Capacity can be either Annual Service Volume or Hourly Capacity

6.3.5 Aviation Innovation

Aviation Innovation is aimed at supporting new technologies and processes related to aviation with objectives in supporting innovation in the aviation system and aeronautics. The primary purpose of this metric is to foster, embrace, and enable aviation innovation through monitoring emerging innovation opportunities, providing support, and communicating the opportunities to engage WSDOT’s support. The recommended minimum for the Integration of Aviation Innovation Metric (Table 6-15) is to track and report on the activities and projects being completed by the airport that support the integration of these innovative projects with an ultimate target of increasing the activities and projects over the years. The activities include fostering and enabling, while infrastructure projects could include ensuring the electrical system is built to a standard that allows for additional navigational aids, constructing natural gas fueling locations for the shuttles, or participating in a research study. By supporting and partnering in the research and advancement of the technologies through industry providers, aviation-related associations, and academia, sponsors can stay informed and potentially be involved in evolving programs.

Table 6-15. Aviation Innovation Metric: Integration of Aviation Innovation

CLASSIFICATION	DESCRIPTION	RECOMMENDED MINIMUM	TARGET
I	Major	Track and report activities and projects that support integration of aviation innovation (NextGen, alternative fuels)	Increase activities and projects that support integration of aviation innovation
II	Regional	Track and report activities and projects that support integration of aviation innovation (NextGen, alternative fuels)	Increase activities and projects that support integration of aviation innovation
III	Community	Track and report activities and projects that support integration of aviation innovation (NextGen, alternative fuels)	Increase activities and projects that support integration of aviation innovation
IV	Local	Track and report activities and projects that support integration of aviation innovation (NextGen, alternative fuels)	Increase activities and projects that support integration of aviation innovation
V	General Use	Track and report activities and projects that support integration of aviation innovation (NextGen, alternative fuels)	Increase activities and projects that support integration of aviation innovation

6.3.6 Modal Mobility, Capacity, and Accessibility

Modal Mobility, Capacity, and Accessibility is intended to ensure the airport is easily accessible by the general public. *Regional* access to airports has been identified as a reoccurring problem across the nation as airports are not always considered in the regional transportation planning process. Objectives include providing adequate ground access to and from the airport, supporting road capacity access initiatives, and supporting and improving multimodal connections. The Ground Access Metric (Table 6-16) recommends a certain level of accessibility to the airport. It recommends ensuring there is adequate parking for users and tenants, ensuring users are able to find their way to the airport when departing and to their destination when arriving through signage, car rental, or multiple modes of public transportation.

Table 6-16. Modal Mobility, Capacity, and Accessibility Metric: Ground Access

CLASSIFICATION	DESCRIPTION	RECOMMENDED MINIMUM	TARGET
I	Major	Collaborate with regional transportation and business partners to reduce delay and provide sufficient road access on key routes, address parking demand, provide adequate directional signage, and coordinate with public transit and transportation for hire	Optimize road access capacity, provide sufficient parking capacity, enhanced directional signage, collaborate with public transit and transportation for hire
II	Regional	Collaborate with regional transportation and business partners to reduce delay and provide sufficient road access on key routes, address parking demand, provide adequate directional signage, and coordinate with public transit and transportation for hire	Optimize road access capacity provide sufficient parking capacity, enhanced directional signage, collaborate with public transit and transportation for hire
III	Community	Collaborate with regional transportation and business partners to reduce delay and provide sufficient road access on key routes, address parking demand, provide adequate directional signage, and coordinate with public transit and transportation for hire	Optimize road access capacity, provide sufficient parking capacity, enhanced directional signage, collaborate with public transit and transportation for hire
IV	Local	Sufficient road access capacity and adequate directional signage	Sufficient road access capacity and adequate directional signage
V	General Use	Sufficient road access capacity and adequate directional signage	Sufficient road access capacity and adequate directional signage

6.3.7 Stewardship

Stewardship is intended to ensure an airport is looking after the long-term welfare of itself. Objectives include protecting the investment by implementing and maintaining planning documents, conducting preventive and corrective maintenance of the infrastructure, and advocating for land-use protection and height hazard zoning.

The Airport Maintenance Metric (Table 6-17) indicates the minimum and targeted standards for the different classifications of airports. Preventive maintenance programs ensure that an airfield is being maintained to the correct standards and regular inspections and investigations conducted. At a minimum, *General Use* airports should maintain the maintenance records but ideally should complete quarterly inspections and complete all routine maintenance. *Local*, *Community*, and *Regional* airports should, at a minimum, perform annual required corrective and preventive maintenance in addition to maintaining their records. *Local* airports should ideally conduct monthly inspections, and *Community* and *Regional* airports should ideally conduct daily and monthly inspections and maintain sponsor-owned facilities in good condition. *Major* airports should meet the federal airport certification regulation Title 14, Code of Federal Regulations, Part 139 maintenance requirements. Each airport works with the FAA to develop an Airport Certification Manual that describes individual airport inspection and maintenance requirements.

Table 6-17. Stewardship Metric: Airport Maintenance

CLASSIFICATION	DESCRIPTION	MINIMUM STANDARD	TARGET
I	Major	Meet Part 139 maintenance requirements	Meet Part 139 maintenance requirements; maintain sponsor-owned facilities in good condition
II	Regional	Annual required corrective and preventive maintenance performed and records maintained	Conduct daily and monthly inspections and implement routine surface management; records maintained; maintain sponsor-owned facilities in good condition
III	Community	Annual required corrective and preventive maintenance performed and records maintained	Conduct daily and monthly inspections and implement routine surface management; records maintained; maintain sponsor-owned facilities in good condition
IV	Local	Annual required corrective and preventive maintenance performed and records maintained	Conduct monthly inspections and implement routine surface management and records maintained
V	General Use	Annual preventive maintenance performed and records maintained	Conduct quarterly inspections and implement routine surface management and records maintained

The Planning Metric (Table 6-18) is based on the type of planning document to be used to guide future airport development. The Airport Master Plan and Airport Layout Plan (ALP) are comprehensive analyses of an airport that ultimately illustrate the short- and long-term development plans to meet the future aviation demand requirements.

ALPs are generally needed for airports with less than 50 based aircraft, lower activity levels, and no unusual activity. As such, *General Use* airports should, at a minimum, to complete an ALP, and, *Local*, and *Community* both an ALP and Master Plan. *Regional* and *Major* airports should have completed a master plan, ideally within the past 5 to 7 years. These documents should be reviewed every 10 years, at a minimum, for applicability to the current goals and conditions of the airport. Additionally, a review of obstructions and survey effort through Airport Geographic Information System (AGIS) should be completed to assist in the national data collection and analysis effort.

Table 6-18. Stewardship Metric: Planning

CLASSIFICATION	DESCRIPTION	MINIMUM STANDARD	TARGET
I	Major	Master Plan (last 10 years)	Review Master Plan (5 years), AGIS Survey/Evaluation (5 years), eALP and update plans as needed
II	Regional	Master Plan (last 10 years)	Review Master Plan (7 years), AGIS Survey/Evaluation (7 years), eALP and update plans as needed
III	Community	Master Plan and ALP	Review Master Plan (10 years), AGIS Survey/Evaluation (10 years), and update plans as needed
IV	Local	Master Plan and ALP	Review Master Plan (10 years), AGIS Survey/Evaluation (10 years), and update plans as needed
V	General Use	ALP	Review Master Plan (10 years) and Obstructions and update plans as needed

The Land Use Metric (Table 6-19) encourages municipalities to address protection of airports and their future improvements in in the future land use, transportation, intergovernmental coordination, and capital improvement program elements of their local government comprehensive plan. This may include adopting land use compatibility and height hazard zoning into the municipal code. Ideally, there should be no new incompatible land uses near an airport and the municipalities work with the airport to promote compatible uses.

Table 6-19. Stewardship Metric: Land Use

CLASSIFICATION	DESCRIPTION	RECOMMENDED MINIMUM	TARGET
I	Major	Airports integrated into local comprehensive and transportation plans, policies and development regulations that discourage development of incompatible land uses within the airport influence area, and adoption of Overlay Zones 1-6	No additional incompatible land uses introduced in airport influence area and promotion of compatible and complimentary land uses
II	Regional	Airports integrated into local comprehensive and transportation plans, policies and development regulations that discourage development of incompatible land uses within the airport influence area, and adoption of Overlay Zones 1-6	No additional incompatible land uses introduced in airport influence area and promotion of compatible and complimentary land uses
III	Community	Airports integrated into local comprehensive and transportation plans, policies and development regulations that discourage development of incompatible land uses within the airport influence area, and adoption of Overlay Zones 1-6	No additional incompatible land uses introduced in airport influence area and promotion of compatible and complimentary land uses
IV	Local	Airports integrated into local comprehensive and transportation plans, policies and development regulations that discourage development of incompatible land uses within the airport influence area, and adoption of Overlay Zones 1-6	No additional incompatible land uses introduced in airport influence area and promotion of compatible and complimentary land uses
V	General Use	Airports integrated into local comprehensive and transportation plans, policies and development regulations that discourage development of incompatible land uses within the airport influence area, and adoption of Overlay Zones 1-6	No additional incompatible land uses introduced in airport influence area and promotion of compatible and complimentary land uses

The Emergency Response Plan Metric (Table 6-20) recommends that airports have an emergency response plan in case an emergency happens at the airport utilizing nonairport first responders. The target is for airports to have a documented plan that demonstrates coordination with the appropriate public service agencies and organizations to react to the different types of emergencies that may occur at an airport.

Table 6-20. Stewardship Metric: Emergency Response Plan

CLASSIFICATION	DESCRIPTION	RECOMMENDED MINIMUM	TARGET
I	Major	Emergency/hazard response plan including support for nonairport emergency response	Fully developed emergency/hazard response plan coordinated with relevant public service agencies and organizations
II	Regional	Emergency/hazard response plan including support for nonairport emergency response	Fully developed emergency/hazard response plan coordinated with relevant public service agencies and organizations
III	Community	Emergency/hazard response plan including support for nonairport emergency response	Fully developed emergency/hazard response plan coordinated with relevant public service agencies and organizations
IV	Local	Emergency/hazard response plan including support for nonairport emergency response	Fully developed emergency/hazard response plan coordinated with relevant public service agencies and organizations
V	General Use	Emergency/hazard response plan including support for nonairport emergency response	Fully developed emergency/hazard response plan coordinated with relevant public service agencies and organizations

6.3.8 Sustainability

Sustainability can mean different things to different people and organizations, but the aviation industry has mainly adopted the “economic vitality, operational efficiency, natural resources, and social responsibility” approach. The objectives of sustainability for WSDOT include reducing environmental impacts, providing an aviation system that is sustainable, and implementing financial sustainability measures.

The Environmental Sustainability Metric (Table 6-21) recommends, at a minimum, that all classifications of airports have a plan in place for waste, air, and water quality management and mitigation, have completed a wildlife assessment, consider future extreme weather/climate resilience, and encourage the use of alternative energy sources. These programs and practices can be implemented into any planning, design, or construction project as well as in an overall Sustainability Plan that outlines the overall goals and objectives of the airport. By connecting sustainability to the other goals at the airport, it is outlining a successful program that is more easily achieved. The target is to track and report on the methods used and achievements, complete a wildlife management plan as needed, and continue to accommodate alternative energy sources and uses.

In terms of resilience, Washington has developed a climate change strategy (available at http://www.ecy.wa/gov/climatechange/2012ccrs/infrastructure.htm). This strategy includes information on infrastructure resilience, addressing the capacity of a system to absorb disturbance and still retain its basic function and structure. Infrastructure resilience is about making the state's transportation system and other infrastructure better prepared to withstand catastrophic events and be able to bounce back more quickly post event.

Table 6-21. Sustainability Metric: Environmental Sustainability

CLASSIFICATION	DESCRIPTION	RECOMMENDED MINIMUM	TARGET
I	Major	Plans for waste, air and water quality management and mitigation and completed wildlife assessment, and encourage consideration of extreme weather/future climate resilience and accommodation of alternative energy sources/uses	Tracking and reporting sustainability methods and achievements; wildlife management plan, as needed; accommodate alternative energy sources/uses through support facilities
II	Regional	Plans for waste, air and water quality management and mitigation and completed wildlife assessment, and encourage consideration of extreme weather/future climate resilience and accommodation of alternative energy sources/uses	Tracking and reporting sustainability methods and achievements; wildlife management plan, as needed; accommodate alternative energy sources/uses through support facilities
III	Community	Plans for relevant environmental sustainability measures and encourage consideration of extreme weather/climate resilience and accommodation of alternative energy sources/uses	Tracking and reporting sustainability methods and achievements; wildlife management plan, as needed; accommodate alternative energy sources/uses through support facilities
IV	Local	Plans for relevant environmental sustainability measures and encourage consideration of extreme weather/climate resilience and accommodation of alternative energy sources/uses	Tracking and reporting sustainability methods and achievements; wildlife management plan, as needed; accommodate alternative energy sources/uses through support facilities
V	General Use	Plans for relevant environmental sustainability measures and encourage accommodation of alternative energy sources/uses	Tracking and reporting sustainability methods and achievements; wildlife management plan, as needed; accommodate alternative energy sources/uses through support facilities

The Land Use Control Metric (Table 6-22) recommends that the airport sponsor control the land use in the Federal Aviation Regulation Part 77 Imaginary Surfaces. Ideally, there should be no incompatible uses in these areas. These surfaces are based on the Safe, Efficient Use, and Preservation of the Navigable Airspace and include horizontal, conical, primary, approach, and transitional surfaces. These surfaces may be found in the ALP drawing set.

Table 6-22. Sustainability Metric: Land Use Controls

CLASSIFICATION	DESCRIPTION	RECOMMENDED MINIMUM	TARGET
I	Major	Land Use Control of Part 77 Surfaces	No Incompatible Uses in Part 77
II	Regional	Land Use Control of Part 77 Surfaces	No Incompatible Uses in Part 77
III	Community	Land Use Control of Part 77 Surfaces	No Incompatible Uses in Part 77
IV	Local	Land Use Control of Part 77 Surfaces	No Incompatible Uses in Part 77
V	General Use	Land Use Control of Part 77 Surfaces	No Incompatible Uses in Part 77

The Financial Sustainability Metric (Table 6-23) is a key topic for many airports as they strive to become self-sufficient or continue to provide their local share of the funds for development projects. At a minimum, all classifications of airports should conduct a business plan to ensure they are choosing development projects that give them the best returns on their investments, charging the correct rates, operating and marketing the airport properly and efficiently, and reviewing additional sources of revenue. Ideally, the business plan would be reviewed every five years and updated as necessary. Additionally, airports should report on the success and failures of the recommendations from the business plan.

Table 6-23. Sustainability Metric: Financial Sustainability

CLASSIFICATION	DESCRIPTION	MINIMUM STANDARD	TARGET
I	Major	Business plan	Review business plan every 5 years and update as needed; report on implementation of recommendations
II	Regional	Business plan	Review business plan every 5 years and update as needed; report on implementation of recommendations
III	Community	Business plan	Review business plan every 5 years and update as needed; report on implementation of recommendations
IV	Local	Business plan	Review business plan every 5 years and update as needed; report on implementation of recommendations
V	General Use	Business plan recommended	Review business plan and update as needed

6.3.9 Summary of Airport Metrics

A summary of all Airport Metrics by goal category according to whether classified as a minimum standard or recommended minimum is provided in Figure 6-2.

Figure 6-2. Summary of Airport Metrics

All Airport Metrics (by Goal)

MINIMUM STANDARDS

Aeronautical and Airport Safety
- *Obstructions*
- *Weather Services*
- *Airfield Geometry Design Standards*

Infrastructure Improvement, Preservation and Capacity
- *Physical Condition of Infrastructure*

Stewardship
- *Airport Maintenance*
- *Planning*

Sustainability
- *Financial Sustainability*

RECOMMENDED MINIMUMS

Economic Development and Vitality
- *Collaboration with Government Agencies on Economic Opportunities*
- *Partner with Industry to Support Activities*
- *Cargo Activity Reporting*

Infrastructure Improvement, Preservation and Capacity
- *Airport Capacity*

Stewardship
- *Land Use Stewardship*
- *Emergency Response Plan*

Sustainability
- *Environmental Sustainability*
- *Land Use Controls*

Modal Mobility, Capacity, and Accessibility
- *Ground Access*

Education, Outreach and Community Engagement
- *Aviation Outreach and Engagement*

Innovation
- *Integration of Aviation Innovation*

6.4 NPIAS Classifications and Evaluation

The FAA's classification system of airports is important from the perspective that airports included in the NPIAS are deemed by FAA to be important to the national system of airports and are typically eligible to apply for federal funding for certain project types. For the most part, the NPIAS has consisted of publicly owned, public-use airports, although in some states there are privately owned, public-use airports that have been deemed important to the state and national systems. Approximately 65 percent of the public landing facilities in the U.S. are in the NPIAS. As part of the WASP, the eligibility criteria for airports not currently included in the federal aviation system were reviewed.

As previously presented, airports are first categorized as primary or nonprimary. Primary airports are the commercial service airports, served by airlines that provide service to the general public with more than 10,000 boardings or enplaned passengers per year (enplanements). These primary commercial service airports are categorized into nonhub, small, medium, or large hub based on the percentage of the passengers they handle annually. Nonprimary commercial service airports serve less than 10,000 enplanements per year.

Due to the different operating characteristics between larger commercial and smaller GA aircraft, GA operations, especially single-engine propeller aircraft, typically prefer and use noncommercial airports to the extent possible. GA airports are considered nonprimary.

Airports that are officially designated to relieve commercial airports from GA traffic are referred to as Relievers in the NPIAS. They must have at least 100 based aircraft or 25,000 annual itinerant operations, provide access to the overall community, and support a metropolitan commercial service airport that has a population of at least 250,000 or has at least 250,000 enplanements and that is operating at least 60 percent of its operational capacity.

To further address the roles and characteristics of GA airports, the FAA developed the Asset Study.[5] The FAA classified all GA airports currently in the NPIAS into groups, including National, *Regional*, *Local*, and Basic, depending on the types and levels of activity. There is also a classification of "Unclassified" for airports for which the FAA could not determine a specific role and that did not meet the established criteria. The new categories were intended to better capture the various functions and contributions GA airports make to their community and the nation overall.

National airports serve national to global markets and have very high levels of jet activity and based aircraft of 200 or more. The *Regional* airports serve regional and some national markets and have high levels of jet activity and based aircraft of 90 or more. *Local* airports supplement communities by providing access to primarily intrastate and a few interstate markets and have low levels of instrument flight rules operations with at least 15 based aircraft. Basic airports serve local to regional markets and have moderate levels of single-engine aircraft activity with based aircraft of 33 or more. The NPIAS airports that could not be classified and were identified as "Unclassified" have lost eligibility for FAA's nonprimary entitlement funding.

[5] General Aviation Airports: A National Asset (ASSET 1 & 2) **http://www.faa.gov/airports/planning_capacity/ga_study/**

6.4.1 NPIAS and ASSET Criteria

To meet the demand for air transportation, per the 2015 NPIAS Report to Congress, the following guiding principles are provided for the airports and the airport system:

- Airports should be safe and efficient, located where people will use them and developed and maintained to appropriate standards.
- Airports should be affordable to both users and government, relying primarily on producing self-sustaining revenue and placing minimal burden on the general revenues of the local, state, and federal governments.
- Airports should be flexible and expandable, able to meet increased demand and to accommodate new aircraft types.
- Airports should be permanent, with assurance that they will remain open for aeronautical use over the long term.
- Airports should be compatible with surrounding communities, maintaining a balance between the needs of aviation, the environment, and the requirements of residents.
- Airports should be developed in concert with improvements to the air traffic control system and technological advancements.
- The airport system should support a variety of critical national objectives, such as defense, emergency readiness, law enforcement, and postal delivery.
- The airport system should be extensive, providing as many people as possible with convenient access to air transportation, typically by having most of the population within 20 miles of a NPIAS airport.

There are more specific criteria to be considered eligible to be included in the NPIAS and subsequently categorized in ASSET for GA airports. The NPIAS criteria for GA airports are outlined in FAA Order 5090.3C *Field Formulation of the NPIAS*, which was reviewed in 2015 by the *Report to Congress—Evaluating the Formulation of the NPIAS*.

NPIAS criteria include the following for an airport:

- Is included in the State Aviation System Plan (SASP) (such as the WASP) or Metropolitan Airport System Plan, and
- Has at least 10 based aircraft (currently or within 5 years), and
- Serves a community located 30 minutes or more average ground travel time (approximately 20 miles) from the nearest existing or proposed NPIAS airport, and
- Is an eligible sponsor willing to undertake the ownership and development of the airport.

Special cases may be made for airports that were previously included in the NPIAS that meet the current criteria, an analysis determines that the benefits of the airport exceed the development costs, serves the needs of native American communities, or supports isolated communities, recreation areas, or important national resources. Cases may also be made for airports that are official airstops for U.S. mail service or have a permanently assigned unit of Air National Guard or reserve component of the Armed Forces.

A public use heliport that doesn't meet the criteria may be included if it is deemed it makes a significant contribution to public transportation and if it has at least 4 based rotorcraft, 800 annual itinerant operations, or 400 annual operations by air taxi rotorcraft.

If a GA airport is eligible for the NPIAS, it would be classified within an ASSET category if it met the minimum criteria:[6]

- At least 10 based aircraft, or
- Heliport with at least four based helicopters, or
- Identified and used by either U.S. Forest Service, U.S. Marshals Service, U.S. Customs and Border Protection, U.S. Postal Service, or has Essential Air Service, or
- New or replacement airport activated after January 1, 2001, or
- Considered remote access (nearest NPIAS airport is at least 30 miles away) or is identified in SASP as remote access, and
- Publicly owned (if privately owned then must be designated as a Reliever with at least 90 based aircraft).

6.4.2 Evaluation

An evaluation of the non-NPIAS airports within the state of Washington was completed based on the above criteria for the NPIAS and subsequent ASSET.[7] There were seven airports identified that may be considered by WSDOT for further study and evaluation, and discussion with FAA, regarding their ability and interest in potential inclusion in the NPIAS. The analysis of potential airports that could be considered for inclusion in the NPIAS is based purely on the criteria; however, it is recognized that through the ASSET classifications, FAA appears to be winnowing the number of airports included in the NPIAS and eligible for federal funding. Coordination with FAA on consideration of NPIAS expansion is warranted based on this analysis. It is also possible that airports may choose to leave the NPIAS as the evaluation of airports continues every two years.

[6] Minimum criteria are an airport classified as “Basic” in the ASSET Report.
[7] A variety of sources were utilized during the evaluation. Airnav.com – Based Aircraft, Fleet Mix, Activation Data, Nautical Miles to airports; Google Maps – Driving distances; SASP – Airport Activities and Based Aircraft forecasts; Washington National Guard – National defense role

CHAPTER 7 – ALTERNATIVE STRATEGIES

7.1 Introduction

Previous chapters of the Washington Aviation System Plan (WASP) created goals, objectives and performance measures; identified the existing system's infrastructure; evaluated emerging issues and the potential for impact to Washington's aviation system; estimated future demand; analyzed capacity constraints; and established a classification system and series of airport metrics. These prior analyses help to formulate needs of the system. To provide further insight and information that can be used in future decision making, alternative strategies were analyzed at the statewide, regional, and airport levels to provide additional data and approaches that can be considered.

Options available to meet Washington's aviation needs

At the statewide level, there are several emerging issues identified as having the potential for significant impact on the statewide airport system. These include the continued growth in unmanned aircraft systems, changes in airspace and FAA's NextGen technologies, and infrastructure funding challenges that continue to impact the health of the overall system. Alternative strategies that can be considered by WSDOT to facilitate and/or enhance the positive impact of these issues on the system and are outlined below.

Regionally, Washington's aviation system is diverse in the composition of airports, the activities served throughout each region, and the level of accessibility afforded by the airports due to regional topography, transportation infrastructure, and services available at airports. The system was analyzed on the regional level to determine redundancies, gaps, and opportunities in terms of capacity, accessibility, and activities that exist in the regions within the state. The regional analysis provides another layer of evaluation that can be used to inform decision making about future airport needs and the options or strategies available to leverage the positive aspects for airport development and support.

Finally, options or strategies available to individual airports in the system were identified. WSDOT recognizes that to have an effective airport system, airports need to leverage their existing capabilities and infrastructure, the aviation activities, and potential emerging issues to maximize their vibrancy, financial sustainability, and functionality. The airport metrics developed as part of the WASP provide a means of measuring how the airports are working toward creating a high functioning element of the entire statewide aviation system. Achieving these metrics will take time and to support their advancement specific strategies or options were identified for airports to consider implementing that can enhance or improve their future.

The following summarize the analysis in each of these three areas and identify potential alternative strategies for future consideration.

7.2 Statewide Alternative Strategies to Support Emerging Issues

As part of the WASP, considerable effort was expended on the evaluation of a wide range of emerging issues and how these issues are impacting and have the potential to affect Washington's future aviation system. In total, eight different issues were studied, four of which included the use of working groups to obtain input and different perceptions of the issues. Of the eight emerging issues, three were identified as having the potential to most significantly impact the state's aviation system in the near-term:

- Unmanned aircraft systems (UAS)
- NextGen implementation
- Airport infrastructure funding challenges

The following summarizes alternative strategies available to WSDOT to support these three emerging issues. These strategies are used to evaluate and inform future policy recommendations to improve the State's airport system and to adequately prepare for the future Washington air transportation system.

7.2.1 Unmanned Aircraft Systems (UAS)

UAS, also commonly referred to as drones, have revolutionized the National Airspace System (NAS) in recent years. Developments in UAS technology and growth in their demand and use in several industries have increased concern due to the current NAS not being tailored to accommodate manned and unmanned aircraft operating in the same environment. The FAA's vision for a modernized air transportation system, referred to as NextGen, has been under development and implementation for many years, with an evolving schedule for full implementation dependent on federal funding and a commitment by system users. However, the initial NextGen system did not anticipate accommodating UAS activity, especially at the levels being experienced and expected to be reached in the next 10 years. For UAS and manned aircraft to operate safely and efficiently in an integrated system within the NAS, continued study is needed that may affect policies at all levels.

Per the FAA's UAS website, "The FAA's vision for fully integrating UAS into the NAS entails UAS operating harmoniously, side-by-side with manned aircraft, occupying the same airspace and using many of the same air traffic management systems and procedures. This vision goes beyond the accommodation practices in use today, which largely rely on operational segregation to maintain systemic safety."

To identify potential statewide strategies to support the safe integration of UAS into the NAS and Washington's aviation system, a working group was established to discuss the wide-ranging issue and provide options for consideration. These options include actions that WSDOT could consider to assist and generally enable safe and effective UAS implementation in the state and are as follows:

- Facilitate a process for establishing GeoFencing and support the development and implementation of a universal standard
- Assist in the development of documentation to address new infrastructure requirements to support UAS ranging from power to hazardous materials disposal and others

- Encourage and promote establishment of zones where UAS activity might be prohibited or regulated for purposes such as safety, noise, privacy or inappropriate use
- Support and facilitate the development, clarification, and/or promulgation of procedures for close-proximity manned and unmanned aviation agriculture operations
- Actively engage the flying public in participation in the "Know Before You Fly" campaign or others that are subsequently developed
- Monitor and evaluate potential development of "droneports" and how these might be integrated into the Washington aviation system, including potential consideration of standards that might be promoted to ensure compatibility with the existing and future aviation system
- Serve as a repository of information for airports and UAS operators, compiling data, resources, and materials to promote the safe operation of drones in the NAS
- Engage in national dialogue on UAS activity on airports related to separating facilities and activities to promote both activities at existing airports
- Utilize existing outreach opportunities to promote awareness, education, and compliance with evolving regulation and standards

7.2.2 NextGen

Initiated in the early 2000s, the FAA has taken major steps to improve the NAS by implementing numerous NextGen initiatives. The full NextGen program, which consists of a series of more than 100 initiatives such as technology programs and procedure changes, profoundly affects the U.S. air traffic system. The implementation of NextGen is a complicated, nationwide process involving the FAA, state departments of transportation, airports, airlines, and individual aircraft operators. Anticipated benefits and effects of NextGen include:

- Flight efficiency and fuel savings
- Fewer delays and improved airport access
- Improved safety
- Environmental benefits (primarily air quality)

While recent implemented elements of NextGen have proven to be successful in terms of an upgrade to the legacy airspace system, in many instances, other areas of aviation have yet to integrate the new technologies and continue to rely on the soon-to-be outdated methods of utilizing the NAS. An important major milestone in the NextGen program occurs in 2020, the deadline for aircraft equipage requirements for operations in Class B airspace. This requirement has a major impact on general aviation aircraft that must have automatic dependent surveillance–broadcast (ADS-B) transmitter.

As part of the WASP, an analysis of how airports in the state are preparing for NextGen implementation was prepared. The analysis documented four key, fundamental elements:

- Wide Area Augmentation System (WAAS)
- Associated global positioning system (GPS) satellites
- FAA satellite-based approach procedures
- WAAS-enabled aircraft instrumentation

WAAS provides horizontal and vertical navigation capability for all phases of flight, including approaches, departures, and enroute operations. Area Navigation (RNAV) is a method of navigation that permits aircraft operations on any desired flight path within the coverage of ground or space-based navigation aids, or a combination of both.

To take advantage of the full benefits of NextGen technology and procedures, airports must have certain infrastructure in place. FAA's requirements may require runway and taxiway widening; parallel taxiways; taxiway relocation; runway and taxiway lighting; and obstruction lighting, marking, and removal. Other actions include airport master plan and airport layout plan updates, obstruction surveys and obstruction removal, and land acquisition for runway safety areas and runway protection zones, approach protection, and acquisition of avigation easements.

Currently, any NPIAS airport can request an improved approach procedure for an airport. All new approaches fall into the NextGen realm, with development of approaches such as Performance Based Navigation (PBN), Required Navigation Performance (RNP), and vertically guided approaches, typically Localizer Performance with Vertical guidance (LPV).

As an alternative, WSDOT can assist airports and the system through an evaluation of the capabilities and needs of the entire statewide airport system, developing a prioritized list of airports for which new NextGen procedures could best benefit the state system. For example, the Puget Sound Regional Council (PSRC) evaluated its regional system needs and worked closely with FAA to determine how NextGen can improve the accessibility of the system. This regional approach is beneficial to the Seattle-Tacoma area, however, this focused effort could be expanded to evaluate the opportunities and needs of the state system. This is especially true for airports that may not meet the FAA's guidelines such as airports that have a lower level of service but the approach is needed for medical evacuation or to serve an area with remote terrain.

WSDOT is engaged at the national level with other states in supporting NextGen implementation that benefits all users, while identifying the challenges that exist in each state specific to their conditions and environment. As part of the WASP, WSDOT Aviation convened a working group to evaluate and discuss NextGen implementation and provide options for consideration. These options include actions that WSDOT could consider to assist with NextGen implementation in the state and are as follows:

- Continue the statewide airports geographic information system (AGIS) project to support NextGen implementation at select airports
- Explore and pursue the streamlining of avionics hardware and software certification to reduce costs for the pilot community and increase the availability
- Pursue legislation addressing geo-fencing and reduce the need for ADS-B in areas where ADS-B is not required
- Work with airport sponsors and the FAA to communicate changes to approach procedures associated with NextGen such as RNAV procedures or others that may impact the communities' perception of the airport
- Partner with education institutions and the aerospace industry to increase the number of individuals in the career field of avionics through marketing and education to meet demand caused by the ADS-B Out rule taking effect on January 1, 2020
- Develop a brochure to educate airport sponsors on how to protect airports from obstructions

7.2.3 Infrastructure Funding Challenges

Airport infrastructure preservation and development is critical to enhance safety and security, and meet capacity demands. Infrastructure preservation and development is an ongoing process that requires large amounts of funding to sustain an effective aviation system and funding challenges continue to be experienced by airports of all sizes. The funding needs are not only for infrastructure, but also day-to-day operational requirements to keep airports running. With constantly increasing costs and sometimes limited resources available to airports, especially for capital infrastructure projects, WSDOT and airport owners and sponsors continue seeking both traditional and innovative solutions to funding challenges.

Challenges and potential solutions for infrastructure funding were studied by WSDOT in the *Airport Investment Study* (also called Phase I, with the subsequent Airport Investment Solutions Study sometimes referred to as Phase II). The study identified thirty-three (33) preliminary solutions to address both funding and non-funding related implementation strategies. The solutions were categorized into the following: New Funding Sources; Refinements of Current Funding Programs; Revisions to Current Funding Sources; and Other Potential Solutions. Of these 33 solutions, ten (10) core study solutions were identified and recommended for performance analyses. These 10 solutions were those that scored highest against a set of screening and evaluation criteria to help ensure the solutions are "feasible, acceptable, suitable, distinguishable and complete." The full *Airport Investment Solutions Study* that documents the 33 preliminary and 10 core study solutions can be accessed at http://www.wsdot.wa.gov/aviation/AirportInvestmentStudy.htm

During the WASP, other funding related challenges were identified such as the inability of current WSDOT Aviation funding to allow for lower priority projects to receive funding and the costs of airport management and maintenance functions for many small airports. WSDOT Aviation convened a working group to further evaluate and discuss aviation infrastructure and other funding challenges and provide additional options and strategies for consideration. The actions identified by the working group and throughout the WASP for WSDOT consideration are as follows:

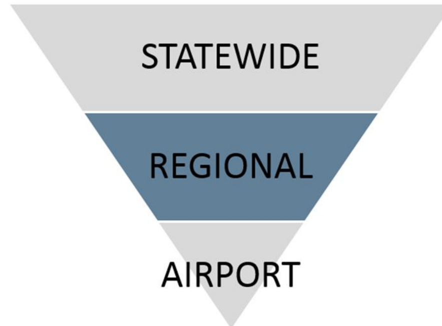
- Evaluate a program related to reduced infrastructure standards for non-NPIAS airports, including vetting optimized infrastructure and safety standards
- Evaluate WSDOT Aviation's current funding project prioritization program to determine if separate "pools" of funding could be set aside to address low priority projects that are unlikely to be funded with the current program, possibly through use of specific functional or regional needs based on the outcomes of the WASP
- Develop interim guidance to airports that are not federally obligated and requests/grants of temporary exemption from standards with an accompanying roadmap or plan for the requesting airport that outlines improvement goals with milestones and benchmarks
- Evaluate opportunities to voluntarily opt out of the aviation system, which could release an airport sponsor from any responsibility to meet state standards and include an accompanying release of eligibility for grants and loans from the state Airport Aid Program
- Support the continuation of the Advisory Committee membership from the Airport Investment Solutions Study or a similar group to continue the momentum developed during the study regarding the importance of finding state funding solutions to assist with the funding needs

- Solidify support from groups such as the Washington State Aviation Alliance (WSAA), Washington Pilots Association (WPA), WAMA, and/or the WSCAA to help lobby the state legislature to vote in favor of legislation that supports one or more of the funding solutions
- Work with airport sponsors to identify aviation-supportive state legislators that could draft and support legislation for solutions that would benefit the airport system
- Build support from aviation-supportive officials to consider development of a task force or work group within the legislature to evaluate the top funding solutions, including consideration of fiscal analysis, that could be used to determine the potential solution that may receive the highest support in the full legislature
- Support implementation of regional airport system commissions or airport authorities or similar recognized organizations that could combine multiple airports under a single administration, association, or partnership to reduce costs to each individual airport sponsor

7.3 Regional Airport Needs and Alternative Strategies

An understanding of the system at a regional level is an important consideration of the WASP's analysis. The regional analysis provides additional data and analysis that indicates if there are areas of the state that are deficient in any key aviation services and metrics, examines the system's redundancies, gaps, and opportunities, and identifies potential strategies or options that may be considered in development of recommendations. The regional evaluations include analysis of the following:

- Capacity – airfield and aircraft storage
- Aviation activities
- System accessibility



Options available to meet Washington's aviation needs

Significant data were necessary to conduct the regional analysis. There were a variety of sources utilized to support the evaluation. Data collected as part of the inventory effort was used to identify the level of aviation activities at each airport. The aviation activities were examined to determine how many airports supported the various activities, indicating redundancies and opportunities in various Washington regions.

Another analysis evaluated airports that provided facilities and services that typical business aviation users are seeking, indicating the locations and accessibility of the system to these users. Specific criteria were established identifying the most critical factors to typical business aviation users and data from the inventory also supported this analysis.

Airfield operational and storage capacities were determined through previous WASP efforts and compared to WASP forecasts to yield a demand to capacity ratio for both airfield capacity and aircraft storage. These capacity analyses were examined on the regional level to determine if there were opportunities for other airports to provide supplemental service or support where deficiencies existed.

Finally, a Geographic Information System (GIS) analysis was used to evaluate the accessibility of the system. Drive times within the various system classifications, as well as coverage and accessibility of commercial air service were developed to determine how well the state's population was served by the system of airports.

These analyses are documented in the subsequent sections.

7.3.1 Capacity Evaluation

Capacity is a critical component of the overall efficiency of Washington's airport system. The ability to provide for and accommodate current and future demand is critical to the overall success of the system. As such, an analysis was conducted to determine which airports in Washington are anticipated to have capacity issues over the next 20 years (through 2034). For this analysis, both airfield capacity and aircraft storage capacity were investigated. Overall, the analysis shows that airfield capacity issues are localized to the metropolitan area surrounding Seattle, while aircraft storage capacity is a bigger issue around the state at numerous airports. The following two sections provide more information regarding the capacity at Washington's airports.

Airfield Capacity

In Chapter 5 of the WASP, annual airfield capacity was analyzed and documented. To examine annual airfield capacity, each airport's annual service volume (ASV) was calculated. ASV is a measure of an airport's ability to process annual operational activity based on airport characteristics, such as airfield configuration and fleet mix. Each airport's ASV was either calculated using the methodologies contained in FAA AC 150/5060-5, *Airport Capacity and Delay*, or obtained from a recent airport master plan. More information on the airfield capacity analysis can be found in Chapter 5.

While Seattle-Tacoma International Airport (SEA) was included in this WASP analysis, SEA calculates capacity and demand on an hourly basis (not annual) for its planning purposes in determining needed capacity improvements at the airport. It should also be noted that SEA is currently undertaking an Airport Master Plan but the capacity analysis was not available at the time of the WASP analysis.

For this study, airfield capacity was analyzed over four thresholds: under 60 percent, between 60 and 80 percent, between 80 and 100 percent, and above 100 percent. The FAA recommends that planning for capacity improvements should start when the 60 percent threshold is passed and that implementation of the improvements should be underway at 80 percent. The WASP analysis shows that in 2034 there will be four airports operating between 60 and 80 percent of their capacity, one airport operating between 80 and 100 percent capacity, and one airport operating above 100 percent capacity. A graphical depiction of this information is provided in Figure 7-1.

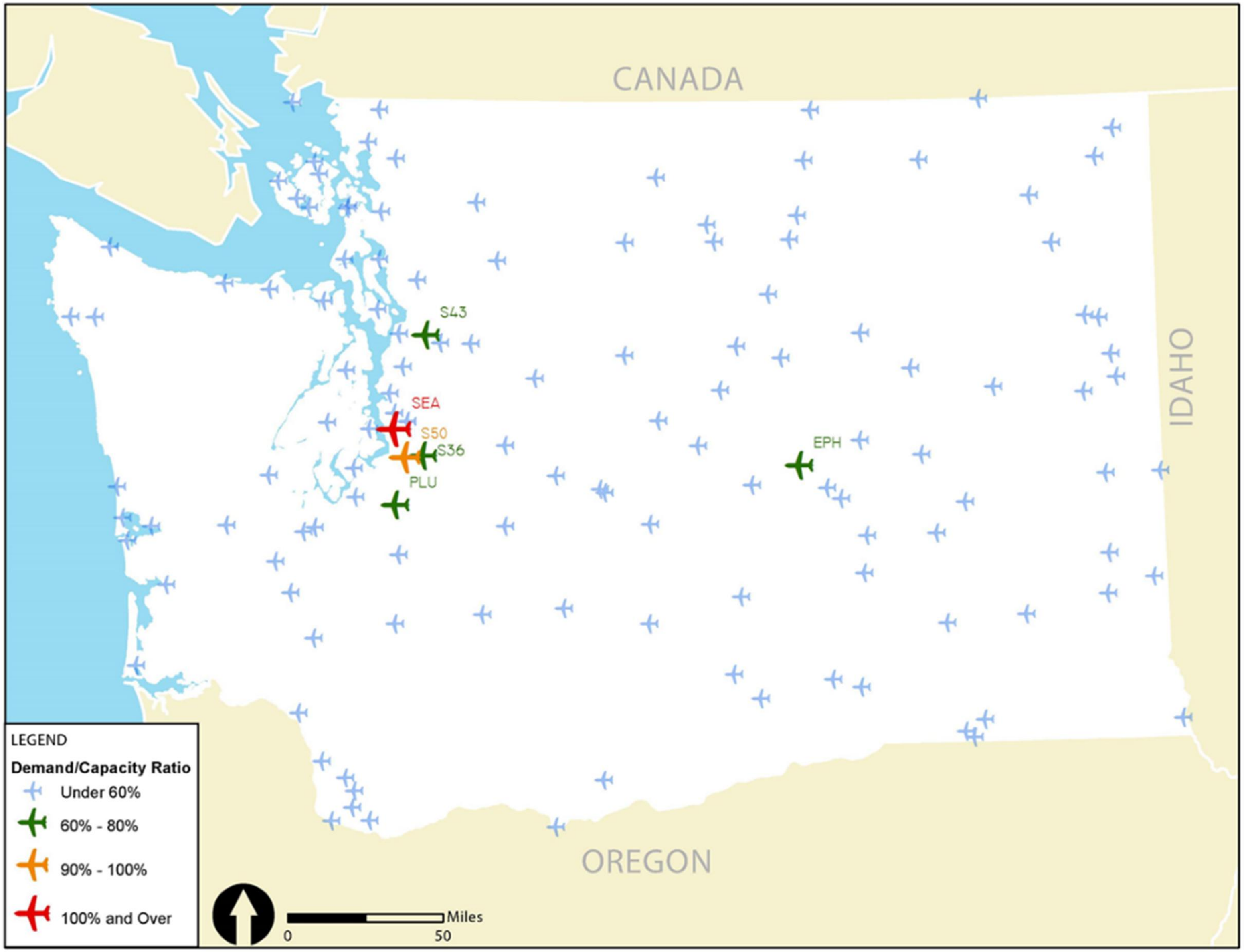
Most of Washington's airports do not appear to have an airfield capacity issue based on the WASP's high level analysis. SEA may exceed its annual airfield operating capacity by 2034 if its current ASV does not change in the future. SEA's Master Plan will include an updated airfield capacity analysis which will document the hourly capacity and any future capacity needs. A summary of airports that were identified to have potential airfield capacity constraints are provided in Table 7-1.

Table 7-1. Airfield Capacity

AIRPORT NAME	ID	CAPACITY RATIO
Sea-Tac International	SEA	103%
Auburn Municipal	S50	96%
Ephrata Municipal	EPH	68%
Harvey Field	S43	68%
Crest Airpark	S36	64%
Pierce County | Thun Field	PLU	63%

Source: WASP analysis.

Figure 7-1. 2034 Airfield Capacity Constraints



As shown in Figure 7-1, of the six airports with demand to capacity ratios estimated to be over 60 percent in 2034, five are in the WSDOT Northwest Region of the state, with only Ephrata Municipal located outside of the Puget Sound region. This concentration of airports with capacity constraints in the largest metropolitan area in the state is of concern. Providing sufficient capacity in the region is of critical importance to ensure the continued interest in development of the region and population growth, with aviation supporting the region's development.

To mitigate against the potential issues that can be caused by having a concentration of airports that have capacity-related delays, options should be considered for how to best address these issues on a regional basis. There are three options that are typically evaluated to address operational capacity deficiencies:

1. Do nothing
2. Infrastructure improvements
3. Use of "reliever" facilities

The do-nothing scenario assumes airports will not take any actions to improve capacity or reduce delay, and that delays will be accepted or demand will naturally adjust. The adjustment could be a relocation of activity to less congested facilities. It is also possible that users will operate at different times or operate less frequently.

Infrastructure improvements could include several developments that could relieve congestion at an airport. Examples include building a new runway and/or taxiways or improving the instrumentation abilities such as improved approaches. Another potential option could be development of an air traffic control tower for non-towered airports, however, this option has a low probability in the current environment. Future use of remote air traffic control does present an opportunity, but a timeline for the conclusion of the pilot program and actual implementation of remote towers has not yet been established.

Depending on the airport experiencing the capacity constraint, other airports could be considered "alternative" either officially by the FAA or just recognized as facilities that could be used by operators that are in proximity to the airport with the capacity issue. The use or reliance on reliever airports to provide capacity relief cannot be mandated and typically has been used to relieve general aviation demand from commercial service airports.

Similar to reliever airports, when the capacity issue exists at commercial service airports, development of commercial service at other airports has also been promoted to offer alternatives to passengers. Many large metropolitan areas have several commercial service airports that provide alternatives and act as a system. Some of the systems are operated by a single entity while others are operated independently with each airport looking to serve different niches either within the industry or the region being served.

Given that the most significant operational capacity concerns identified in the WASP are in the Seattle region and that there is a mix of commercial and general aviation capacity constraints, a more thorough capacity study is needed to evaluate the issues and opportunities available in the region.

Aircraft Storage Capacity

Being able to serve airport users with facilities that meet their needs is an important aspect of the Washington airport system. An analysis of aircraft storage capacity was completed to evaluate needs of the airports and to examine the capacity constraints on a regional basis. For purposes of the WASP analysis, aircraft storage was measured by looking at the ratio of the number of based aircraft forecast at each airport in 2034 as a percentage of the existing available storage spaces at each airport. Four thresholds were used to determine the storage capacity concerns: under 60 percent, between 60 and 80 percent, between 80 and 100 percent, and above 100 percent. As shown in Figure 7-2, the WASP analysis shows that Washington will have a significant shortage of aircraft storage capacity by 2034. In total, there will be 56 airports that are anticipated to have capacity issues by 2034, defined as having a ratio of greater than 80 percent of their available storage capacity utilized by projected based aircraft. Of these, 47 airports are estimated to be over 100 percent capacity for aircraft storage and 11 airports between 80 and 100 percent of existing available storage capacity. In addition, 15 airports are estimated to have a storage demand to capacity ration between 60 and 80 percent (see Table 7-2). These anticipated aircraft storage limitations are spread across all WSDOT regions and affect airports of all sizes. More specifically, the WSDOT Northwest Region is showing the most instances of storage issues (18) while the Olympic and South Central WSDOT Regions reported the least (nine) (see Table 7-3). More information on the airfield capacity analysis can be found in Chapter 5.

Table 7-2. 2034 Aircraft Storage Capacity

CAPACITY RATIO	NUMBER OF AIRPORTS
Under 60 percent	62
Between 60 and 80 percent	15
Between 80 and 100 percent	11
Over 100 percent	47

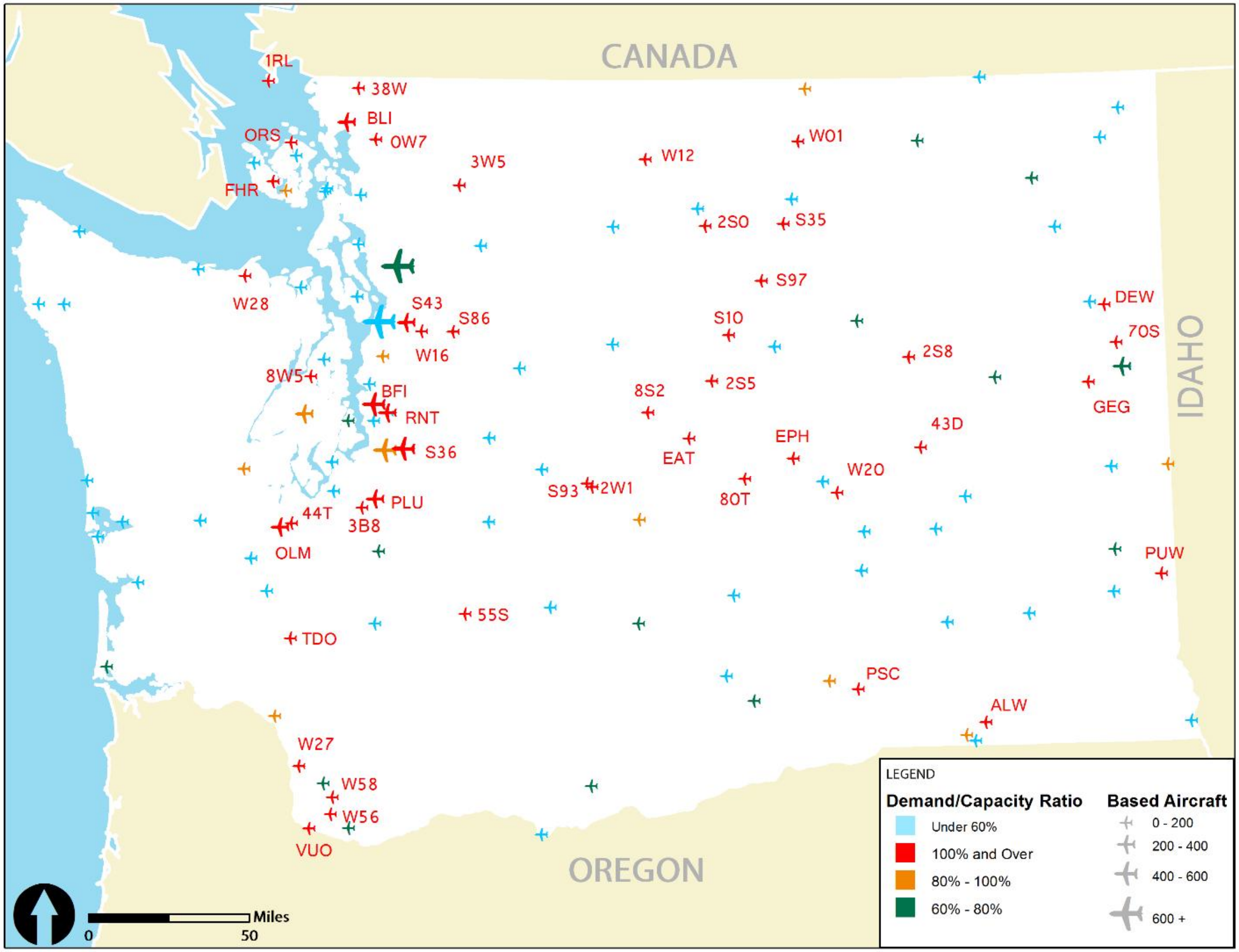
Source: WASP analysis.

Table 7-3. Airports Over 60 Percent Capacity by Region

WSDOT REGION	NUMBER OF AIRPORTS OVER 60% CAPACITY
Eastern	12
North Central	14
Northwest	18
Olympic	9
South Central	9
Southwest	11

Source: WASP analysis.

Figure 7-2. 2034 Aircraft Storage Capacity



The airports that are expected to be over 60 percent capacity are comprised of the following airport classifications:

- Major – 7 airports (70 percent of all Major airports)
- Regional – 15 airports (75 percent of all Regional airports)
- Community – 29 airports (83 percent of all Community airports)
- Local – 12 airports (32 percent of all Local airports)
- General Use – 10 airports (29 percent of all General Use airports)

As shown, a significantly higher percentage of Community, Regional, and Major airports are expected to experience a storage capacity deficiency by 2034. Focusing storage capacity solutions at these airports may help to assist in mitigating this potential future issue. Consideration should be given to planning and providing for storage facilities to be developed around the state and specifically at airports expected to experience over 100 percent of their existing operational capacity. Currently, there are two options for addressing the aircraft storage capacity issues that are anticipated in 2034:

1. Do nothing
2. Develop additional storage facilities

Under the do-nothing scenario, the market would dictate people's choices and those that wished to use aircraft storage facilities would find a location that had availability, or if they were considering a new aircraft purchase, they may not proceed with the purchase until adequate storage was located. This might also mean that some aircraft owners would not obtain the type of storage they desire (such as a T-hangar or conventional/box hangar) or others may drive further than they want to find acceptable facilities.

Airports typically do not build storage facilities until demand warrants due to the cost of development and ensuring a return on the investment. The WASP analysis is more of a high-level evaluation and was conducted to determine if there were specific regions of the state where storage facilities were likely needed to serve future demand. Airport master plans may identify potential storage needs, but are typically looking only at the individual airport's needs, not at a regional level.

Capacity Summary

The regional evaluation of both operational and storage capacity provides WSDOT and all the airports with information that could be useful in determining need to address operational capacity deficiencies and the opportunities for development of additional storage.

In terms of operational capacity, the analysis revealed that in 2034 there will be four airports operating between 60 and 80 percent of their capacity, one airport operating between 80 and 100 percent capacity, and one airport operating above 100 percent capacity (SEA). At the statewide level, it does not appear that Washington has major airfield capacity concerns; however, SEA is the primary commercial service airport in the state and is reporting a demand capacity ratio of 103 percent in 2034. Several of the other airports in the Seattle region also are expected to experience capacity constraints, indicating the need for a more thorough capacity study to evaluate the issues and opportunities available in the region.

For storage capacity, considerations such as current airport hangar waiting lists, available developable land, and funding are all critical elements of each airport's decision-making process when determining if additional storage will be sought. The WASP analysis provides further input into this process by showing that in some regions, aircraft storage deficiencies are anticipated and that even though an individual airport's current waiting list may not reveal high demand, within the region there may be opportunities to attract additional aircraft if storage were provided. Each airport needs to evaluate the opportunities, constraints, and regional marketplace to make the best decision regarding developing new storage facilities.

An important issue for WSDOT is examining funding options that might be available to assist airports who desire additional storage but do not have the resources to construct the facilities.

Because funding can be difficult to obtain, options for different funding programs must also be considered. Options include a revolving loan program could be established through the State, public private partnerships, aviation clubs, or other similar ventures.

7.3.2 Activity Evaluation

Washington's airport system supports a wide variety of aviation activities that play an integral role in supporting numerous industries across the state. As part of WSDOT Aviation's Economic Impact Study, 17 aviation activities were identified that provide "value to users". The 17 activities include:

- Commercial passenger service
- Business and corporate travel
- Personal transportation
- Pilot training and certification
- Air cargo
- Blood, tissue, and organ transportation
- Medical air transport
- Search and rescue
- Firefighting
- National security
- Emergency preparedness and disaster response
- Aircraft manufacturing
- Agriculture
- Scientific research
- Aerial photography
- Aerial sightseeing
- Skydiving

All activities are not accommodated at every airport and some airports only focus on one or two activities. The activities also have some linkages such as air cargo and commercial passenger service due to the type of aircraft that are operated and the facilities that these operators require. Others such as scientific research, aerial photography, national security, and blood, tissue, and organ transportation do not require a specific type of aircraft and can be supported at nearly any size airport, depending on the user's needs.

An activity such as commercial passenger service is a critical activity in the state, however, airlines decide where to provide this service and airports have a limited opportunity to influence this activity (other than by providing a subsidy to attract an airline).

Of the 17 activities (and not including commercial passenger service), five were identified as having a significant impact on airport facility needs and serving the economic needs of the state, including:

- Agriculture
- Pilot training and certification
- Business and corporate travel
- Air cargo
- Aerospace manufacturing

The evaluation of where the activities are supported throughout the system helps to identify where potential redundancies, gaps, and opportunities in new activities or services may exist. To determine this, a GIS analysis was conducted to determine the number of airports that support high levels of certain activities in each WSDOT region. WSDOT regions are available online at http://wsdot.maps.arcgis.com/home/index.html.

The analysis provided below summarizes the activities that airports self-reported during the WASP inventory survey. It should be noted that data provided below is self-identified by the airport and responses were provided as either "yes" or "no." Therefore, the quality and level of activity is not known. For reference, the number of airports in each WSDOT region is provided in Table 7-4.

Table 7-4. Number of Airports by Region

WSDOT REGION	NUMBER OF AIRPORTS BY REGION
Eastern	21
North Central	24
Northwest	36
Olympic	25
South Central	16
Southwest	14

Source: WASP analysis.

The analysis revealed that across all WSDOT regions there is a good mix of these five activities at the airports in the system. In general, the Eastern, North Central, and Northwest WSDOT Regions have the most airports with all five of these activities, while the Olympic, South Central, and Southwest WSDOT Regions have the fewest airports with the five activities.

The following sections provide an overview of the primary aviation activities that were identified in each WSDOT region.

Agricultural Activities

Across all WSDOT regions, 46 airports reported supporting agricultural activity. Agricultural activity is primarily concentrated in the Eastern (11 airports) and North Central (13 airports) WSDOT Regions (see Table 7-5). As shown in Figure 7-3, there is a heavy concentration of agricultural activity in the northeast portion of the state. Because there is a significant amount of farm land in this area, the presence of agricultural activities at airports supports this industry.

Table 7-5. Agricultural Activity by Region

WSDOT REGION	NUMBER OF AIRPORTS WITH ACTIVITY (PERCENT OF TOTAL IN REGION)
Eastern	11 (52 percent)
North Central	13 (54 percent)
Northwest	6 (17 percent)
Olympic	3 (12 percent)
South Central	9 (60 percent)
Southwest	5 (36 percent)

Source: WASP analysis.

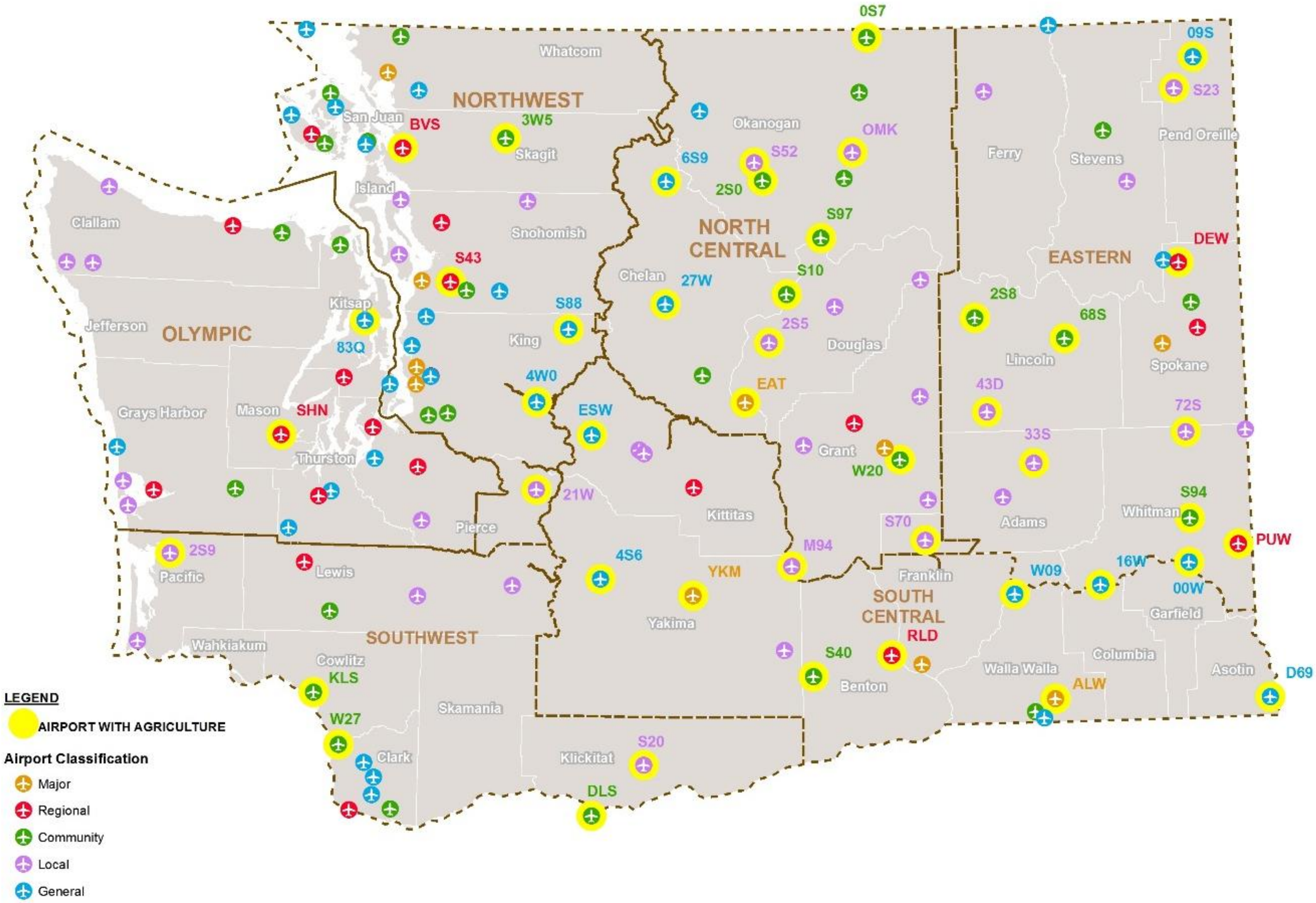
The analysis also examined the classifications of airports that support each of the activities. Based on the responses to the survey, the following number of airports in each classification indicated they serve agricultural activities:

- Major – 3 airports (30 percent of a Major airports)
- Regional – 6 airports (30 percent of all Regional airports)
- Community – 13 airports (37 percent of all Community airports)
- Local – 12 airports (32 percent of all Local airports)
- General Use – 12 airports (35 percent of all General Use airports)

Based on these findings, agricultural activity is well supported at a relatively even percentage of airports in each classification group, even though it is focused in the Eastern and North Central WSDOT Regions.

To support agricultural activities, an airport would need to be in proximity to areas that support agriculture. This activity does not present an area of potential growth in most cases and is not an activity that generates significant revenue for an airport. It is a critical activity to the state in support of the agricultural sector of the economy and ensuring this sector can thrive.

Figure 7-3. Agricultural Activity by Region



Source: Washington State Department of Transportation, Aviation Division

Pilot Training and Certification

Pilot training and certification is the most common activity found at Washington's airports. Across all regions, 72 airports reported supporting pilot training and certification activity. As shown in Table 7-6, this activity is evenly distributed across all regions, though the Southwest reported the lowest figures. The North Central WSDOT Region had the most activity at 18 airports reporting having pilot training. As shown in Figure 7-4, coverage is spread throughout the state, with very few identifiable gaps in coverage.

Table 7-6. Pilot Training and Certification Activity by Region

WSDOT REGION	NUMBER OF AIRPORTS WITH ACTIVITY (PERCENT OF TOTAL IN REGION)
Eastern	12 (57 percent)
North Central	14 (58 percent)
Northwest	18 (50 percent)
Olympic	9 (36 percent)
South Central	13 (87 percent)
Southwest	6 (43 percent)

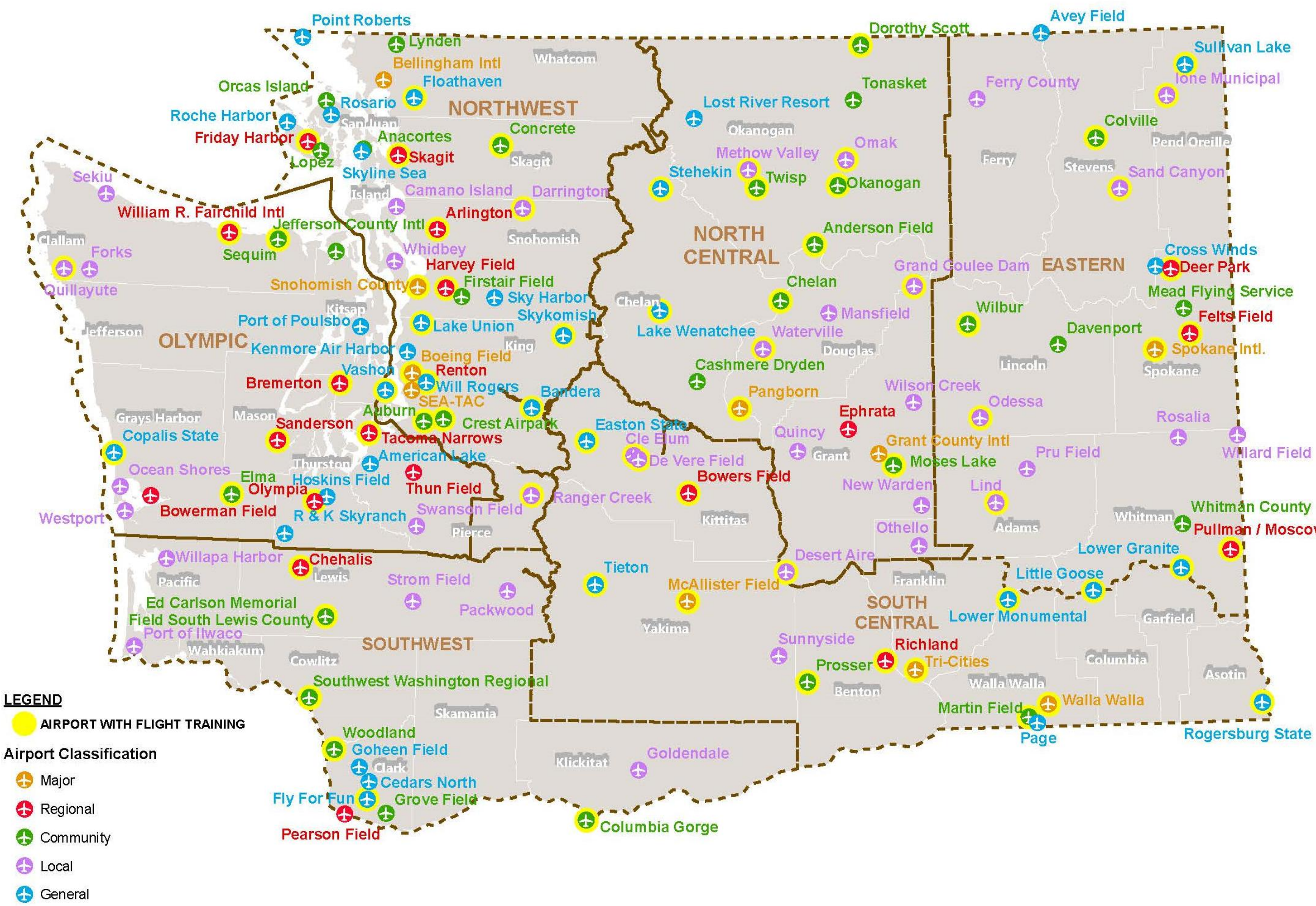
Source: WASP analysis.

Based on the responses to the survey, the following number of airports in each classification indicated they serve pilot training and certification activities:

- Major – 7 airports (70 percent of a Major airports)
- Regional – 6 airports (30 percent of all Regional airports)
- Community – 19 airports (54 percent of all Community airports)
- Local – 13 airports (35 percent of all Local airports)
- General Use – 17 airports (50 percent of all General Use airports)

It is interesting that most of the Major and Community airports in the state reported supporting pilot training and certification and that the lowest levels were at Regional and Local airports. This may be a reflection of self-reporting, but also likely that several of the Major airports are smaller commercial service airports (not SEA or GEG). Many beginner pilots prefer to start training at smaller airports such as those identified as Community, Local, and General Use (although General Use airports do not have a paved surface). Pilot training can be a significant revenue generator for an airport depending on the type of school and level of students supported. This training also typically generates a high level of operations at an airport which would be a concern at airports that have an identified operational capacity constraint. The analysis shows that the state is well supported and provides significant opportunities for pilot training at all sizes of airports and at locations throughout Washington.

Figure 7-4. Pilot Training and Certification Activity by Region



Source: Washington State Department of Transportation, Aviation Division

Business and Corporate Travel

Business and corporate travel activity was identified at 52 airports across the state. It is important to note that this data was self-reported by airports and likely reflects a wide range of "business" aviation. The range is reflected primarily in the types of aircraft used for business purposes which can include jet, turboprop, and piston engine aircraft as well as rotorcraft. These aircraft have varying airport facility needs such as runway length and strength, from 5,000 feet in length and able to accommodate aircraft above 12,500 pounds to 3,500 feet or less and weights below 12,500 pounds. This wide range is reflected in the airport-reported data on those that are accommodating business and corporate travel.

As shown in Figure 7-5 and Table 7-7, there is business activity in all WSDOT regions, but it is most highly concentrated in the Northwest and Eastern WSDOT Regions. This is likely due to these regions having the two largest population centers in the state and therefore, are more likely to have businesses that require aviation business transportation. Across all regions, the southern portion of the state (South Central and Southwest WSDOT Regions) has the lowest concentration of business activity, likely due to the rural nature of the area.

Table 7-7. Business and Corporate Travel Activity by Region

WSDOT REGION	NUMBER OF AIRPORTS WITH ACTIVITY (PERCENT OF TOTAL IN REGION)
Eastern	11 (52 percent)
North Central	8 (33 percent)
Northwest	13 (36 percent)
Olympic	9 (36 percent)
South Central	6 (40 percent)
Southwest	5 (36 percent)

Source: WASP analysis.

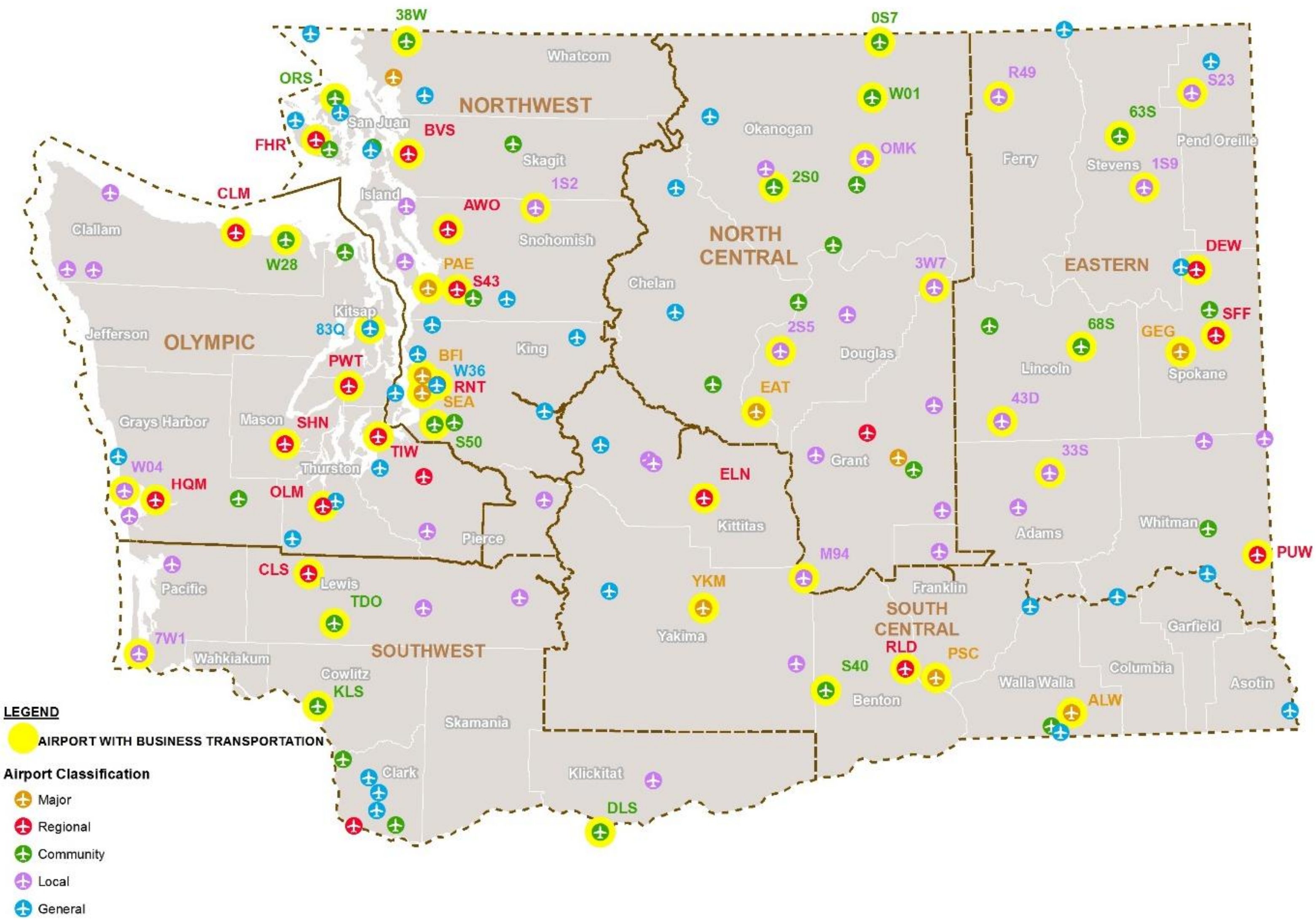
Based on the responses to the survey, the following number of airports in each classification indicated they serve business and corporate travel activities:

- Major – 8 airports (80 percent of a Major airports)
- Regional – 17 airports (85 percent of all Regional airports)
- Community – 15 airports (43 percent of all Community airports)
- Local – 12 airports (32 percent of all Local airports)
- General Use – 2 airports (6 percent of all General Use airports)

Based on the airport classifications summary provided in Chapter 6, business and corporate travel activity is typically focused at Regional and Community airports and is least likely to be needed at Local or General Use airports. As noted above, many Major airports also report serving business and corporate travel primarily due to their location in the larger, more populated areas of the state which are where more businesses are located.

Business and corporate activity can be a major source of revenue, especially the activity served by jet aircraft. These aircraft buy more fuel, but the operators are also seeking services such as rental cars, catering, and other FBO services to support the pilots that sometimes are transporting the business travelers.

Figure 7-5. Business and Corporate Travel Activity by Region



Source: Washington State Department of Transportation, Aviation Division

Air Cargo

Air cargo activity was identified as being supported at 22 airports in Washington. As shown in Figure 7-6 and Table 7-8, most of these airports are in the Northwest region, most likely attributable to the concentration of population in that area. The Southwest WSDOT Region reported having no airports that supported air cargo activity; this is the only instance of a region not being served by an airport activity.

Table 7-8. Air Cargo Activity by Region

WSDOT REGION	NUMBER OF AIRPORTS WITH ACTIVITY (PERCENT OF TOTAL IN REGION)
Eastern	2 (10 percent)
North Central	5 (21 percent)
Northwest	8 (22 percent)
Olympic	4 (16 percent)
South Central	3 (20 percent)
Southwest	0

Source: WASP analysis.

Based on the responses to the survey, the following number of airports in each classification indicated they serve air cargo activities:

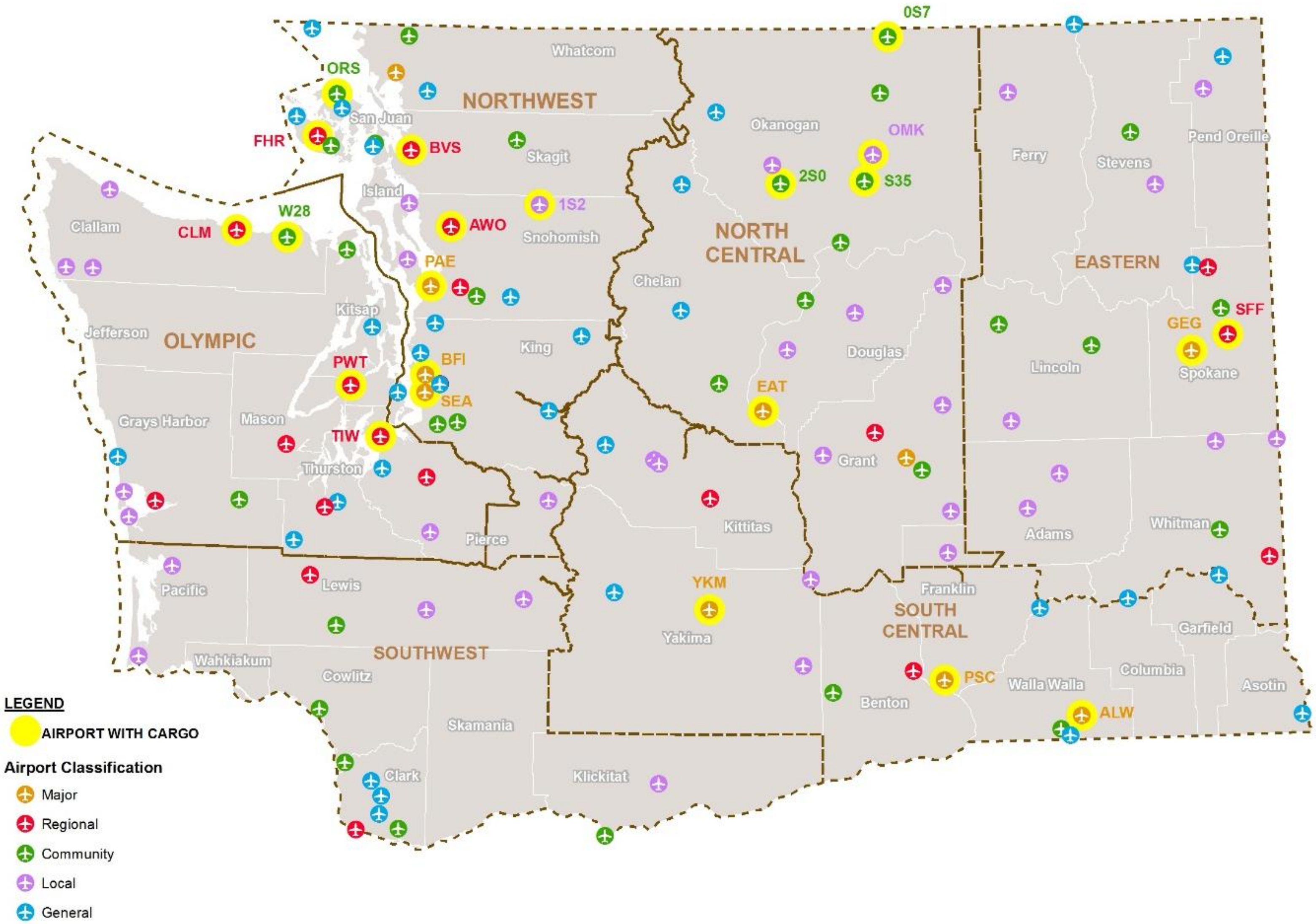
- Major – 8 airports (80 percent of a Major airports)
- Regional – 7 airports (35 percent of all Regional airports)
- Community – 5 airports (14 percent of all Community airports)
- Local – 2 airports (5 percent of all Local airports)
- General Use – None

As noted, cargo is primarily supported at Major and Regional airports. This is consistent with the fact that these airports can handle larger aircraft and are in populated areas. It is also important to note that many of the larger cargo airlines want to operate at commercial airports to have access to the “belly” of the planes at these airports. The cargo carriers make their own decisions about which airports they choose to operate at and consider other factors such as locations of demand generators and supporting industries.

Though no General use airports and only two Local airports reported having cargo activity, it is likely that these facilities can’t accommodate the carriers that provide this service nor do they have the necessary facility infrastructure. It is likely that if additional cargo facilities are needed, they would be provided at the existing airports or at other Major or Regional airports.

Air cargo activity can also generate significant revenue for airports from the purchase of large quantities of fuel to leasing land and/or buildings and paying applicable landing fees. This activity is highly sought after by airports due to revenue, but also due to the opportunity to support their community’s attractiveness to business development.

Figure 7-6. Air Cargo Activity by Region



Source: Washington State Department of Transportation, Aviation Division

Aerospace Manufacturing

Of the five activities examined in this analysis, aerospace manufacturing had the fewest airports reporting serving this activity. As shown in Figure 7-7 and Table 7-9, all regions are served by a combined total of 16 airports that serve aerospace manufacturing. Of these, the largest concentration is in the Northwest WSDOT Region, where a large majority of the population and the Boeing Company are located. Outside of the Northwest WSDOT Region, no other region reported having more than three airports serving this activity.

Table 7-9. Aerospace Manufacturing Activity by Region

WSDOT REGION8	NUMBER OF AIRPORTS WITH ACTIVITY (PERCENT OF TOTAL IN REGION)
Eastern	2 (10 percent)
North Central	2 (8 percent)
Northwest	7 (19 percent)
Olympic	1 (4 percent)
South Central	3 (20 percent)
Southwest	1 (7 percent)

Source: WASP analysis.

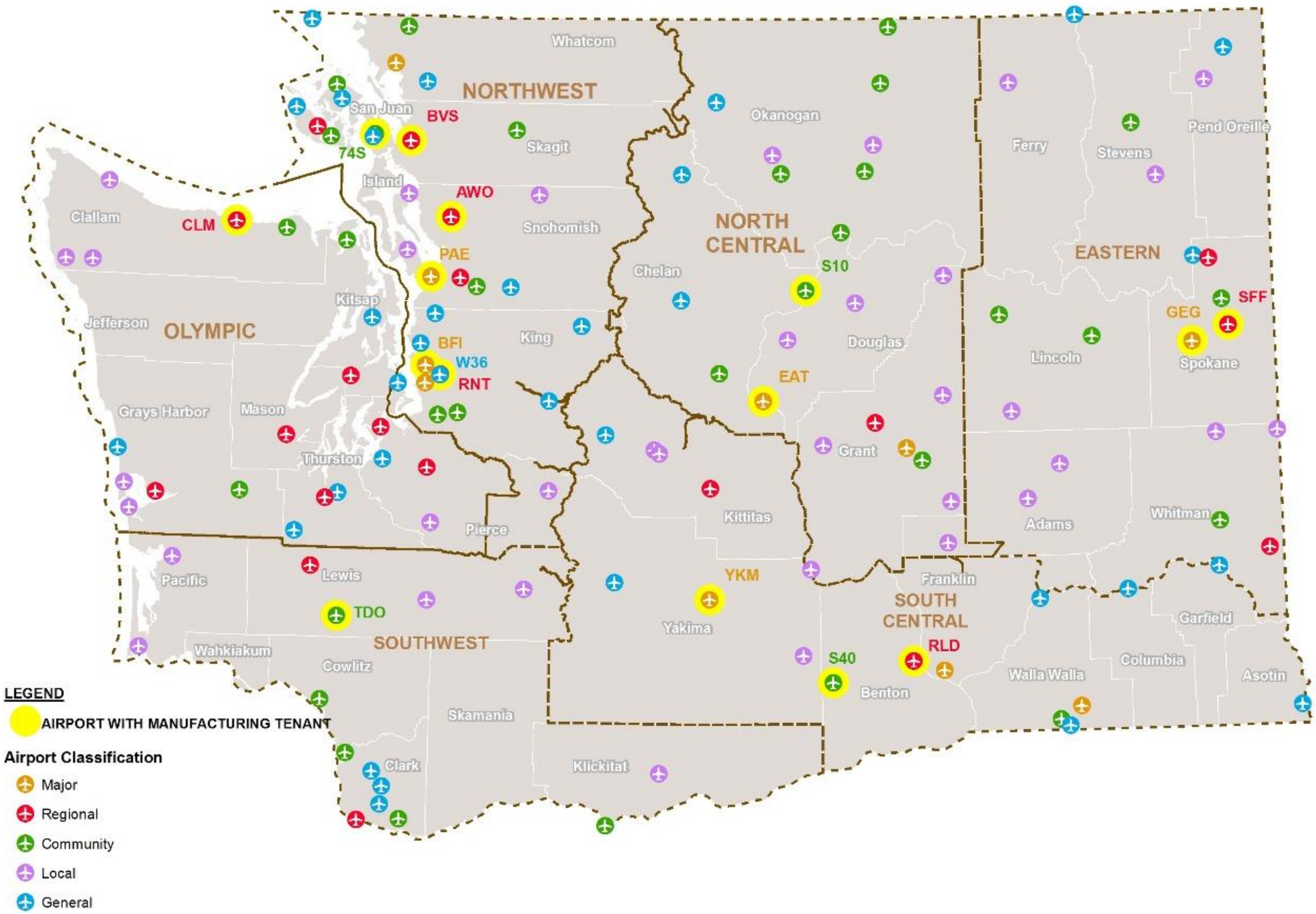
Based on the responses to the survey, the following number of airports in each classification indicated they provided aerospace manufacturing activities:

- Major – 5 airports (50 percent of a Major airports)
- Regional – 6 airports (30 percent of all Regional airports)
- Community – 4 airports (11 percent of all Community airports)
- Local – None
- General Use – 1 airport (3 percent of all General Use airports)

As shown, almost all manufacturing activity is located at Major, Regional, and Community airports, with the largest percentage being located at Major airports. Because this type of activity likely necessitates a larger population center as well as significant support facilities at the airport, it is to be expected that aerospace manufacturing activity is more highly concentrated at larger facilities.

Aerospace manufacturing is a highly sought-after economic activity as it can contribute to high levels of revenue generation and creation of jobs at an airport and for the community. From leasing land to fuel sales, the manufacturers generate revenue and activity that is not easily replaced by other aviation activities.

Figure 7-7. Aerospace Manufacturing Activity by Region



Source: Washington State Department of Transportation, Aviation Division

Activities Summary

The previous analysis of the locations of significant activities throughout the state provides data that can be used as WSDOT and the airports evaluate alternative strategies for future airport development. Knowing where there are other airports serving different activities and the breadth of the activities that are provided within the state gives airport sponsors and users information that is not typically available through other data sources, nor readily available without time-consuming research.

The activities at the airports also help to shed light on the relationship between airport development needs and the opportunities to increase revenue based on those activities that are likely to generate more demand and potentially more economic activity. Other than agriculture, which is an important aviation activity but one that does not necessarily generate tremendous revenue for airports, the other four activities are typically provided at airports that support many other activities and have an important aviation function within the state.

7.3.3 System Accessibility

The third component in the regional evaluation is the accessibility of the state's airport system to population. The accessibility was analyzed related to general aviation as well as commercial service.

To understand how the aviation system is serving the state's population for both commercial service activities and general aviation services, and its accessibility to populated areas, a drive time analysis was completed using the ESRI Community Analyst. This analysis examined the population of Washington that is located within standard driving times for both general aviation and commercial service airports. For the WASP, 30-minute drive times were used for general aviation service areas as this is a standard used by FAA in evaluating airports eligible for inclusion in the National Plan of Integrated Airport Systems (NPIAS). This drive time represents an average that most general aviation aircraft owners are willing to drive to an airport, although it is recognized that owners will drive further to access an airport that provides certain facilities and services desired by the aircraft owner. In addition to traditional 30-minute drive times, 45-minute drive times were analyzed for the entire system to evaluate the differences and additional population that had this level of accessibility for general aviation purposes.

For commercial service airports, 60 and 90-minute drive times were developed. Airports such as SEA and GEG attract commercial service passengers from a larger service area due to the higher levels of service that are provided including more airlines and more flights. For these two airports, 90-minute drive times were used. For the remaining commercial service airports, 60-minute drive times were used to evaluate the accessibility of the existing commercial service airports.

To better understand the coverage and accessibility analysis, other factors that affect the locations of airports and their service areas were examined. The Northwest WSDOT Region is home to the largest commercial service airport in the state as well as the largest population center (Seattle) while the Eastern WSDOT Region has the second largest population center (Spokane). These large population centers typically require more airports and services to support the population and economies of these areas. Much of the Olympic WSDOT Region is sparsely populated due to the large amount of federal and state forest and recreation land (Department of Natural Resources [DNR], U.S. Forest Service [USFS], National Park Service [NPS]). The North Central and South Central WSDOT Regions have large tracts of federal, Tribal, and State forest, recreation, and cultural lands that are not available for development. These areas cover a significant portion of these regions and limit the population and developable areas. The South Central WSDOT Region also has large tracts of Federal, Tribal, and State forest, recreation, and cultural lands that are not available for development. Analysis of these areas indicate that approximately 23.1 million acres or 54 percent of the state's land area is being managed long-term as undeveloped. As part of the accessibility evaluation, these areas were further examined to graphically depict and evaluate the impact of the significant size of these areas.

General Aviation Airport Drive-Times

Analyses presented in the maps below show that, when all system airports are considered with 30-minute drive times representing the accessibility of airports for general aviation users, 64 percent of Washington's population is within a 30-minute drive of at least one and, in some cases, multiple system airports. The coverage or accessibility analysis identifies that there are multiple areas that have overlapping service and other areas that have gaps or do not have easy access to airports in the Washington system.

An additional effort was conducted to determine the percentage of the statewide population within a 30-minute drive time of the five airport classifications. Table 7-10 shows the percentage of Washington's population that is located within a 30-minute general aviation drive time of any airport in the different classifications. As shown, 31 percent of the population is within a 30-minute drive time of a Major airport. While general aviation is not the primary activity at most of the Major airports, these airports do serve a role in accommodating general aviation activity. This coverage is graphically depicted in Figure 7-8. When 30-minute drive times of Regional airports are added to the coverage provided by Major airports, 45 percent of the state population is covered. This information is shown graphically in Figure 7-9. Figure 7-10 presents the coverage provided by system airports when the 30-minute drive times of Community airports are added. For this grouping, 59 percent of the state population is located within a 30-minute drive time of these airports. When Local airport drive times are included, 61 percent of the statewide population is covered by 30-minute drive times. This information is depicted in Figure 7-11. To complete the analysis, Figure 7-12 details the coverage when General Use airports are included and all classifications are analyzed.

Table 7-10. Percent of Statewide Population within a 30-minute Drive Time of System Airports by Classification

. AIRPORT CLASSIFICATION	PERCENT OF POPULATION COVERAGE BY INDIVIDUAL CLASSIFICATION	PERCENT OF CUMULATIVE POPULATION COVERAGE
All System Airports	64%	N/A
Major	31%	31% (Major Only)
Regional	56%	45% (Major + Regional)
Community	34%	59% (Major + Regional + Community)
Local	5%	61% (Major + Regional + Community + Local)
General Use	30%	64% (all five classifications)

Source: ESRI Community Analyst.

Figure 7-8. 30-Minute Drive Times of Major Airports

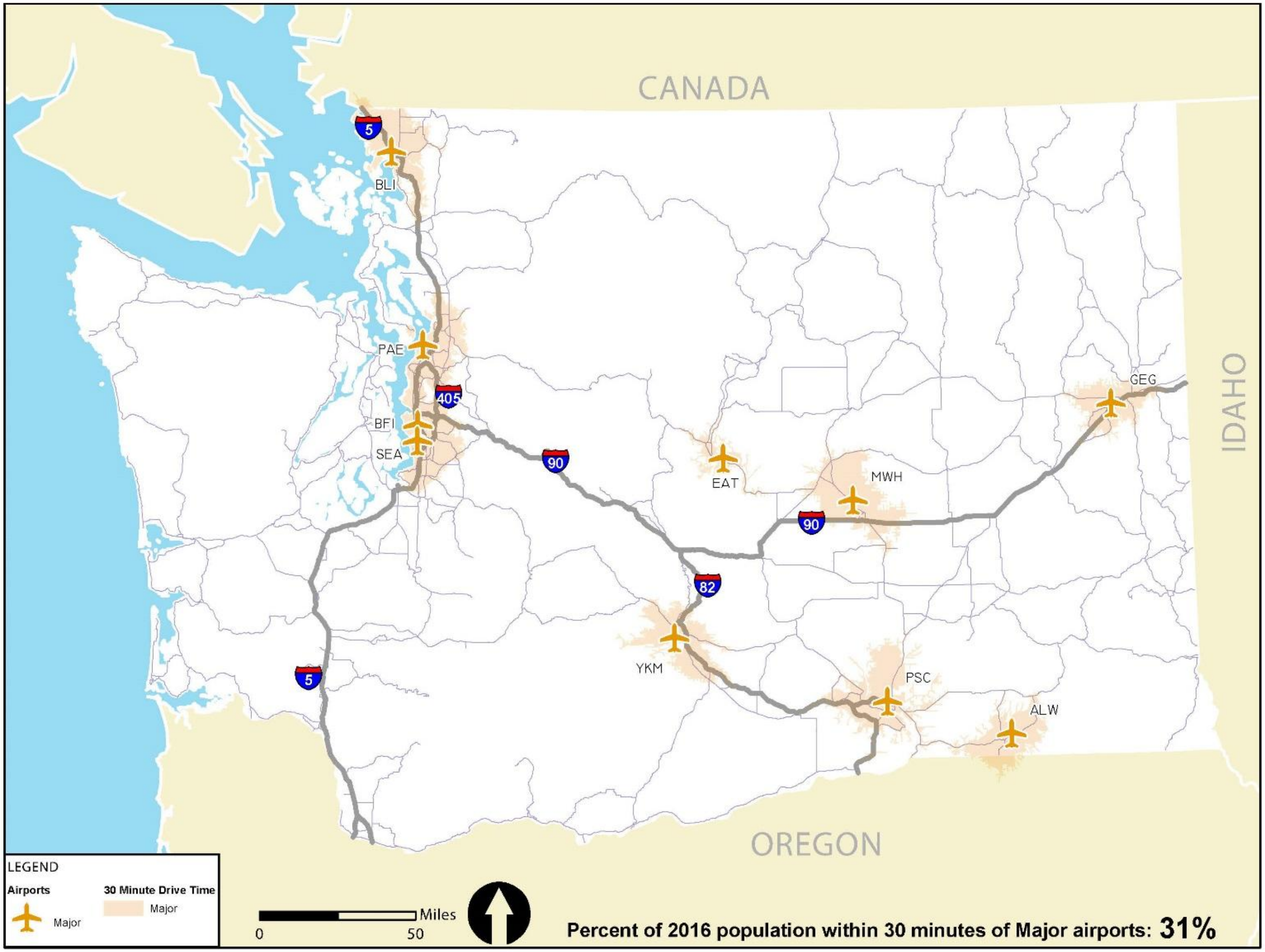


Figure 7-9. 30-Minute Drive Times of Major and Regional Airports

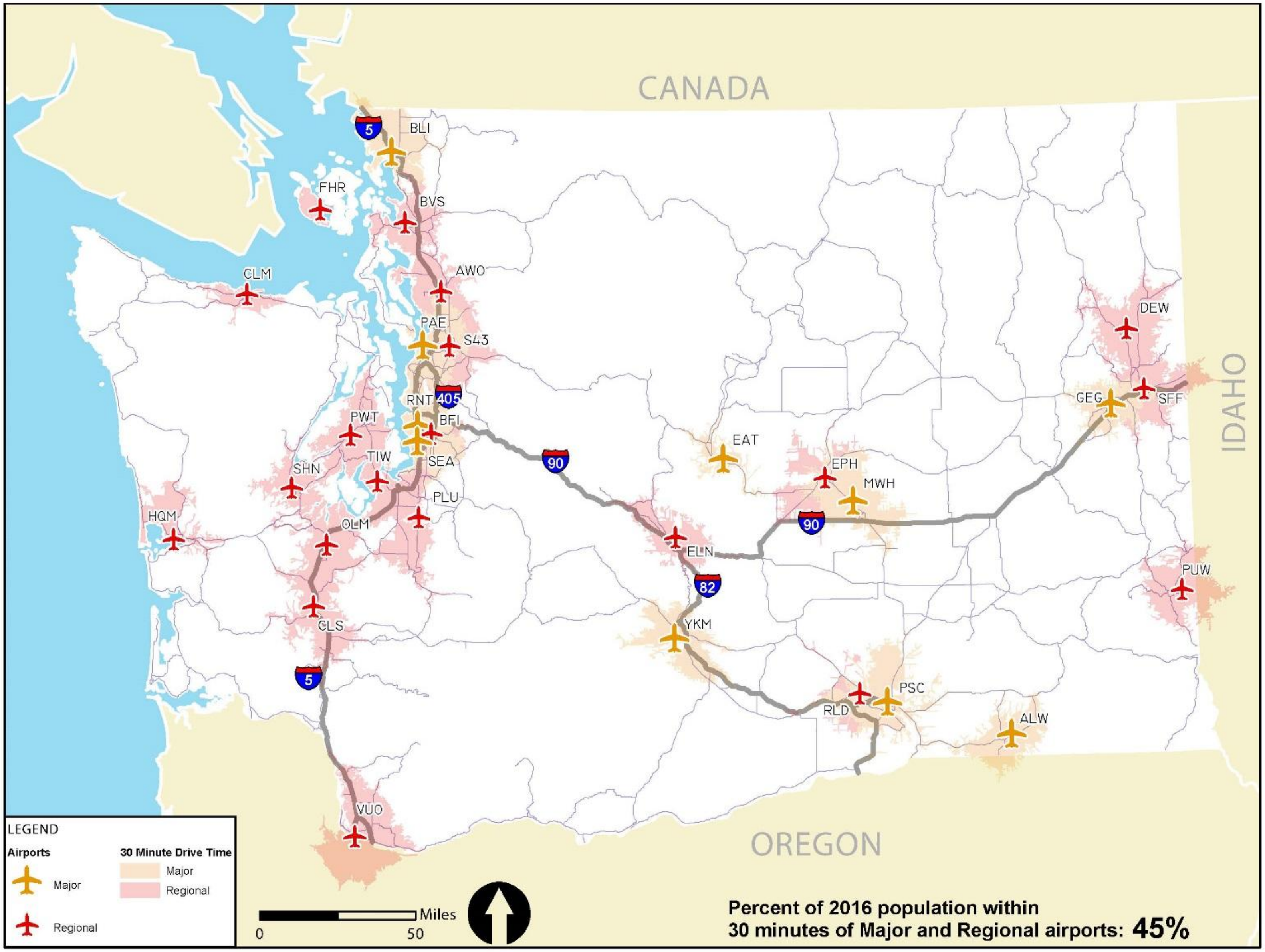


Figure 7-10. 30-Minute Drive Times of Major, Regional, and Community Airports

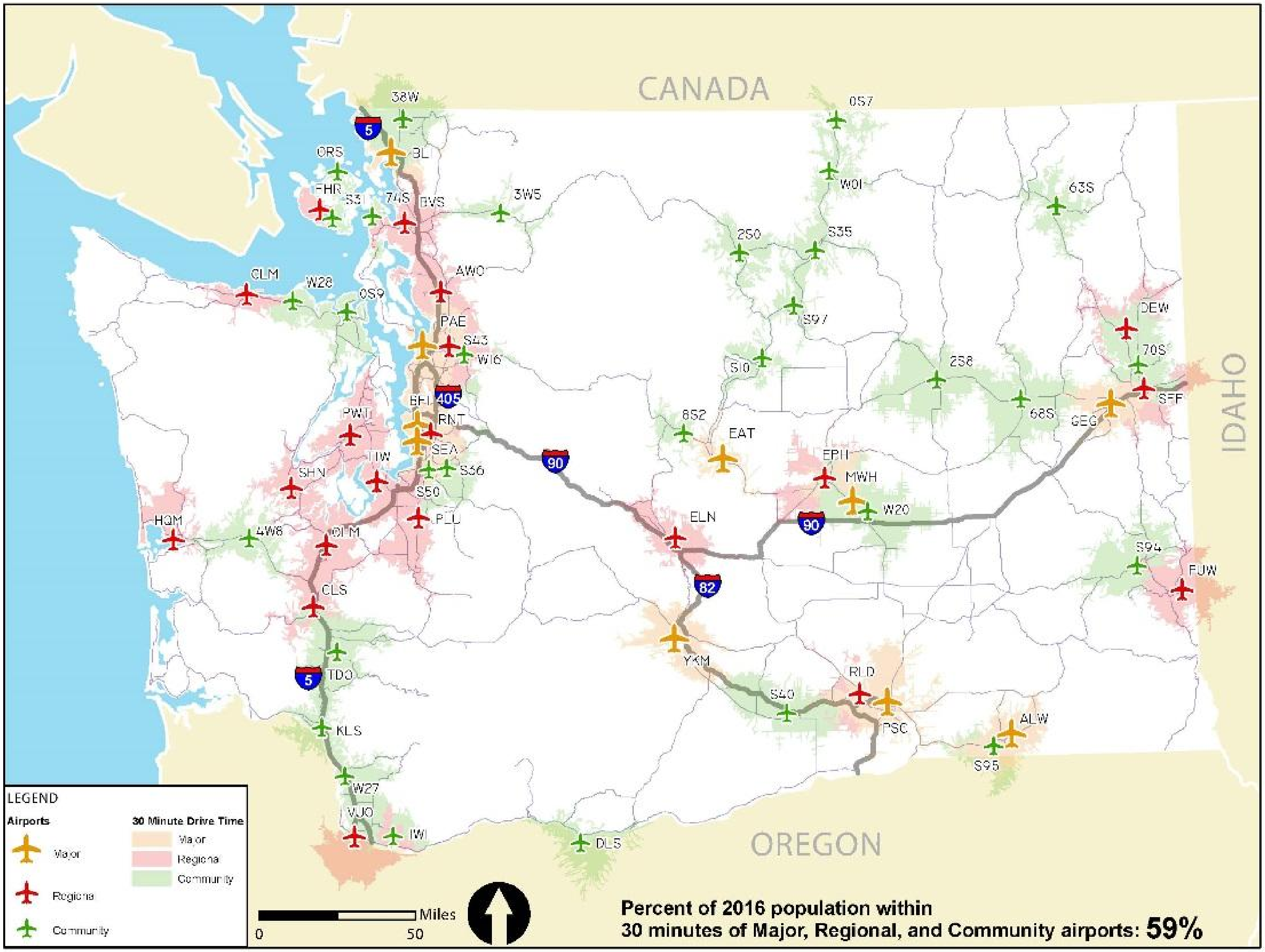


Figure 7-11. 30-Minute Drive Times of Major, Regional, Community, and Local Airports

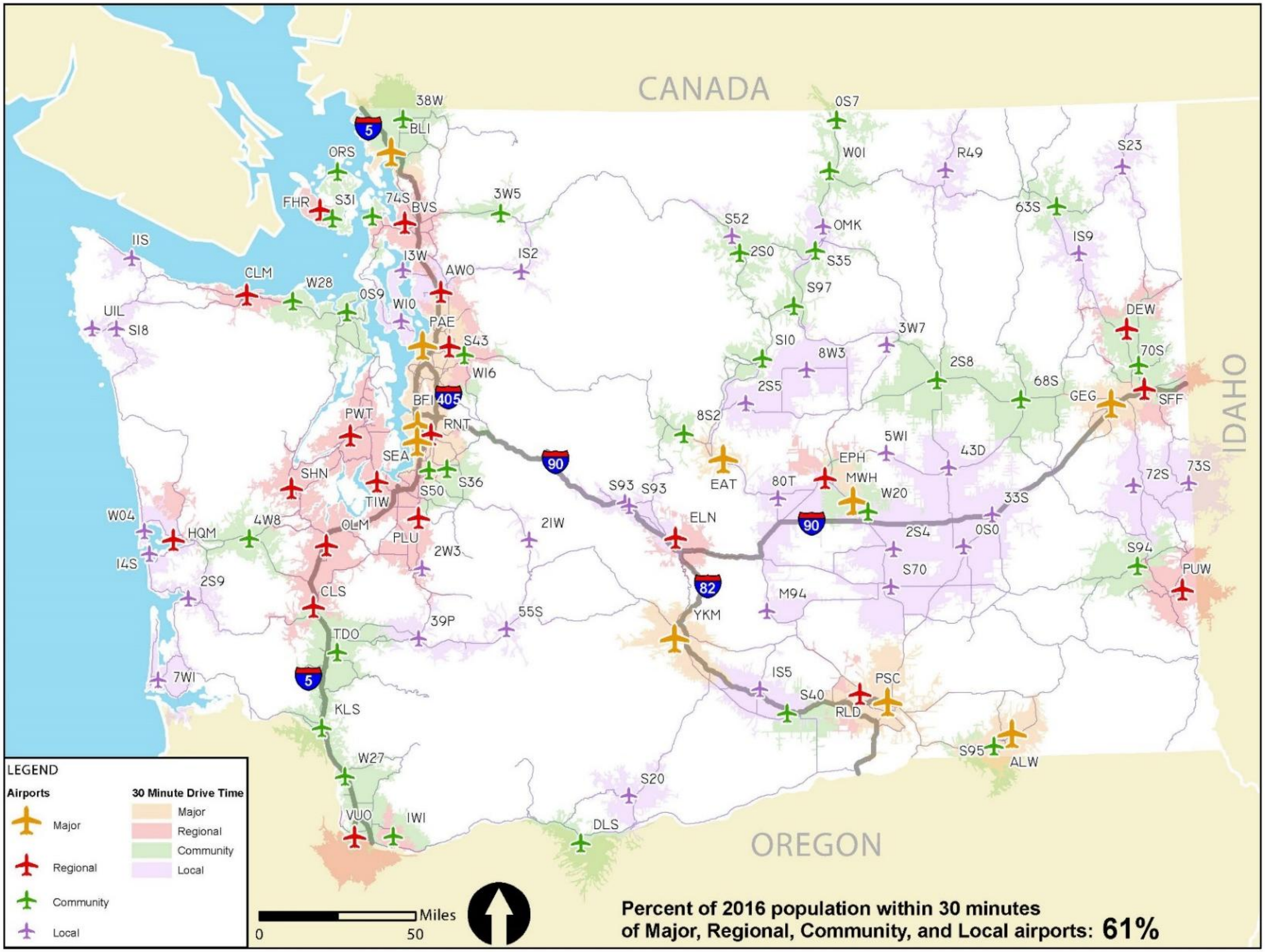
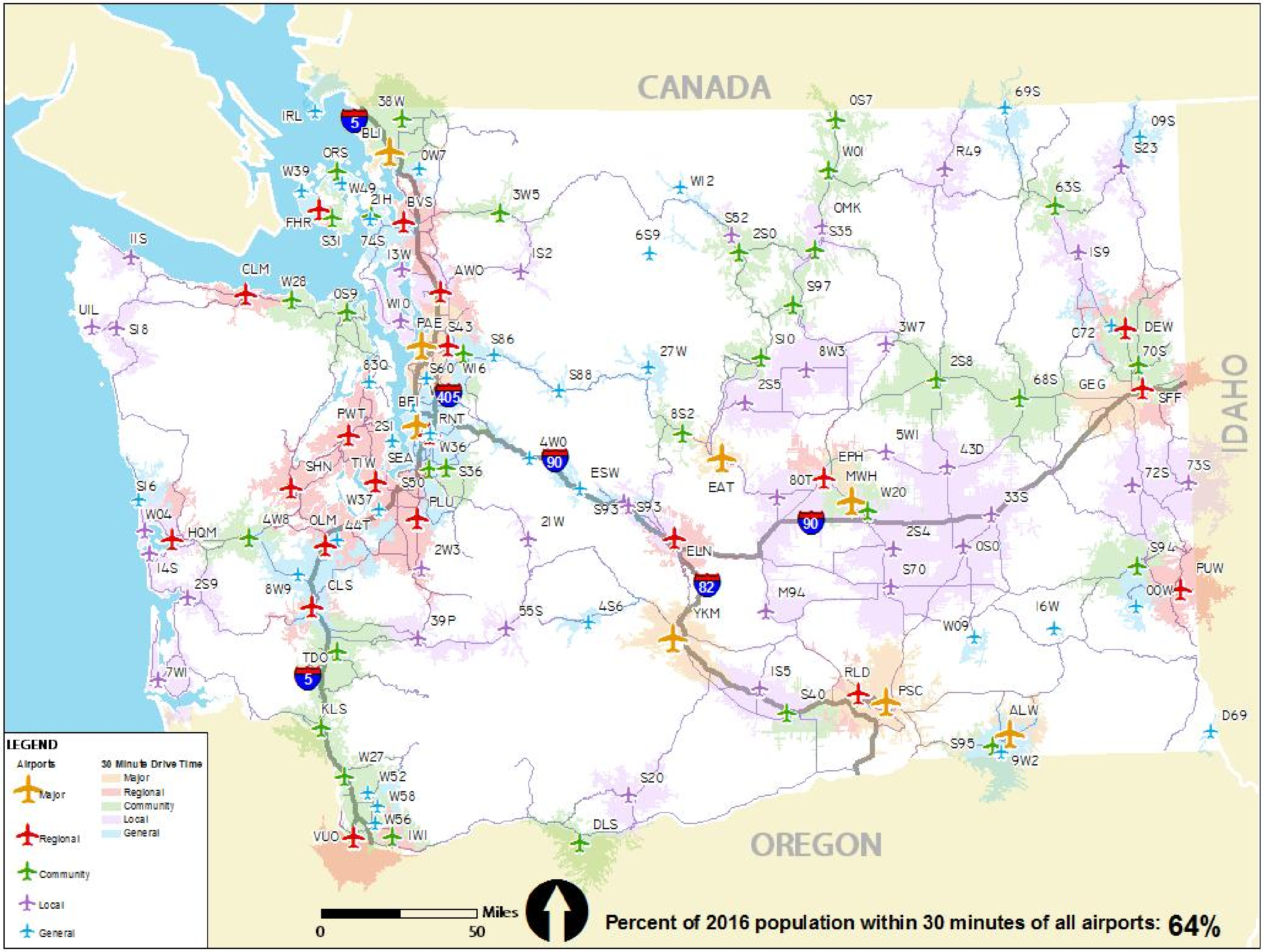


Figure 7-12. 30-Minute Drive Times of All Airports



As shown in the figures and in the table, when all airports in the system are analyzed, 64 percent of the state's population is within a 30-minute general aviation drive of a Washington airport, representing less than two-thirds of the state's population. The identified protected areas were also mapped in comparison to the 30-minute drive times associated with general aviation users and drive times of the five airport classifications. These are depicted in Figure 7-13. The maps depict the moderate overlap of drive time areas for population coverage, particularly in the Northwest WSDOT Region and around major population centers where general aviation users have multiple options for accessing the system. This accessibility is important to consider as an element of the transportation system's service to the state. Many individual airport pilots and businesses utilize aviation for recreational and business purposes and those areas without reasonable access to an airport are less likely to attract population and economic development opportunities.

While the analysis shows that less than two-thirds of the state's population is within a 30-minute drive of a Washington airport that provides access for general aviation users, the following should also be considered relative to the accessibility of the system:

- Airports in Oregon, Idaho, and Canada provide additional coverage to support populations near the borders of the state
- Many of the areas that do not have airports are undevelopable lands due to terrain or their protected status (National Park, National Forest, etc.) that have sparse population
- There are also many privately owned, private use airports throughout the state that provide access to approved users

For comparison purposes, 45-minute drive times were also considered for the state's system of airports. If the 30-minute drive time is expanded by 15 minutes, the percent of the state's population that is in proximity to an airport increases to 97 percent (see Figure 7-14). While beyond the traditional service area considered for general aviation airports (30 minutes), the 45-minute drive times indicate that nearly all of Washington's residents have relatively good access to at least a public-use general aviation airport in the state's system.

Figure 7-13. 30-Minute Drive Times of All Airports with Managed Lands

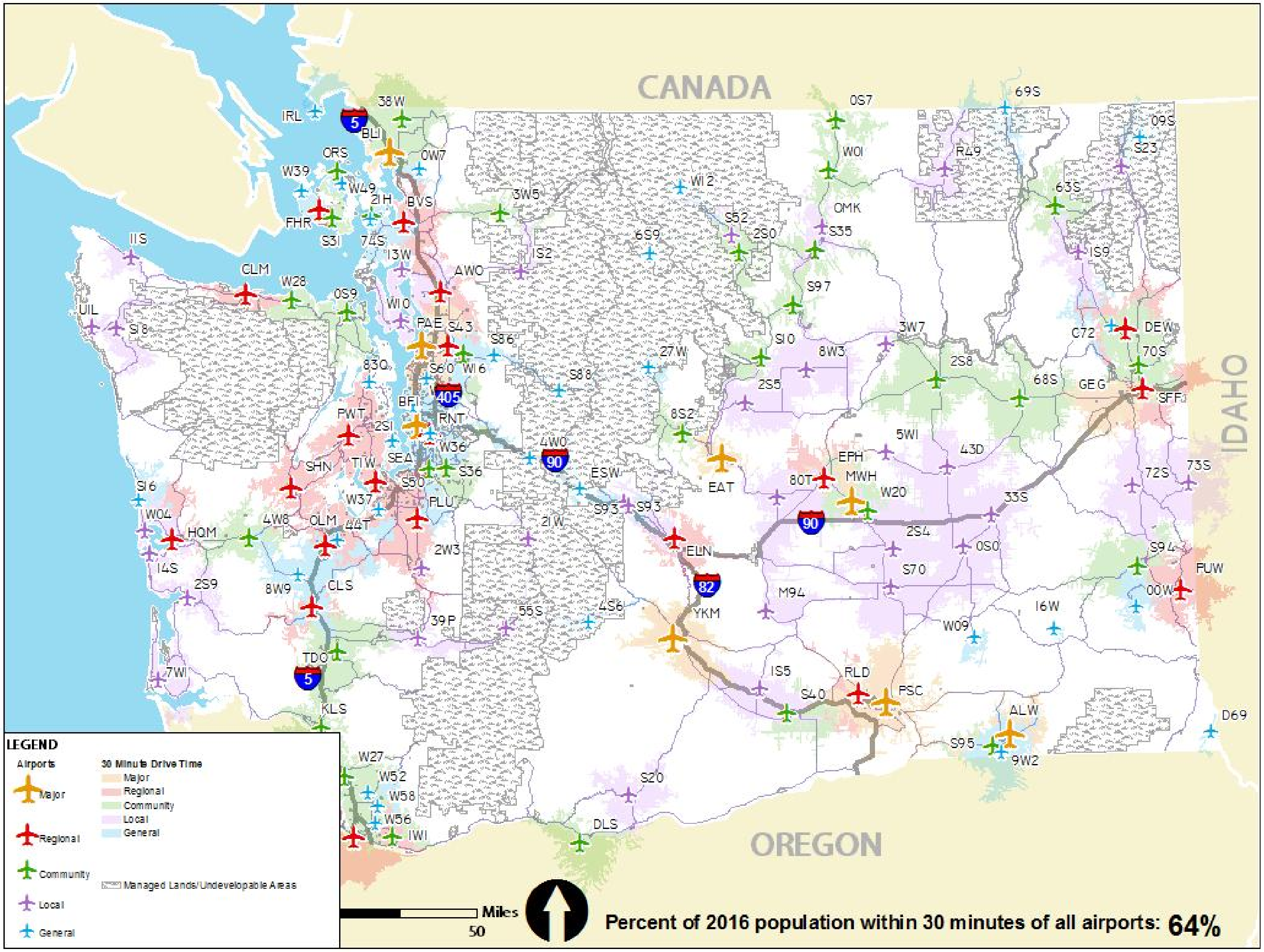
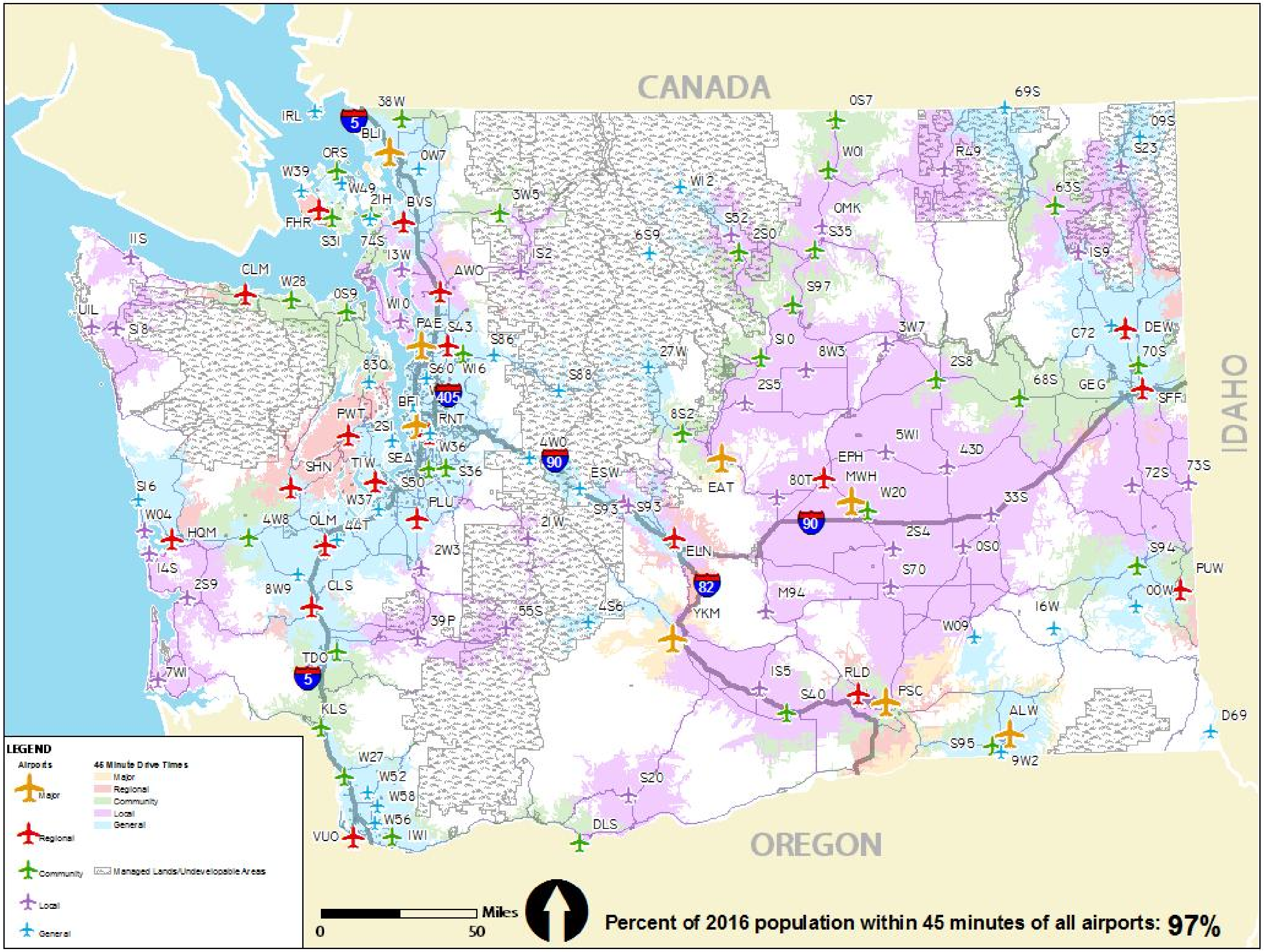


Figure 7-14. 45-Minute Drive Times of All Airports with Managed Lands



Commercial Service Accessibility

Another important component of system accessibility is the access to commercial service airports. Commercial service airports provide an opportunity for Washington residents and visitors to travel around the world and serve an important function in supporting economic growth and diversification. While the distance that commercial airline passengers are willing to travel varies, standard travel times of 60 and 90 minutes are used to evaluate the accessibility. For airports such as SEA and GEG which have numerous airlines and flights per day, passengers are willing to drive further to access these airports. Ninety-minute service areas were used for these two airports, although it is possible that passengers are driving further depending on factors such as price, destination, airline, and flight frequency. For the remaining commercial service airports in the state that have fewer airlines and serve smaller service areas, 60 minutes was used to evaluate the accessibility of the system.

Figure 7-15 depicts the 90-minute service areas for SEA and GEG and reveals that approximately 67 percent of Washington's population is in these service areas. The other commercial service airports provide access to 67 percent of the population (see Figure 7-16). When combined and overlaps are removed, as well as the protected areas are considered, Washington's commercial service airports coverage supports 83 percent of the population as shown in Figure 7-17. While there are areas of the state that must drive further to access commercial airline service, this level of coverage is considered adequate for a state, especially the size of Washington and with significant terrain.

Figure 7-15. Commercial Service Accessibility – SEA and GEG 90-Minute Drive Times

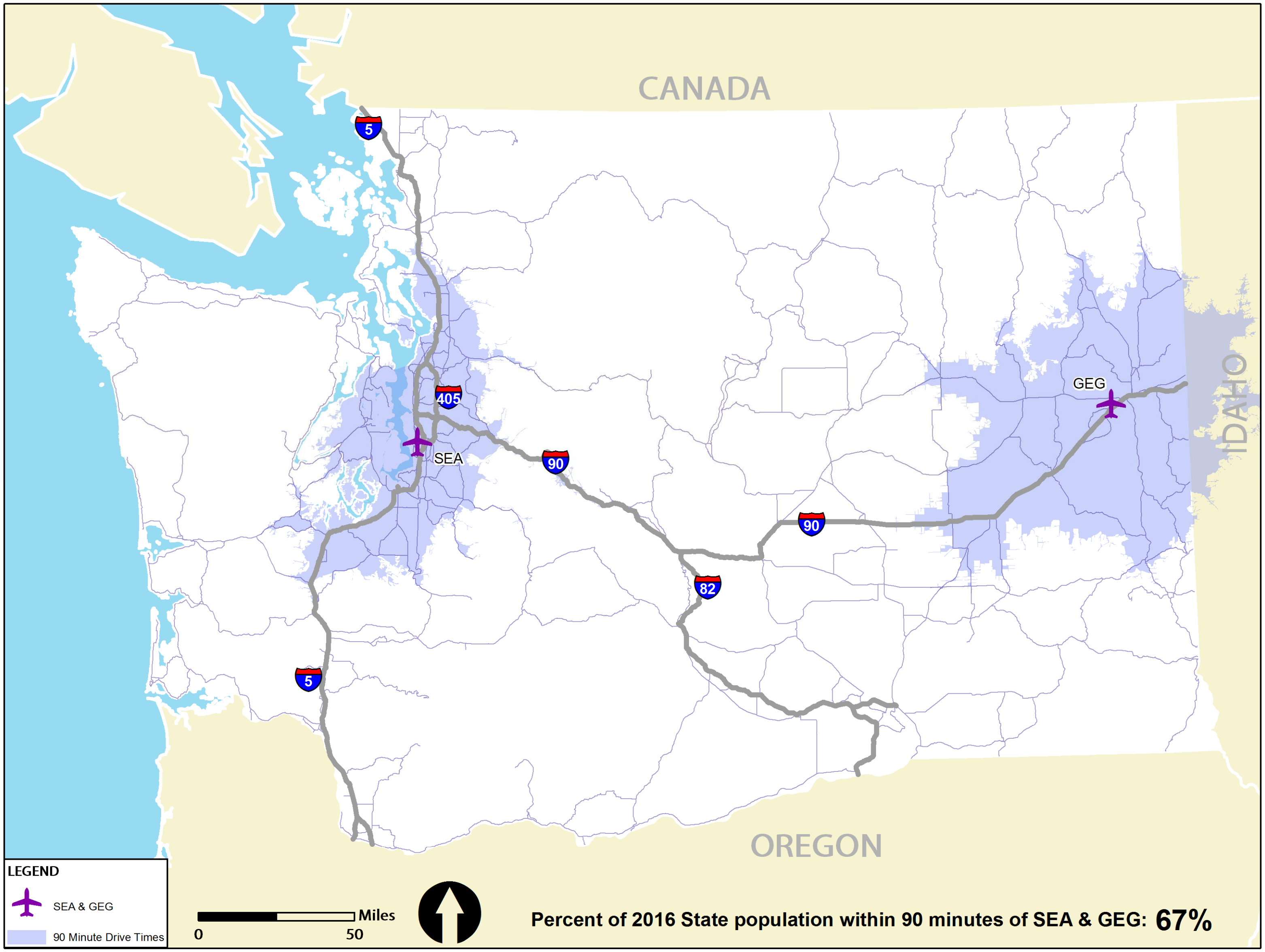


Figure 7-16. Commercial Service Accessibility – Other Commercial Airports 60-Minute Drive Times

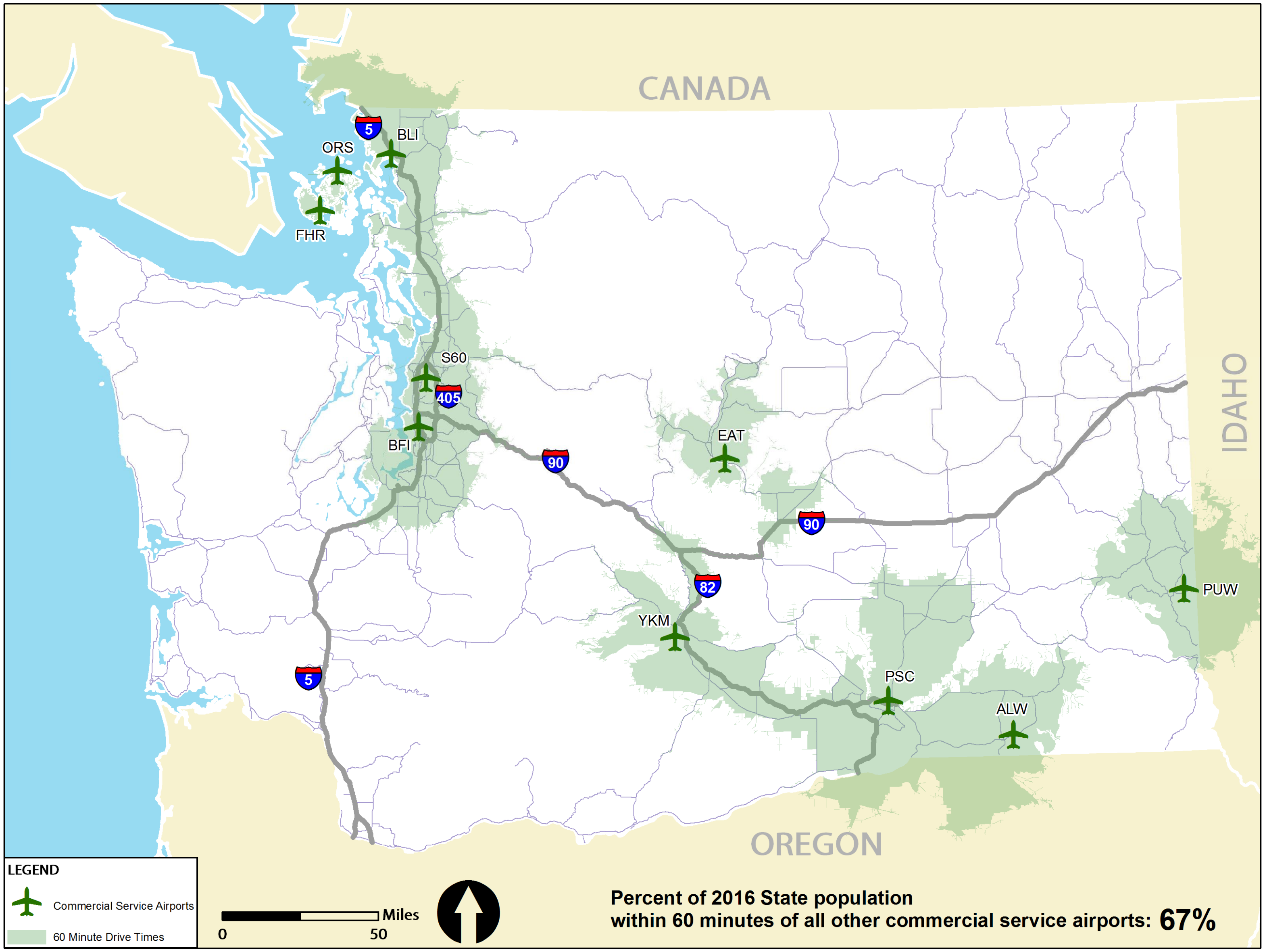
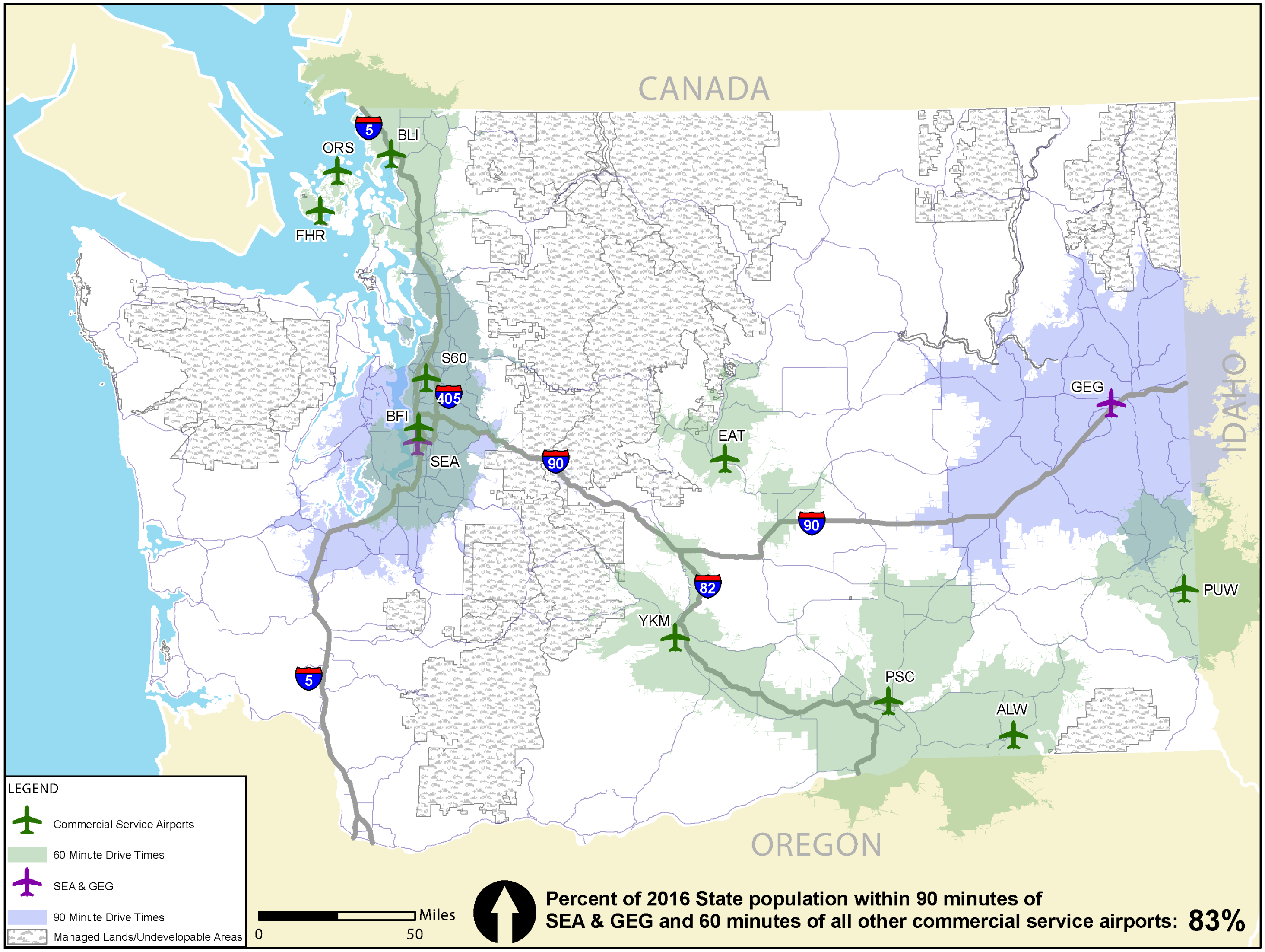


Figure 7-17. Combined Commercial Service Airport Accessibility



Business User Accessibility

In addition to general accessibility of the overall public airport system, accessibility for business user purposes was also examined. Previous analyses identified the airports that self-reported business and corporate travel activities. That analysis showed 52 airports that reported serving this activity, including 29 airports in the Community, Local, and General Use categories and 25 in the Major and Regional categories. Many of the Community, Local, and General Use airports are serving business and corporate users that travel in smaller, lighter weight aircraft that can operate on shorter runways with lower weight bearing capacities. These are sometimes referred to as commerce and/or volunteer activities as opposed to business or corporate aviation and include activities such as flight schools, crop dusting, Part 135 air taxi, and package cargo. Several of these activities were discussed in previous sections, identifying where these activities are occurring according to airport-reported data. It is worthwhile to note that of the 52 airports reporting this activity, 31, or more than half, support smaller business aviation aircraft. While it is difficult to measure the economic contribution of these operations, these statistics highlight the important role airports serve in meeting business aviation travel.

The emphasis of the evaluation of business user accessibility is on larger corporate aircraft that generally require larger and more extensive airfield infrastructure and other attributes typically desired by business users. The following were identified as the typical attributes needed to support the average business user:

- 5,000-foot long runway
- JetA fuel
- At least a non-precision approach
- AWOS

Depending on the aircraft that are using the airport, the FAA design standards are also an important element of consideration, however, the design standards were not the focus of this analysis.

Across the state, there are 21 airports that have all four of these attributes. While each WSDOT Region has at least one airport that has all four attributes, indicating they can support the average business user needs, they are primarily located in the Northwest and Olympic WSDOT Regions. Figure 7-18 displays the airports that that meet the four attributes of average business users. As depicted, these airports are Major and Regional and are located throughout the state, but there are many areas that do not have an airport in proximity that can accommodate an average business user's needs.

An analysis was conducted to also understand which airports currently have three of the four attributes needed to support business activity. This was done to understand the potential for supporting business activity in areas that may currently have limited access for these users. Again, it is important to note that the analysis did not include an evaluation of the FAA design standards associated with accommodating larger corporate aircraft. The analysis indicated there are seven airports that have three of the four attributes (these airports are also depicted in Figure 7-18):

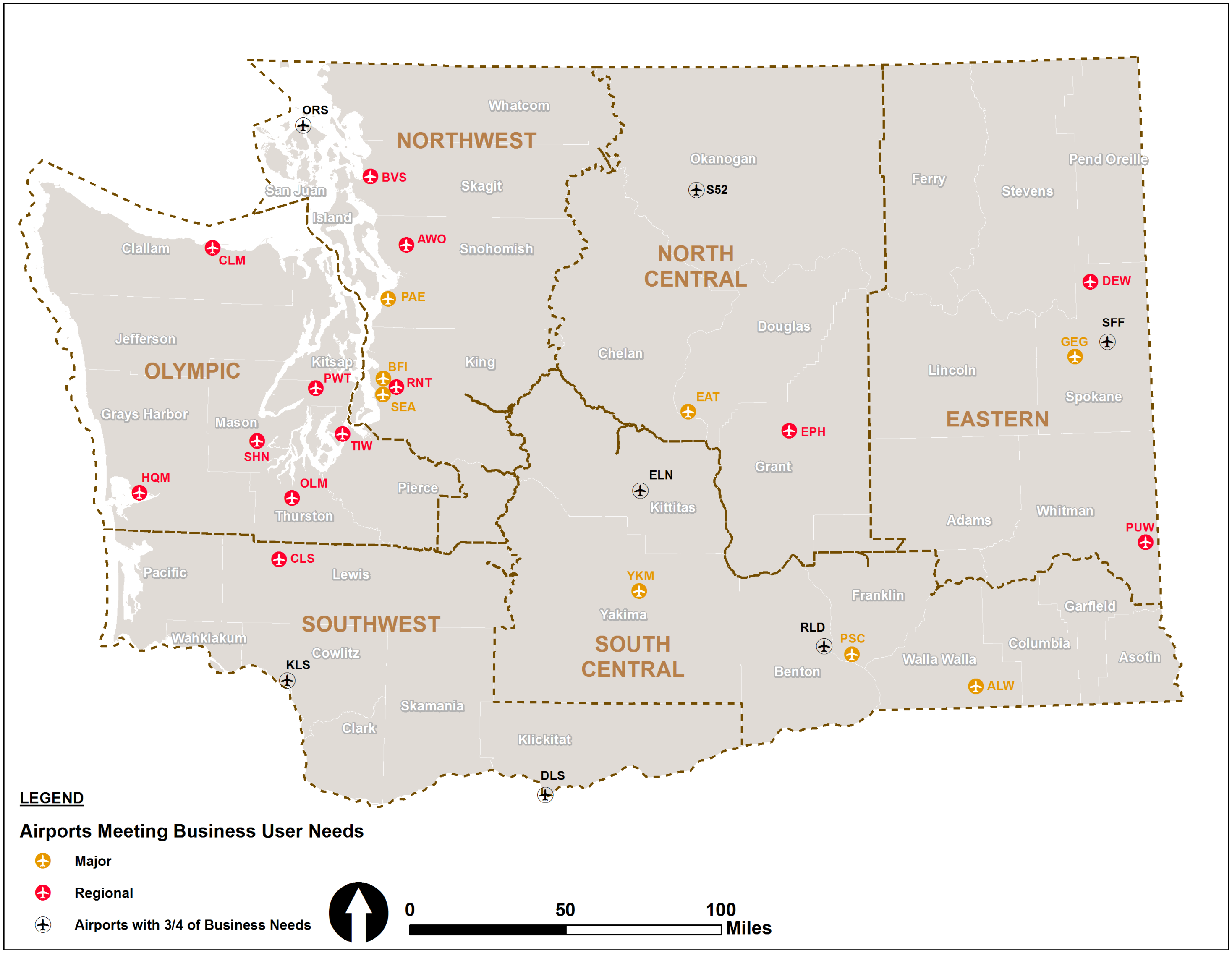
- All seven have both JetA fuel and AWOS systems
- Three have at least a 5,000-foot long runway but do not have at least a non-precision approach

- Of these, there is a Local airport located in the North Central Region, a Community airport located in the Southwest Region, and Regional airport located in the South Central Region
  - Columbia Gorge Regional/The Dalles
  - Bowers Field
  - Methow Valley State (Winthrop)

- Four have at least a non-precision approach but do not have at least a 5,000-foot long runway
  - Of these, there are two Regional airports (one located in the Eastern WSDOT Region and one located in the South Central WSDOT Region) and two Community airports (one located in the Southwest WSDOT Region and one located in the Northwest WSDOT Region)
    - Felts Field
    - Southwest Washington Regional
    - Orcas Island
    - Richland

If these airports could secure the fourth attribute and are able to meet the FAA design standards for the critical corporate aircraft that is operating at the airport, all regions would have an airport that provides the infrastructure needed by the average business user which would increase the opportunities for business expansion throughout the state. Though there is a good distribution of coverage, the overall number of facilities that have the potential to support business activity is still low.

Figure 7-18. Airports with Attributes to Meet Average Business User by Region



Accessibility Summary

The accessibility evaluation revealed that less than two-thirds (64 percent) of the state's population is within a 30-minute drive of a Washington airport that provides access for general aviation users, however, if the service areas are expanded to 45 minutes, this increases to 97 percent. It was noted that while the 30-minute coverage seems low, there are several factors that impact the accessibility for general aviation users and that this analysis is conservative. The increase in coverage to users by driving an additional 15 minutes reveals that providing additional general aviation airports for accessibility is not warranted. Throughout the WASP and in previous studies, there has also not been an identification of a need for a new airport to serve an existing community. Finally, through airports located just beyond Washington's borders to private airports located throughout the state, the accessibility for the state's population is considered very high.

In terms of commercial service accessibility, the state's two largest airports are within 90 minutes driving time of over two-thirds of the population. By adding in 60-minute service areas for the remaining commercial service airports, the coverage increases to 83%. As previously noted, these are standard drive times and many people are willing to drive further for a variety of reasons to reach an airport served by a commercial airline. This level of coverage or accessibility is considered adequate. It is important to note that the provision of commercial service is an airline decision and that recent trends in the national airline industry have resulted in overall reductions in frequency and number of airlines and the number of airports with airline service has declined. Washington continues to have service at many airports across the state, providing access for residents and visitors.

The analysis of the state's accessibility for business aircraft has shown there are airports that could be improved to offer the typical attributes that business users are looking for to operate at an airport, however, the provision of the attributes does not indicate that business operators will necessarily operate at those airports. The existing Washington aviation system provides an extensive array of airports of different sizes and serves population centers throughout the state.

7.4 Airport Alternative Strategies

The prior statewide and regional airport needs and strategies provide the "bigger picture" perspective on the future opportunities for the state's airport system to address system needs in the context of emerging issues, aviation activities, and demand constraints. The airport alternative strategies provide specific opportunities on strategies that airports can consider to increase revenue, serve customer needs, create a competitive advantage, or bring relevance of the airport to the communities that are served. The airport alternative strategies focus on the options available to leverage the positive opportunities and mitigate risks to the future of the airport and system.

Options available to meet Washington's aviation needs

During the WASP, 17 aviation activities, 8 emerging issues, and 18 airport metrics were identified. Some of the aviation activities, emerging issues, and metrics are likely to have a greater potential to impact the options available to an airport. As an example, blood and organ transportation is one of the 17 aviation activities. While this activity is a critical medical need and could possibly be increased at an airport, it is more of an indirect impact to the airport and is not likely to result in a sustained increase in revenue or create a competitive advantage to the airport since the activity is likely tied to factors beyond the control of the airport or the community.

WSDOT convened a working group to develop a set of strategies that were aligned with WSDOT's and the WASP's goals and objectives. The methodology used can be applied by others to develop additional strategies that are specific to the needs and desires of their airport and community. To guide the working group, a three-step process was proposed. The first step was to determine a category that the strategy could be applied to, indicating what type of action would be necessary. As shown in Figure 7-19, five categories were identified: Infrastructure Improvements, Education and Training, Stakeholder Collaboration, Industry/Community Partnerships, or Planning. Infrastructure Improvements address a physical attribute at the airport to support the strategy, including the addition of infrastructure. Education and Training would provide learning opportunities through various media methods on the selected topic. Stakeholder Collaboration involves the applicable stakeholders in the information gathering stage or implementation. Industry/Community Partnerships would include working directly with other agencies and organizations to mutually advance the airport and aviation industry. Planning addresses the research and analysis that would be conducted to provide strategic visions and implementation plans for the airports.

Figure 7-19. Alternative Strategy Categories

The second step in alternative strategy development is to select a focus area such as Airport Metrics, Emerging Issues, or Aviation Activities, as shown in Figure 7-20. The focus areas allow an airport to hone in on a specific topic related to aviation element that they wish to improve upon. Airport Metrics were developed to provide guidance for airports to meet the WASP goals and are discussed in detail in Chapter 6. Emerging Issues are topics that have been identified as impacting the future the aviation industry either from a physical standpoint or a policy perspective. Aviation Activities are the 17 types of activities that are conducted at airports within Washington State.

Figure 7-20. Alternative Strategy Focus Areas

The goal is to develop strategies that achieve specific objectives or outcomes as shown in Figure 7-21. It is possible for a single strategy to provide multiple outcomes.

Figure 7-21. Alternative Strategy Objectives/Outcomes

A process was developed to allow an airport to select a focus area, a category, and a potential objective or outcome to then formulate a strategy. The process is depicted below in Figure 7-22 for the following example:

- An Infrastructure Improvement is desired
- The focus area is an Airport Metric dealing with Aeronautical and Airport Safety
- The objective is to serve the customer's needs

Figure 7-22. Alternative Strategy Development Process

Using this process, a potential strategy could be to:

Conduct an aerial survey and obstruction evaluation to design an obstruction removal project for the primary runway.

While it is possible for a single strategy to integrate multiple categories or focus areas, the emphasis was to formulate strategies that could be implemented in the near term by the airports. It is also possible for a strategy to help achieve multiple categories, such as reconfiguring aircraft hangars to adapt to newer aircraft designs. This strategy could be considered to address Airport Capacity, under Airport Metrics, or Emerging Issues.

Strategies were developed through use of a working group. The working group met to discuss potential airport alternative strategies, utilizing the process identified above with selection of a focus area, a category, and a potential objective or outcome. The results of the working group were synthesized according to the focus areas, with identification of the category and anticipated outcomes. Figures 7-23 through 7-27 display the strategies that were developed through the working group for each of the five strategy categories. All identified strategies are not applicable to all airports, and each airport is encouraged to develop their own strategies using the above methodology or process. It should be noted that while there were a few focus areas for which no strategy was developed during the working group, strategies can be developed for each category and focus area as pertinent to the individual airport and situation.

Infrastructure Improvements

Airport Metrics	Emerging Issues	Aviation Activity
AIRPORT CAPACITY	NEXT GEN IMPLEMENTATION	EMERGENCY PREPAREDNESS & DISASTER RESPONSE
Adapt hangar/parking space to emerging trends of aircraft design (e.g., the wingspan of airplanes tend to be wider than in the past)	Install ground Airport Surface Detection Equipment – Model X (ASDE-X) or Airport Surface Surveillance Capability (ASSC) infrastructure to support ground traffic control in synchronization with air traffic control	Plan fuel resources to be seismically resistant so that fuel can be accessed after a natural disaster, such as the Cascadia Subduction Zone
Maintain a waiting list for hangar vacancies to show the demand and help airports plan for demand-based needs for hangar construction	Install infrastructure that allows airports to meet FAA requirements for PBN/LPV approaches	Communicate the need for community airports to have fuel available to provide wider access for general aviation aircraft during emergencies
	Obtain survey services to support data collection for GIS/NextGen implementation	Have contingency supplies on-hand for hasty airport repairs/needs, examine potential emergency-related vulnerabilities (e.g., operational incidents, natural disasters), and use those vulnerabilities to determine needed supplies
	Coordinate with FAA to review VOR deactivation schedules to time deactivation in a way that does not impact aircraft capabilities during IMC conditions or prevent access to airports for certain aircraft	Install generators at airports for backup power

Serving customer needs | Increasing revenue | Creating a competitive advantage | Conveying an airport's ties to the community

Figure 7-23. Alternative Airport Strategies – Examples of Infrastructure Improvements (continued)

Infrastructure Improvements (CONTINUED)

Airport Metrics

FINANCIAL SUSTAINABILITY

- Limit the length of land leases and optimize leasing hangars; consider that airports make more money per square foot by building hangars for lease as opposed to leasing land for hangar development (e.g., leasing hangar space at $200/month per hangar versus leasing land for hangar development at $0.34/square foot)
- Dedicate advertising space at airports for tourism opportunities

Emerging Issues

AVIATION FUELS

- Assist and advise community airports regarding investing in fueling services to increase operations and help the system of airports by facilitating ease of flight planning (Note: Pilots often fly out of their way to refuel because many small airports between their departure and arrival locations do not have fuel)
- Consider providing alternative fuel services, as the aircraft manufacturing industry is continuously manufacturing more aircraft that use these different fuels (e.g., 100LL alternative, MOGAS, biofuel, etc.) after exploring the facility needs of these fuels based on a survey of the aviation community
- Provide infrastructure to facilitate electric aircraft (e.g., construct charging stations/battery exchange infrastructure)

UNMANNED AERIAL SYSTEMS

- Consider the development of future warehouses to facilitate UAS package delivery

Aviation Activity

PILOT TRAINING

- Provide a pilots lounge that pilots can use for classroom training and flight planning including classroom facilities, flight planning room (with publications, computer terminal for weather, and NOTAMS), and CATS testing center
- Increase opportunities to get involve youth in Science, Technology, Engineering, and Mathematics (STEM) careers by locating STEM education centers on airports that can feed into pilot/engineer/mechanic/manufacturer training (e.g., Future of Flight on Paine Field and Pearson Field Education Center provide fun, hands-on educational opportunities for youth and adults)

Serving customer needs | Increasing revenue | Creating a competitive advantage | Conveying an airport's ties to the community

Figure 7-24. Alternative Airport Strategies – Examples of Education and Training

Education and Training

Airport Metrics	Emerging Issues	Aviation Activity
	NEXT GEN IMPLEMENTATION	**EMERGENCY PREPAREDNESS & DISASTER RESPONSE**
	Educate pilots on equipage requirements and ADS-B operations	Prepare an Airport Emergency Plan and conduct internal training for airport staff, pilots, community volunteers, and the traveling public for emergency response operations Show local communities, government officials, and planning officers the importance of airports during emergencies to better integrate airports into local emergency management plans
	UNMANNED AERIAL SYSTEMS	**PERSONAL TRANSPORTATION & BUSINESS/CORPORATE TRAVEL**
	Encourage flight schools to provide training for both pilots and unmanned operators	Provide information/training to local businesses about opportunities for corporate travel at their local airport
		COMMERCIAL SERVICE
		Educate aircraft operators about expanding opportunities for commercial service airports Educate community regarding need for support of air routes (e.g., providing information on opportunities, benefits, airspace needs, etc.) to promote commercial services Seek Small Community Air Service Development Program (SCASDP) Grants from USDOT (SCASDP is a USDOT grant program designed to help small communities address air service and airfare issues)

Serving customer needs | Increasing revenue | Creating a competitive advantage | Conveying an airport's ties to the community

Figure 7-25. Alternative Airport Strategies – Examples of Stakeholder Collaboration

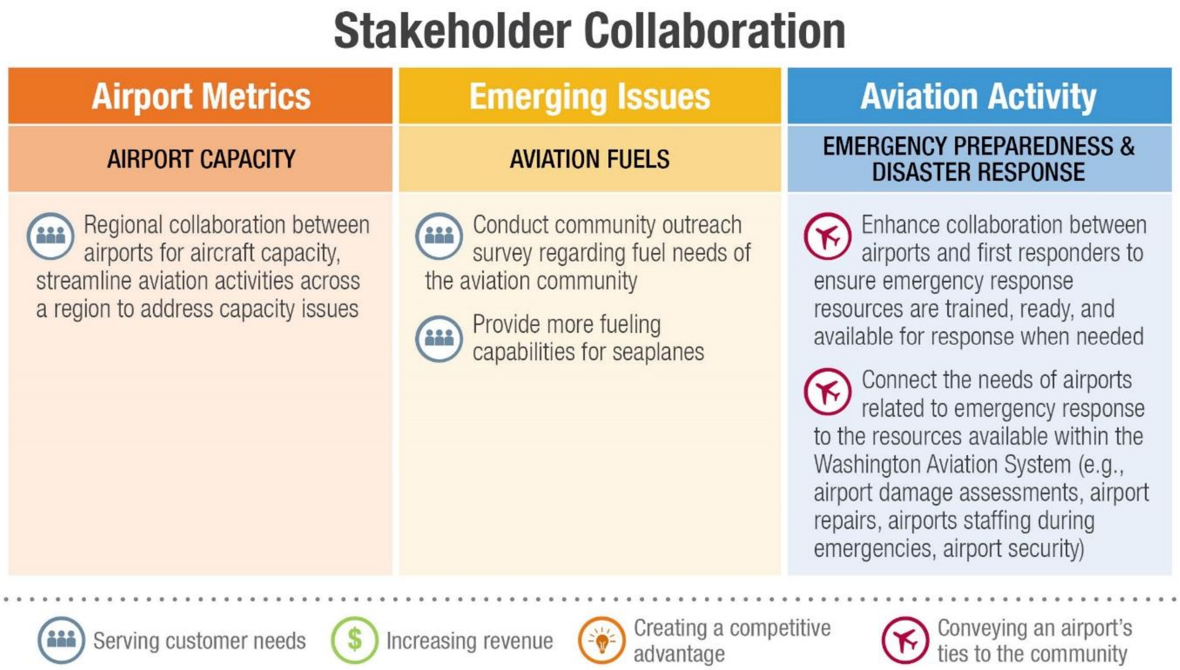


Figure 7-26. Alternative Airport Strategies – Examples of Industry/Community Partnerships

Industry/Community Partnerships

Airport Metrics

FINANCIAL SUSTAINABILITY

Support partnerships between airports with department of commerce, tourism bureau, and local businesses to connect ties between the airport and local community

Dedicate advertising space at airports for tourism opportunities

PILOT TRAINING

Partner with high schools/ middle schools to encourage career development in aviation (e.g., invite classes to airport open houses, provide tours, send airport staff or tenants to career days, host youth aviation programs on the airport)

Partner with the vast Aviation Community (e.g., Civil Air Patrol, Experimental Aircraft Association Young Eagles, other aviation organizations, and aviation volunteers)

Emerging Issues

NEXT GEN IMPLEMENTATION

Support partnering of FBOs and local avionic shops with industry representatives and ADS-B installation-qualified personnel to make installation services more readily available to aircraft owners across the state

AVIATION FUELS

Working with aviation partners to explore fuel alternatives. Exploring facility needs to provide those fuel alternatives

UNMANNED AERIAL SYSTEMS

Incorporate UAS subjects within STEM programs at airport-based education centers to introduce youth to the emerging industry and educate youth on safety in regards to small UAS/hobbyist operations, as many children now receive drones as gifts

Aviation Activity

EMERGENCY PREPAREDNESS & DISASTER RESPONSE

Discuss with airports and communities the role of the airport and surrounding community in the event of a natural disaster or heightened security event to support the understanding of the State's position of preparedness and how airports are contributing

Make sure that the airport is in the community's emergency plan

PERSONAL TRANSPORTATION & BUSINESS/CORPORATE TRAVEL

Conduct outreach to local businesses about what services the airport has to offer and connect the ties between the airport and local businesses

Consider joint marketing with private firms (e.g., work with charter aviation companies or jet rental services to communicate opportunities to support clients or customers)

Serving customer needs | Increasing revenue | Creating a competitive advantage | Conveying an airport's ties to the community

Industry/Community Partnerships (CONTINUED)

Airport Metrics

COMMERCIAL SERVICE

- Ensure TSA supports emerging commercial service airports
- SCASDP Working group
- Community surveys, "*Where would you like to travel by air*?"
- Partnership/collaboration between commercial operators/ services (ex. Alaska, Delta, UPS, and FEDEX at Sea-Tac). Working groups for solutions between commercial services and airport operators

MASTER PLAN UPDATES/LAND USE

- Work with community/ local planners so they can understand the importance of the airport and the needs of the pilots and operators (e.g., include local planners during master plan updates)
- Work with local planners during master plan updates
- Work with WSDOT Aviation to provide guidance to local planners about the needs of the community regarding the airport and the needs of the airport regarding the community

Emerging Issues

UNMANNED AERIAL SYSTEMS

- Incorporate STEM programs for UAS operations

Aviation Activity

COMMERCIAL SERVICE

- Ensure TSA services will be available when developing new commercial service airports
- Educate airport sponsors/ managers about commercial service opportunities/operations through regional SCASDP working groups
- Consider conducting community surveys: "Where would you like to travel by air?"
- Enhance partnerships/ collaboration between commercial operators/services (e.g., Alaska, Delta, UPS, and FEDEX at Sea-Tac) through working groups to identify problems and solutions between commercial services and airport operators

Serving customer needs | Increasing revenue | Creating a competitive advantage | Conveying an airport's ties to the community

Figure 7-27. Alternative Airport Strategies – Examples of Planning

Planning

Airport Metrics	Emerging Issues	Aviation Activity
AIRPORT CAPACITY		
During master plan updates, plan for the role that the specific airport plays within the Washington Aviation System and consider the capacity analysis from the WASP, including regional capacity constraints and opportunities		
FINANCIAL SUSTAINABILITY		
Prepare and maintain business plans that are relevant to the airport ("make general aviation airport business plans simple")		

Serving customer needs | Increasing revenue | Creating a competitive advantage | Conveying an airport's ties to the community

7.5 Summary

The information from the WASP serves as input in the decision-making process as WSDOT, regional organizations, and individual airports move toward enhancing the system's ability to meet demand and support the system users and communities throughout the state that rely on aviation. The analysis examined all three perspectives, providing options for consideration at each level.

The statewide analysis of opportunities related to emerging issues shows that there are numerous actions that can be considered by WSDOT to support emerging issues. These actions range from conducting outreach to engaging support related to infrastructure funding challenges.

The regional evaluation identified specific regions of the state with airfield and storage capacity concerns, as well as where existing primary activities are occurring throughout the state. This analysis can be used to identify opportunities for potential activities that are prevalent in Washington that may present revenue streams at airports. In terms of airfield capacity, five airports in the Puget Sound region were identified as likely to experience capacity constraints over the next 20 years. Options to address capacity were documented and it was noted that SEA is evaluating its capacity as part of its ongoing Master Plan. For storage capacity, there are many airports throughout the state that are anticipated to have insufficient storage by 2034 based on the WASP forecasts and evaluation of storage availability.

In addition, analysis of system accessibility on the regional level revealed that two-thirds of the state's population is within a 30-minute drive time of a public use airport to access general aviation services, as well as a 90-minute drive time of either SEA or GEG for commercial service. Larger general aviation service areas of 45 minutes for all airports increases the coverage and accessibility to over 97 percent for general aviation users. Commercial service coverage increases to 81 percent of the state's population when all the commercial service airports are considered, with 60-minute service areas for the remaining commercial airports (not SEA or GEG).

Finally, the airport alternative strategies provide a process that can be used by airports throughout the state to develop relevant strategies that can help to improve service to customers, increase revenue, create competitive advantages, and/or strengthen an airport's ties to the community.

CHAPTER 8 – MULTIMODAL PLANNING[1]

Multimodal planning is an important element of the aviation system planning process to review, coordinate, and enhance the connection of the aviation system to the other transportation modes. This planning encourages the coordination with other agencies to ensure the airport is properly connected to the full transportation system and the development is integrated with other agencies efforts to include the local MPO's and RTPO's. Airport owners should be represented during interagency planning activities to ensure updates to the comprehensive plans are in alignment with the airport's needs and goals.

WSDOT engages in multimodal planning activities Statewide for all modes of transportation. WSDOT is available to assist and support airport integration into the local planning processes as part of their continual planning activities. The current information on WSDOT multimodal planning can be found on the website at the following link.

http://www.wsdot.wa.gov/planning/default.htm

8.1 Planning

Transportation has a profound effect on the character of a community and affects access to jobs, education, recreation, health and wellness opportunities, and goods and services. WSDOT's strategic plan places an emphasis on Modal Integration, with a goal to "Optimize existing system capacity through better interconnectivity of all transportation modes." A multimodal approach to transportation system capacity identifies ways to address problems and improve system performance. WSDOT seeks to foster integrated multimodal planning in local, regional, and state planning efforts through the framework provided below.

8.1.1 Which Transportation Modes Should Cities and Counties Address in Their Plans?

Cities and counties should plan for all transportation modes available in their communities, such as walking, biking, driving, sharing a ride, or taking a bus, streetcar, train, boat, ferry, or airplane. They should also consider the needs of different types of travelers, such as commuters, students, tourists, farmers, freight haulers, and people with disabilities.

8.1.2 What Are the Benefits of Planning for All Modes?

Planning for all the ways people travel improves people's transportation choices and their ability to access jobs, shopping, health care, and other services efficiently and safely.

[1] *Working Together to Support Transportation Efficient Communities*, September 2015

Because travelers typically use more than one mode to make a trip, connecting the modes is also important. For example, bus riders are pedestrians for a portion of their travel (e.g., walking to the bus stop from their houses). Park-and-ride lots that serve vanpools and carpools, railways that regionally connect people with places and airports that provide access to more distant locations are all important pieces of the overall transportation system. Safe and efficient transportation choices are especially important to youth, seniors, people with low income, and people with disabilities.

8.1.3 How Is the Planning for All Modes Integrated?

There are many ways to integrate planning for walking, biking, driving, transit, and marine and air transport. Outlined in the following pages are some options. Cities and counties should select the approaches that best fit the context of their communities.

Invite Partners

Invite partners responsible for or interested in other transportation modes into the planning process. For example, encourage walking and biking advocates, local health and community planning departments, active living groups, regional and state transportation agencies, advocates for seniors and people with disabilities, schools, transit agencies, trucking associations, and private transportation providers to be involved in the planning process. Review partners' visions, policies, and plans to identify conflicts and opportunities to improve connections.

Adopt Policy Goals

Engage the public and other stakeholders to develop goals and adopt policies that support an integrated, multimodal network. Here are some examples:

- Develop a network of walking and biking facilities that connect residential, employment, community, and regional destinations, rather than standalone or spot improvements.
- Provide easily identifiable, safe, comfortable, efficient, and universally accessible connections between modes.
- Connect walking and biking facilities to transit stops, transit stations, rail stations, ferry terminals, airports, and park-and-ride lots.
- Reduce the time it takes walkers, bikers, and transit riders to reach their destinations by reducing crossing distances, increasing safe crossing opportunities, providing strategic shortcuts, and implementing pedestrian-prioritized signal timing at crosswalks.
- Provide adequate amenities to improve safety and comfort at transit stops, transit stations, rail stations, ferry terminals, airports, and park-and-ride lots (e.g., covered bike parking, street furniture, lighting, landscaping, shade, traffic calming).
- Work with transit agencies and private transportation providers to provide frequent, reliable transit, shuttle, and bike/car share and bike/car rental services at rail stations, ferry terminals, airports, and park-and-ride lots.
- Support the development and expansion of commute trip reduction incentive programs to encourage modes of transport other than driving alone.
- Establish local programs to educate citizens on alternatives to automobile use, encourage carpooling and use of transit, and promote walking and bicycling.

- Provide signage and wayfinding (e.g., transit signage and maps, time-to-destination signage, real-time signage adjacent to stations and terminals, smart technologies, in-pavement markings).
- Encourage economic development opportunities and aviation-related uses adjacent to airports.
- Improve economic vitality by connecting people and goods to regional markets.
- Ensure buses and trains are equipped to transport bikes, especially in dense urban areas.
- Address Americans with Disabilities Act requirements when planning walking and biking improvements.
- Manage demand and improve transportation system operations to optimize the performance of existing multimodal transportation infrastructure and services.

Select Performance Measures

Select performance measures that balance available or planned transportation modes and evaluate the best investments across the network.

- Identify a limited set of key measures to best support goals and objectives, guide investment decisions, and evaluate progress.
- Include both mode-neutral and mode-specific performance measures to gauge total effects on the system and specific deficiencies in individual modes.
- Build on required performance-based approaches, such as state asset management and safety plans, regional congestion management processes, and transit asset management and safety plans.
- Include measures that address both freight and people movement.
- Include measures that consider the mobility and accessibility needs of different members of the community.
- Engage the public and stakeholders to identify issues residents care about and ensure measures are easy to understand and resonate with the community.
- Establish a specific performance target for each measure.
- Collect baseline data and establish an appropriate time frame for evaluation.
- Provide context for performance results. Tell a story and combine data with pictures and interviews to explain performance results.
- Identify and remove institutional and organizational obstacles to performance-based decision making.

Map Existing Infrastructure and Collect Data

Use models, maps, field surveys, and other data collection tools to identify connection opportunities for each transportation mode and gaps in the multimodal network.

- Map walking and biking facilities (e.g., bike lanes, shared use paths, paved road shoulders, sidewalks, crossings), transit and ferry connections (transit stops and routes, transit stations, and ferry terminals), rail stations, airports, and park-and-ride lots.
- Map the street grid and identify freight routes and roadways with high vehicular speeds that would cause safety concerns for bikers and walkers.
- Identify 1/2-mile walk sheds and 3-mile bike sheds around transit and rail stations, ferry terminals, and airports.

- Identify existing state, regional, and local designated walking, biking, transit, rail, and freight routes, including high frequency transit corridors.
- Identify points of interest likely to generate walking, biking, and transit trips (e.g., schools, health care facilities, event centers, public institutions, parks, large employers).
- Identify locations with a history of collisions, identified by mode.
- Collect statistics on average block length, intersection density, walk score, density, employment, journey to work, and health.
- Assess the existing condition and characteristics of walking and biking facilities, transit stops, transit and rail stations, ferry terminals, and airports.
- Overlay the maps to identify areas that lack connectivity or present other obstacles to travel.
- Identify opportunities to link transportation facilities in your jurisdiction to those in adjacent jurisdictions.

Identify Strategies and Analyze Alternatives

- Designate which modes have priority on which transportation facilities in the overall transportation network.
- Allocate street space and adjust traffic operations based on modal priorities.
- Evaluate how modal priorities will affect other modes. For example, design roadways prioritized for bikers and walkers for slower vehicle speeds. Conversely, accommodate bikers and walkers on parallel routes where freight is a roadway priority.
- Identify supportive transportation system management and operations strategies, such as traffic management and channelization, intersection modifications, access management, improved traffic control devices, and parking management.
- Prioritize walking, biking, and transit improvements for
  - Corridors designated as walking, biking, or transit priorities
  - Locations with a history of safety problems
  - Locations expected to generate walking, biking, and transit trips, especially those serving youth, seniors, people with low-incomes, and disabled individuals (e.g., schools and medical facilities)
  - Areas where the community design is supportive (e.g., land zoned for mixed-use and compact development)
  - Transit corridors with frequent service (15 minutes or less)
  - Urban centers, high employment centers, high-capacity transit connections, and infill areas
- Involve the public in identifying and ranking different solutions, especially engaging underrepresented populations.

Implement the Plan

- Develop a work plan and agreements with other agencies to implement solutions.
- Form an implementation advisory committee.
- Implement walking and biking improvements in conjunction with the development of other roadway and transit improvements.

- Develop a plan to communicate with customers (e.g., brand frequent transit services, provide signage and wayfinding, distribute walk and bike route maps).
- Provide real-time travel information to the public for all modes.

8.2 Practical Solutions[2]

Practical Solutions is a modern, performance-based approach to transportation decision-making. This data-driven approach uses the latest tools and performance measures to support decision making and considers not just roads, but the entire transportation system. Low-cost efficiencies in operating highways, ferries, transit, and rail and reducing travel demand save money and avoid building costly new capacity.

Community engagement is a key factor in helping to develop Practical Solutions. Practical Solutions are found when all stakeholders work together to identify the purpose of action, assess data from all parts of the system, and examine a range of options before investment decisions are made. A new Corridor Sketch process is being used to present a range of strategies developed through performance-based planning. The Washington State Department of Transportation (WSDOT) is working on developing these sketches across the state to identify practical strategies and solutions that reflect a community's character.

WSDOT has implemented supporting policies and training for the agency's workforce and is using new tools to keep existing assets in good condition. The Practical Solutions approach will continue to evolve as WSDOT works with partners, communities, citizens, and businesses to find ways to bring low-cost, effective solutions to keep transportation vital for generations to come.

8.2.1 Moving Toward an Integrated System: Practical Solutions[3]

Integrating all forms of transportation to meet growing community needs is essential in an era of fewer resources. As demonstrated by recent legislation, planning goals, and directives, transportation providers at the state, regional, and local levels must plan, fund, design, build, and operate a transportation system for the 21st century.

This message is reinforced in a 2014 National Cooperative Highway Research Program report that suggests states change to "a maturity model in which DOTs enhance their ability to support sustainability by gradually shifting toward broad decision-making partnerships, risk-sharing between public and private sectors, integrated infrastructure ownership and operations strategies and sustainability-focused stewardship and regulation" that is routine and institutionalized throughout the state.

Transportation system integration requires all partners to pull from a larger, multimodal toolbox to consider solutions that can best serve the interests of communities and the traveling public. Highways and streets need to be considered as not just a stretch of roadway, but as a community asset with transit facilities and services; bicycle and pedestrian connections; major employment, education, social service, and residential destinations; and other aspects that affect and respond to the needs of people and communities around it. For WSDOT and local partners, this means a continued evolution from a focus on a single roadway, highway, or transit route toward collaboration focused on transportation system performance and thriving communities.

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[2] http://www.wsdot.wa.gov/Projects/PracticalDesign/

[3] *Washington State Public Transportation Plan*, June 2016

WSDOT's Practical Solutions approach facilitates more flexible and sustainable transportation investment decisions at every step in the transportation lifecycle, from planning and investment through design, construction, and operation.

WSDOT employees were recently directed to adopt the Practical Solutions approach via Secretary's Executive Order Number E1096.00:

> *The citizens of Washington expect the delivery of transportation services, programs, and projects that are necessary, high quality, appropriately scoped, and delivered efficiently at the right time and in the right location. In meeting this expectation, our systems must be sustainable. Recognizing this importance requires maintaining, preserving, and operating systems to achieve lowest lifecycle cost. When this cannot be achieved within a constrained budget, a process that considers cross asset tradeoffs that balance between performance and risks is necessary. The department is expected to develop clear base line condition assessments and identify quantifiable, evidence-based performance outcomes and predictable, consistent processes for planning, developing, and delivering projects to facilitate safety, mobility, and economic vitality, while promoting local business and jobs and providing for stewardship of the environment. The goal here is to maximize safety, enhance mobility, and encourage economic development through optimization of the transportation system at the lowest cost for as many communities as possible.*

8.3 Airport Land-Use Policy Overview[4]

The *WSDOT Airports and Compatible Land Use Guidebook* identifies policies local jurisdictions should consider when examining land-use topics.

8.3.1 Multimodal Transportation Policy

Identify, preserve, and enhance, through interjurisdictional planning, goals, policies, and development regulations that promote significant regional transportation linkages and multimodal connections to and from aviation facilities and employment centers.

8.3.2 Economic Policy

- Encourage economic development opportunities and aviation-related uses adjacent to airports and promote the efficient mobility of goods and services region-wide consistent with the economic development element and the regional transportation strategy.
- Protect the viability of the airport as a significant economic resource to the community by encouraging compatible land uses and densities and reducing hazards that may endanger the lives and property of the public and aviation users.

8.3.3 Public Health and Safety Policy

- Encourage the protection of the airport from adjacent incompatible land uses or activities that could impact the present and future use of the airport as an Essential Public Facility, endanger the lives of people on the ground, and promote inadvertent growth of incompatible land uses. Incompatible land

[4] *WSDOT Airports and Compatible Land Use Guidebook*, January 2011

uses may include residential, multi-family, height hazards, uses that attract large concentrations of people, wildlife hazards, and special uses, such as schools, hospitals and nursing homes, and explosive/hazardous materials.

- Ensure that the airport is protected from incompatible uses consistent with WSDOT Aviation Airport and Land Use Compatibility guidelines and best management practices.
- Recognize the airport as an essential public facility and discourage land uses that may promote incompatible development adjacent to it.
- Promote the safe operation of aviation facilities by encouraging compatible land uses and activities and discouraging uses or activities that will impede safe flight operations or endanger the lives of people on the ground.

In 1996 Washington amended the Growth Management Act and the planning enabling legislation to

- Require all towns, cities, and counties to discourage encroachment of incompatible development adjacent to public-use airports through adoption of comprehensive plans and development regulations.
- Require local jurisdictions to consult formally with aviation stakeholders.
- Charge WSDOT Aviation Division with providing technical assistance and participating in formal consultation.
- Identify airports as essential public facilities.

Uses that are incompatible when located adjacent to an airport, depending on a public-use airport's characteristics, location, and geography, may include:

- Residential development
- Wildlife hazards
- Height hazards
- Large public assembly facilities
- Special function land uses
- Light/glare
- Electronic signals
- Storage of hazardous/explosive material

8.3.4 Formal Consultation

Local jurisdictions are required to consult formally with WSDOT Aviation, airport owners, managers, private airport operators, general aviation pilots, and ports prior to adopting comprehensive plan policies or development regulations that may affect property adjacent to public-use airports. WSDOT Aviation recommends that local jurisdictions initiate formal consultation as early as possible in the planning process. This is to ensure that all parties have an opportunity to work together to find comprehensive solutions of mutual benefit that fulfill the intent of the legislation, consistent with local jurisdictions' land use planning authorities and obligations under law.

8.3.5 Requirements

- Include goals or policies that discourage incompatible uses (required).
- Describe all airport facilities and operations in the transportation inventory (required for airport sponsors).

- Recognize the airport as an essential public facility.

8.3.6 Recommendations

- Include an airport layout plan map of the airport facility.
- Include a map of the identified airport influence area.
- Include a map of the Federal Aviation Regulations Part 77 imaginary airspace surfaces.
- Include a description of the airport facility and policies that recognize the significance and benefit of the airport as a transportation hub as well as its importance for economic development.
- Include policies that recognize the benefit of airports for emergency medical and disaster response in the community.
- Adopt airspace and land use development regulations to implement comprehensive plans.

Development tools may include direct zoning, airspace overlays, and overlays for addressing specific activities in an underlying zone that may negatively impact compatibility and airport operations.

CHAPTER 9 – POLICY RECOMMENDATIONS

Achieving the vision set forth in the Washington Aviation System Plan requires new policy guidance and direction. The policy recommendations advance the vision set forth in the WASP by enhancing aviation ties between communities throughout the state and supporting the ability of Washington's airports to better serve their customers, increase revenue, partner, and enhance their competitive advantage.

The policy recommendations presented in this chapter have been developed in close consultation with public and private aviation system stakeholders and incorporate goals established in the Washington Transportation Plan 2035 Policy Plan (WTP). The WTP was organized according to the six statutory transportation policy goals, some of which closely align with the WASP. For each policy goal, strategies and recommended actions were identified. The relationships between the WTP and the WASP's goals and recommendations are noted below.

In addition to the WTP, the WASP also builds from Washington's 2009 Long-term Air Transportation System (LATS) Plan. LATS was authorized in 2005 by the Washington State Legislature which required WSDOT to study the long-term general aviation and commercial service needs, including an extensive evaluation of capacity.

A thriving state aviation system ultimately requires many types of partnership. WSDOT Aviation Division, local airports and communities and other public agencies each have a significant role in achieving WASP's goals and objectives through a range of actions to address needs of our aviation system and develop the economic and community potential of Washington State's system of airports.

The following policy recommendations are presented in accordance with the WASP's eight goal categories.

9.1 Aeronautical and Airport Safety

The goal of *Aeronautical and Airport Safety* is to ensure airports operate safely and efficiently. The objectives of this goal include attaining and maintaining WSDOT's airport metrics, including FAA design standards, and maintaining safe and clear approaches. The metrics provide minimum standards or recommendations on obstructions, weather services, and airfield geometry design that each airport should meet or have a plan in place to meet.

Safety is a top priority for Washington's entire transportation system and is one of the six transportation system policy goals of WSDOT. The following WTP policies were considered in developing safety policy goal policy recommendations in the WASP[1]:

[1] Washington Transportation Plan 2035 Policy Plan.

- Encourage all modal system operators – air, rail and water – to adopt a data driven approach to prioritize and target area that pose the greatest risks to safety and security.

- Continue to reduce airspace impacts due to wildlife and man-made structural obstructions to critical airspace near airports.

The policy recommendations that support aeronautical and airport safety are based on an extensive review of existing conditions and best practice infrastructure standards. The FAA recommends the standards and recommendations in Advisory Circular 150/5300-13A for use in the design of civil airports. Use of this AC is mandatory for all projects funded with federal grant monies through the Airport Improvement Program (AIP) and/or with revenue from the Passenger Facility Charges (PFC) Program. There remain airports in the system that are either not eligible for FAA funding or not federally obligated to meet these standards. Because these airports may still be used by the general public, it is recommended that a series of best practices and facility standards be developed to provide direction to those airports that fall outside of the FAA categories and guidance. To assist all airports in the system, funding should continue to be made available for projects aimed in meeting the safety goals and metrics that fall within FAA categories and guidance.

WSDOT continually strives to be proactive and supportive of all types of aviation activities. As currently defined, our aviation system does not take into consideration non-traditional airports beyond seaplane bases. It does not yet consider heliports or the evolving needs of Unmanned Aircraft Systems (UAS) and the possible emergence of Droneports. By considering inclusion of these other types of aeronautical activities, WSDOT can better plan for future needs related to these uses and how best to integrate them into the aviation system.

Policy recommendations for the Aeronautical and Airport Safety goal are therefore to:

- Develop facility objectives and best practices for state infrastructure standards for non-NPIAS and unobligated airports.

- Continue to prioritize state and federal resource allocation for projects that address federal and state standards, including maintaining safe and clear approaches to airports; continue to reduce airspace impacts due to wildlife and man-made structural obstructions to critical airspace near airports.

- Reconsider the aviation system definition and expand it to include heliports and future 'droneports.'

9.2 Economic Development and Vitality

The goal of *Economic Development and Vitality* is to support the ability of airports to advance the business opportunities that can create prosperity for the airport environment and the communities they serve. The objectives for this goal include supporting and increasing the opportunities for air transportation of goods and passengers, enhancing collaboration between airports and their communities to maintain and support economic growth and development, and increasing tenant revenues by promoting on-airport aerospace manufacturing jobs. Metrics for Economic

Development and Vitality include collaboration with government agencies on economic opportunities, partnerships with industry to support business activities and grow cargo activity.

By actively developing partnerships with local economic organizations, airports can identify and capitalize on future opportunities to grow the airport in a manner that is consistent with the community's drivers. Aligned with the airports metrics, it is recommended that WSDOT partner and collaborate with appropriate industry representatives to promote, support, and advocate for the individual airports and the overall system. Since air cargo activity has consistently risen over the past decade, an emphasis has been placed on working with the air cargo industry to determine trends and future needs. By participating in discussions and supporting economic development, WSDOT can better understand the needs and desires of the industry, and how it may contribute better to the economic vitality of the system.

Economic vitality is also one of the six transportation system policy goals of WSDOT. Recommended actions from the WTP related to airports under the economic vitality policy goal include[2]:

- Promote strategies that address the "first and last mile" of freight connectivity, including prioritizing key connections to ports, freight terminals, agriculture storage facilities, and airports.
- The Legislature should invest in designated freight corridors by making connections with ports (such as completing SR 509 to connect with I-5 near Sea-Tac and SR 167 to connect with the Port of Tacoma) and assist in the development of freight modal centers (such as airports and intermodal facilities) to maintain Washington's competitive advantage for trade.
- WSDOT should collaborate with the Department of Commerce, the Washington Tourism Alliance and smaller commercial service airports to explore the feasibility of maintaining or expanding flight offerings between smaller commercial service airports to "hub" airports.
- The Legislature should direct aviation taxes and fees to fund investments in airport infrastructure.
- The Legislature and WSDOT should treat aviation capacity as a resource and preserve, protect, and enhance such capacity through strategies focusing on airport operations, technology, safety, and land use. Consider strategic aviation system investments that can leverage the value of the aerospace industry and commercial travel to the State's economy.
- Congress and the FAA should continue to invest in aviation technologies, including NextGen and biofuels development, to meet future aviation needs and reduce greenhouse gas emissions.
- Local transportation plans should specifically protect difficult-to-site facilities and the routes that access those facilities, such as airports, marine and inland waterway ports, and intermodal

[2] Washington Transportation Plan 2035 Policy Plan.

facilities, from encroachment by incompatible land uses. These plans should anticipate and provide for potential future expansion of such facilities.

Following are the policy recommendations for the Economic Development and Vitality goal:

- Partner with government agencies (state, regional, airports) and industry freight representatives regarding air cargo data and needs to better understand demands, issues, and opportunities related to ground transportation, economic development, and financial investment.

- Building from WTP direction, collaborate with the Department of Commerce, the Washington Tourism Alliance and smaller commercial service airports to explore the feasibility of maintaining or expanding flight offerings between smaller commercial service airports to "hub" airports and promote aviation industries including maintenance, passenger service, and cargo activities throughout the State.

- Support implementation of strategic aviation system investments that leverage the value of the aerospace industry and commercial travel to the State's economy.

9.3 Education, Outreach, and Community Engagement

The goal of *Education, Outreach, and Community Engagement* is to promote aviation and its importance, impact, and activities on a broad level extending beyond just the airports. The objectives include promoting aviation education to enhance safety and community support, increasing community knowledge of the aviation systems to communicate airport benefits and contributions to local communities and economies, and promoting aviation activities matched to local and aviation community needs. Airport metrics included the recommendation to participate in aviation outreach and engagement through the local community, tourism boards, and academia.

A sustainable future for Washington's airports depends directly on community support and an ongoing workforce pipeline of talent to necessary to build and maintain airplanes and airports. By building public awareness about aviation's economic value to communities and emerging career opportunities in aviation, WSDOT can support a sustainable future for the aviation system. It is recommended that WSDOT continue its efforts to develop educational programs, identify new education partnerships and support industry organizational efforts.

It is also recommended that WSDOT update the 2012 Economic Impact Study to provide quantifiable data on the economic and fiscal impacts of each of the public use airports, and detail how aviation supports economic activities throughout the state.

These are the policy recommendations for the Education, Outreach, and Community Engagement goal:

- Update the State's aviation economic impact study and support economic development growth at airports.

- Demonstrate the benefits and contributions of the aviation system to local, regional, and statewide economies through educational and stakeholder activities.

- Identify collaborative, systematic approaches to enhance airport participation in local, regional and statewide transportation planning activities to recognize multimodal opportunities and needs that support airport activities.

- Continue educational outreach programs that facilitate information sharing across the state with pilots, airports, agencies, and organizations regarding aviation subjects ranging from airspace to land use, unmanned aircraft systems/drones, and aviation emerging issues.

9.4 Infrastructure Improvement, Preservation, and Capacity

Preservation is one of the six transportation system policy goals of the WTP. The goal of *Infrastructure Improvement, Preservation, and Capacity* is to ensure that Washington's aviation system is maintained and improved to handle both current and forecasted capacity. The objectives include providing access for aircraft during all weather conditions, maintaining the facilities to established WASP classification levels, and planning to meet emerging requirements in technology and infrastructure, such as the Next Generation Air Transportation System (NextGen). A minimum standard with the airport metric for Infrastructure Improvement, Preservation, and Capacity is to maintain the physical condition of the infrastructure, primarily the pavement. The metrics also recommend that airports ensure adequate capacity for future operations and based aircraft.

The capacity analysis conducted for WASP demonstrated that a few airports in Washington are at risk of exceeding acceptable airfield capacity thresholds within the forecast period and over 20 airports that are currently at 100 percent capacity for aircraft storage. Strategies are needed to sustain capacity by preserving the existing system as well as facilitating expansion, where necessary, with a combination of financial, legislative, and technological methods.

Research conducted for the WASP indicates that the FAA and WSDOT cannot provide the level of financial assistance necessary to complete all capital development projects desired or needed for Washington's aviation system. It is therefore recommended that WSDOT work with the industry to determine methods beyond traditional grant programs to fund infrastructure projects such as low costs loans, new technologies, alternative airport fee structures, or public-private partnerships.

New legislation may be required to facilitate airports' ability to access new funding tools. Legislation, for example, can help provide the justification for modifying fee structures or alternative tax strategies.

It will also be essential to prioritize funding for capital projects that preserve and improve the existing capacity such as pavement rehabilitation. WSDOT can play an important role in working with airports to ensure they are planning for future growth by regularly monitoring and addressing their maintenance needs.

Following are the policy recommendations for the Infrastructure Improvement, Preservation, and Capacity goal:

- Legislatively direct aviation taxes and fees to fund investments in airport infrastructure.
- Support aviation capacity as a resource from the Legislature and WSDOT by preserving, protecting and enhancing capacity through strategies focusing on airport operations, technology, safety, and land use.
- Emphasize as a priority and continue partnering with the FAA, Washington State Transportation Commission, and others to develop viable solutions to provide adequate future capacity to accommodate documented growth in commercial service demand.
- Continue to provide funding support for pavement, including preservation and maintenance, to continue stewardship of the most critical infrastructure element of the airport system.
- Partner and collaborate with airports and regions identified as having aircraft storage capacity constraints to determine feasible mechanisms, such as a revolving loan fund, that can be used to accommodate facility requirements.
- Continue to seek to implement funding and non-funding airport infrastructure solutions.

9.5 Aviation Innovation

The goal of *Aviation Innovation* is to support new, emerging and innovative technologies and processes in the aviation system and aeronautics. These innovations at airports include NextGen, UAS, alternative fuels, aircraft innovation, and the use of new technologies at airports and in flight. Further, the use of UAS, or drones should be actively addressed to optimize integration into the current aviation system while minimizing negative impacts to the general public. As aircraft innovation and UAS evolve to allow for general use, it will also be necessary to consider future intermodal connections to roadways and unique airport improvements. The metrics recommend that airports provide evidence that they are tracking and planning for the integration of innovative infrastructure and activities to meet aviation innovation needs.

By supporting and partnering in the research and advancement of the technologies through industry providers, aviation related associations, and academia, WSDOT and airports can stay informed and involved in evolving programs. Programs may be as simple as participating in a survey or providing meeting space, or as complex as testing out new material for a construction project. It is specifically recommended that WSDOT and the aviation community continue to engage in and monitor research on infrastructure needs and laws and policies regarding drones. This will allow WSDOT to provide best practices, adequate and proper funding, and ensure impacts to the local communities are minimized.

Following are the policy recommendations for the Aviation Innovation goal:

- Seek opportunities to develop and continue partnerships to sustain and grow Washington's prominence in leading aviation innovation, fostering strategies that support education, training, maintenance, and development of innovative technologies in all areas including aerospace manufacturing.

- Continue engaging at the national level on unmanned aircraft system (UAS)/drone policy and regulation to understand the safety, integration, privacy, and community impacts and provide the best possible integration for Washington citizens, airports, and the overall aviation system.

- Work with partners and stakeholders to determine whether government should establish policy for zones where UAS activity should be prohibited or regulated.

- Host working groups to explore possible future infrastructure needs associated with aircraft innovation.

9.6 Modal Mobility, Capacity, and Accessibility

The goal of *Modal Mobility, Capacity, and Accessibility* is to ensure airports are easily accessible to the general public. Objectives include providing adequate ground access to and from the airport, supporting road capacity access initiatives, and supporting and improving multimodal connections. The airport metrics address ground access through optimization of road access, providing adequate capacity, enhancing signage, and collaboration with public transit agencies.

Mobility is also one of the six transportation system policy goals of WSDOT and the WTP. The WTP provides specific policy direction related to airports under the mobility policy goal as follows[3]:

- Identify gaps and improve intermodal connectivity for freight movement (e.g., ship to rail or truck, and air to truck).

- Encourage partnerships among the state, counties, cities, and transit operators to develop and implement strategies to improve connections between cities, counties and regions for both freight and passenger modes. Approaches may range from improving multimodal connections, such as completing gaps between adjacent service areas and synchronizing schedules among different service providers, to adding capacity strategically for all modes, including public transportation, by completing the system improvements underway today.

Connectivity to airports has been identified as a reoccurring concern across the nation as airports are not always adequately considered in the regional transportation planning process. It is recommended that WSDOT increase coordination, communication, and partnerships between the aviation system and other modes of transportation available with the local communities, region, and statewide modal

[3] Washington Transportation Plan 2035 Policy Plan.

systems. It is also recommended that WSDOT works with individual airports to determine adequate signage is provided at and around their facilities to provide suitable wayfinding for users. Accessibility will be improved to airports when they are linked to the overall transportation system within the State.

It is also recommended that WSDOT pursue a statewide system on NextGen to determine the current and future infrastructure needs of the system. NextGen is set to modernize the national aviation system which will enhance safety and improve efficiency. By identifying deficiencies and opportunities with NextGen improvements, WSDOT will also assist in achieving other WASP goals identified in this study. The Emerging Issues Paper on NextGen identified probable changes to airspace, airport design, and weather systems within Washington with the implementation of NextGen.

Following are the policy recommendations for the Modal Mobility, Capacity, and Accessibility goal:

- Increase multimodal coordination, communication, and partnerships between airports and other modal entities (state, regional, local transportation planning entities) to strengthen connectivity between modal planning and results in identification of policies that support multimodal needs.

- Identify signage, access roads, and ground transportation options that can be improved to support airport accessibility.

- Pursue a statewide NextGen study that will address challenging airspace issues.

9.7 Stewardship

The goal of *Stewardship* is to ensure airports strengthen their long-term welfare through prudent planning and management of their resources. These resources include physical infrastructure (such as the pavement, terminals, and hangars), personnel (such as staff, tenants, and users), and financial management (such as grants, bonds, and general funds). Objectives include protecting investments by implementing and maintaining planning documents, conducting preventive and corrective maintenance of the infrastructure, and advocating for land-use protection and height hazard zoning. Stewardship contains metrics that are considered minimum standards for airports to meet, as well as recommendations that promote achievement without establishing minimums. Airports should complete inspections and maintain records of the maintenance performed on existing infrastructure and regularly go through the planning process to ensure the airport is meeting demand and taking advantage of opportunities. It is recommended that airports encourage and promote protection of the airport through provision of land use compliance and emergency response plans.

As with many of the other WASP goals, stewardship policy recommendations involve partnering with the aviation industry and other associated entities to ensure well-rounded programs that have the buy-in of the community and advocates for the importance, impact, and preservation of aviation. WSDOT can play a role in supporting the planning of projects that strategically develop the system and support economic viability and capacity improvements. These plans may include economic impact studies, business plans, master plans, pavement maintenance management plans, community engagement tools and others. It is also recommended that WSDOT support the development of municipal codes that prevent future incompatible land use near airports.

Following are the policy recommendations for the Stewardship goal:

- Develop plans that promote stewardship of the existing investment in airport facilities that include participation by local, regional, and State government, business, and industry organizations.

- Support development of airport plans and municipal codes that reflect airport needs, implement land use controls for protection from encroachment, and include business planning and evaluation of revenue opportunities to promote land use compatibility and financial diversification.

- Partner with government, communities, academia, and industry to develop aeronautics/ aviation awareness, networking, and mentoring opportunities.

- Continue to grow partnerships and programs to promote general aviation growth.

9.8 Sustainability

The goal of *Sustainability* is to promote the economic vitality (E), operational efficiency (O), natural resources (N), and social responsibility (S) of airports and the overall system, utilizing the EONS concept of sustainability. The objectives include reducing environmental impacts, providing an aviation system that is sustainable, and implementing financial sustainability measures. At a minimum, per the airport metrics, airports should be implementing initiatives that provide for financial sustainability. It is also recommended that airports strive for environmental sustainability with an emphasis on waste, air and water quality, wildlife, and energy as well as have land use controls in place to ensure compatible land use.

Airports can adjust their environmental impact in simple and complex ways, from establishing recycling programs, to utilizing alternative fuels and/or managing wildlife on the airfield. If an airport's development is subject to environmental review under the National Environmental Policy Act (NEPA), a framework for sustainability could be identified as an additional strategy. It is recommended that WSDOT promote sustainability for airports and the community as well as support investment in aviation technologies that are in line with sustainability initiatives. Promotion of sustainability may be in conjunction with promotion and education through other WASP goals.

Following are the policy recommendations for the Sustainability goal:

- Promote sustainable best practices identified on the state and national level that lead to financially and environmentally sustainable development.

- Support investment in aviation technologies, including NextGen and biofuels development, to meet future aviation needs and reduce greenhouse gas emissions.

Table 9-1 summarizes the WASP policy recommendations.

Table 9-1. Summary of Policy Recommendations by Goal

GOAL	POLICY RECOMMENDATIONS
Aeronautical and Airport Safety 	▪ Develop facility objectives and best practices for state infrastructure standards for non-NPIAS and unobligated airports. ▪ Continue to prioritize state and federal resource allocation for projects that address federal and state standards, including maintaining safe and clear approaches to airports. ▪ Continue to reduce airspace impacts due to wildlife and man-made structural obstructions to critical airspace near airports. ▪ Reconsider the aviation system definition and expand it to include heliports and future 'droneports'.
Economic Development and Vitality 	▪ Partner with government agencies (state, regional, airports) and industry freight representatives regarding air cargo data and needs to better understand demands, issues, and opportunities related to ground transportation, economic development, and financial investment. ▪ Building from WTP direction, collaborate with the Department of Commerce, the Washington Tourism Alliance and smaller commercial service airports to explore the feasibility of maintaining or expanding flight offerings between smaller commercial service airports to "hub" airports and promote aviation industries including maintenance, passenger service, and cargo activities throughout the State. ▪ Support implementation of strategic aviation system investments that leverage the value of the aerospace industry and commercial travel to the State's economy.
Education, Outreach, and Community Engagement 	▪ Update the State's aviation economic impact study and support economic development growth at airports. ▪ Demonstrate the benefits and contributions of the aviation system to local, regional, and statewide economies through educational and stakeholder activities. ▪ Identify collaborative, systematic approaches to enhance airport participation in local, regional and statewide transportation planning activities to recognize multimodal opportunities and needs that support airport activities. ▪ Continue educational outreach programs that facilitate information sharing across the state with pilots, airports, agencies, and organizations regarding aviation subjects ranging from airspace to land use, unmanned aircraft systems/drones, and future topics arising from emerging issues.

GOAL	POLICY RECOMMENDATIONS
Infrastructure Improvement, Preservation, and Capacity 	▪ Legislatively direct aviation taxes and fees to fund investments in airport infrastructure. ▪ Support aviation capacity as a resource from the Legislature and WSDOT by preserving, protecting and enhancing capacity through strategies focusing on airport operations, technology, safety, and land use. ▪ Emphasize as a priority and continue partnering with the FAA, Washington State Transportation Commission, and others to develop viable solutions to provide adequate future capacity to accommodate documented growth in commercial service demand. ▪ Continue to provide funding support for pavement, including preservation and maintenance, to continue stewardship of the most critical infrastructure element of the airport system. ▪ Partner and collaborate with airports and regions identified as having aircraft storage capacity constraints to determine feasible mechanisms, such as a revolving loan fund, that can be used to accommodate facility requirements. ▪ Continue to seek to implement funding and non-funding airport infrastructure solutions.
Aviation Innovation 	▪ Seek opportunities to develop and continue partnerships to sustain and grow Washington's prominence in leading aviation innovation, fostering strategies that support education, training, maintenance, and development of innovative technologies in all areas including aerospace manufacturing. ▪ Continue engaging at the national level on unmanned aircraft systems (UAS)/drones policy and regulation to understand the safety, integration, privacy, and community impacts and provide the best possible integration for Washington citizens, airports, and the overall aviation system. ▪ Work with partners and stakeholders to determine whether government should establish policy for zones where UAS activity should be prohibited or regulated. ▪ Host working groups to explore possible future infrastructure needs associated with aircraft innovation.
Modal Mobility, Capacity, and Accessibility 	▪ Increase multimodal coordination, communication, and partnerships between airports and other modal representatives (state, regional, local transportation planning entities) that strengthens connectivity between modal planning and results in identification of policies that support multimodal needs. ▪ Identify signage, access roads, and ground transportation options that can be improved to support airport accessibility. ▪ Pursue a statewide NextGen study that will address challenging airspace issues.

GOAL	POLICY RECOMMENDATIONS
Stewardship 	▪ Develop plans that promote stewardship of the existing investment in airport facilities that include participation by local, regional, and State government, business, and industry organizations. ▪ Support development of airport plans and municipal codes that reflect airport needs, implement land use controls for protection from encroachment, and include business planning and evaluation of revenue opportunities to promote land use compatibility and financial diversification. ▪ Partner with government, communities, academia, and industry to develop aerospace/aviation awareness, networking, and mentoring opportunities. ▪ Continue to grow partnerships and programs to promote general aviation growth.
Sustainability 	▪ Promote sustainable best practices identified on the state and national level that lead to financially and environmentally sustainable development. ▪ Support investment in aviation technologies, including NextGen and biofuels development, to meet future aviation needs and reduce greenhouse gas emissions.

Source: WSDOT Aviation, 2016

9.9 Continuous Planning

In addition to identifying policy recommendations, an important outcome of the WASP is other recommendations that will assist WSDOT with continuing to plan for the future aviation system. As the aviation system is under constant change through internal and external factors, continuous planning is necessary to ensure the future vitality and sustainability of the Washington State aviation system. System plans are typically undertaken at various intervals ranging from 5 to 10 years depending on the needs and changes the system has experienced. If the system is examined or monitored more frequently, on a more continuous basis, WSDOT can appropriately adjust its plans and actions as new information is discovered and continue to adhere to the initial goals and objectives of the WASP.

There are several recommendations related to continuous planning that WSDOT can consider to preserve and enhance the system as well as provide for the longevity of the WASP. Some of these plans require periodic updates based on recurring information such as pavement conditions, while others may need a one-time in depth analysis of the current conditions and potential impacts such as NextGen.

The following presents a summary of continuous planning activities for WSDOT consideration.

9.9.1 Airport Pavement Management System (APMS)

Pavement is one of the most important infrastructure elements of an airport. It is critical, and required by the FAA for obligated airports, that airports have a pavement maintenance management plan, address the condition of their pavement condition, and identify the status of implementation of maintenance activities as part of grant assurances. Maintenance and preservation of pavements is a significant capital investment and ongoing maintenance allows for repairs that help to extend the useful life of the major investments.

Approximately every five years WSDOT conducts a system-wide study of pavement to assess the relative condition of pavements for selected Washington airports. WSDOT uses this tool to identify system pavement needs, shape programming decisions for federal and state grant aid, provide information for legislative decision making, and assist airport sponsors in making informed planning decisions. The program also develops accurate pavement inventories and identifies necessary maintenance, repair, rehabilitation and reconstruction projects.

WSDOT should continue to conduct system-wide studies of pavement conditions to proactively identify the needs and priorities of individual airports and the system as a whole. By gathering this information regularly, WSDOT can monitor the implementation of appropriate maintenance, which can lead to cost savings. The last Washington APMS was conducted in 2013 and was accompanied by a manual that explained the type of deteriorations and developing and implementing a maintenance and repair (M&R) plan, including obtaining grants for rehabilitation projects.

9.9.2 Economic Impact Study

Economic Impact Studies provide a wealth of information that can used to educate the local, regional, and state policymakers and general public on the contributions and values of aviation activities. By regularly updating the Economic Impact Study, WSDOT can provide quantifiable data on the economic and fiscal impacts of airports and aviation on a statewide and individual airport basis. The analysis can also demonstrate how aviation supports economic growth and the vitality of the state, including promoting partnership between aviation, elected officials, and organizations. It is recommended this study be updated every five years to accurately reflect the internal and external factors of the system, including the changes that are quantifiable and qualitative.

WSDOT's last Economic Impact Study was published in 2012 and estimated the total impact attributable to airport-related activity at the 135 public use airports included 248,500 jobs, $15.3 billion in wages and $50.9 billion in total economic activity. From a fiscal perspective, more than $791 million in tax revenue was identified as being generated from aviation activities, with over $548 million supporting the State of Washington general fund. Local governments collect approximately $243 million in tax revenue.

9.9.3 State Aviation System Plan (WASP)

The WASP is the statewide aviation planning document that provides direction to WSDOT on the aviation system's needs and future development. As with many statewide planning initiatives, regular updates to the WASP are necessary to evaluate the system's function and need for changes in policy and guidance. Updating the WASP allows WSDOT to be proactive in responding to changes in the industry, and provides a strategic direction for the future. The WASP also reaffirms WSDOT's role as an advocate in the preservation of aviation facilities, safe air transportation, capacity, and mitigation of environmental impacts. It is recommended this plan be updated every five years to provide an accurate snapshot of the region and be able to proactively adjust for variations and new trends.

9.9.4 Statewide Capacity Study

As the WASP's capacity analysis revealed, there is a potential deficit in airfield and storage capacity that is anticipated to deteriorate over the next 20 years. The study also provided a cursory examination of air cargo needs which shows projected growth, however, the ability of the system to adequately serve this important segment of aviation was not evaluated. As cargo operations more commonly take place at commercial airports due to their size and available facilities, an airfield and air cargo capacity study may be conducted together. This in-depth analysis of statewide opportunities should be considered to more clearly define potential congestion that can impact the State's economy through inhibiting growth in aviation activities that are critical to the state's success. This subsequent analysis could identify appropriate and implementable strategies that could proactively address capacity issues and industry needs.

9.9.5 Best Management Practices

Through the WASP, WSDOT has established a series of Airport Metrics that identify necessary and recommended infrastructure and practices that should be implemented at airports to achieve the goals and objectives outlined in the WASP. The Airport Metrics can be used to measure an airport's contributions to the system and how each airport impacts the overall system's performance. While the Airport Metrics are tailored to airport classifications, the individual airport metrics can be compiled to evaluate the overall system's performance.

The Airport Metrics are supported by Alternative Airport Strategies that assist airports by identifying a process and a starting point for identifying various strategies that can be used by airports to better serve customer needs, increase airport revenue, create a competitive advantage, and convey the airport's ties to the community. These strategies build on the Airport Metrics, Emerging Issues, and Aviation Activities identified in the WASP and identify a range of alternatives that are focused on infrastructure improvements, education and training, stakeholder collaboration, and industry/community partnerships from which to identify potential areas of opportunity.

The information in the WASP is a framework and is not detailed for use in implementing projects or practices at an airport level. To further aid airports, WSDOT is planning to prepare a "Best Management Practices" (BMPs) publication that will provide more definition and information for airports to consider. These practices can tie into the goals, objectives, and metrics of the WASP to promote individual airports working towards a cohesive aviation system. It is recommended that WSDOT involve multiple stakeholders in the BMP study from professional consultants, current airport managers, industry leaders, and the community to provide information on a variety of topics such as administration, finances, maintenance, and compliance.

9.9.6 Statewide NextGen Analysis

The WASP's emerging issues paper summarized the FAA's plans to continue implementation of NextGen, leading to an enhanced air traffic system that provides benefits to pilots, passengers, airports, and the general public. The Puget Sound Regional Council (PSRC) developed a regional NextGen study to help the region's general aviation airports in preparing to accommodate the new technologies associated with NextGen. While NextGen satellite-based arrival procedures have been implemented at many commercial airports like Sea-Tac, most general aviation airports are not yet realizing the identified benefits of NextGen such as saving fuel, reducing emissions and noise, and improving safety.

A statewide study that evaluated how other airports throughout Washington might benefit and the best ways to implement the technologies would help WSDOT and individual airports understand the impacts on infrastructure and procedures related to the modernization of the national aviation system. The timing of such a study needs to be well coordinated with FAA to ensure the latest policy and implementation plans are considered, providing WSDOT and airports adequate time to plan and complete any related projects to support NextGen implementation.

9.9.7 Land Use Compatibility and Stakeholder Engagement

As evident in many of the policy recommendations and airport metrics, WSDOT places high emphasis on ensuring aircraft can safely operate to, from, and around airports and engaging the public and stakeholders. As part of the WASP, WSDOT has conducted obstruction studies to meet the FAA's latest guidelines utilizing Geographic Information Systems (GIS). Conducting additional studies and obtaining data in this format for more of Washington's airports helps to promote safer operations through identification of clear and protected airspace. The data can also be used as part of a program to continue encouraging local land use compatibility planning and community outreach. These plans can help ensure that future objects do not impact the airspace surrounding an airport or pose other threats and requires the support of the local municipality.

9.10 Summary

The policy recommendations set forth in the WASP establish an agenda for future consideration as WSDOT continues with the planning, programming, and development of the state's aviation system. Each policy recommendation serves as a step towards achieving the established WASP goals. As the recommendations are implemented, it is likely that aviation ties between communities throughout the state will be enhanced and Washington's airports will be poised to better serve their customers, increase revenue, partner, and improve their competitive advantage.

Implementation of policy recommendations will require a partnership. WSDOT Aviation Division, local airports and communities, and other public agencies each have a significant role in the statewide airport system and must work together to achieve the WASP's goals and objectives. The policy recommendations serve as a starting point to work together toward the continued successful development of the aviation system which supports the Washington State's transportation, economic, and safety needs.

In addition to policy recommendations, additional planning efforts needed to support implementation of the WASP were identified. These continuous planning activities identify efforts that can assist in preserving and enhancing the system and provide for the longevity of the WASP's analysis and recommendations.


Appendices

July 2017

Washington State
Department of Transportation

WASP
Washington Aviation System Plan

Appendix A

July 2017

Washington State
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WASP
Washington Aviation System Plan

GLOSSARY OF TERMS

A

A-WEIGHTED SOUND LEVEL: The sound pressure level which has been filtered or weighted to reduce the influence of low and high frequency (dBA).

AC: Advisory Circular published by the Federal Aviation Administration.

ADPM: Average Day of the Peak Month

AIP: Airport Improvement Program of the FAA.

AIR CARRIER: The commercial system of air transportation, consisting of the certificated air carriers, air taxis (including commuters), supplemental air carriers, commercial operators of large aircraft, and air travel clubs.

AIR NAVIGATIONAL FACILITY (NAVAID): Any facility used for guiding or controlling flight in the air or during the landing or takeoff of an aircraft.

AIR ROUTE SURVEILLANCE RADAR (ARSR): Long-range radar which increases the capability of air traffic control for handling heavy enroute traffic. An ARSR site is usually located at some distance from the ARTCC it serves. Its range is approximately 200 nautical miles. Also called ATC Center Radar.

AIR TAXI: Aircraft operated by a company or individual that performs air transportation on a non-scheduled basis over unspecified routes usually with light aircraft.

AIRCRAFT APPROACH CATEGORY (AAC): A grouping of aircraft based on a reference landing speed (V_{REF}) if specified, or if V_{REF} is not specified, 1.3 times stall speed (V_{SO}) at the maximum certificated landing weight.

AIRCRAFT LANDING GEAR: The main landing gear consists on a single wheel under each wing. Single-wheel landing gear typically used on a single-engine aircraft that weighs less than 20,000 pounds.

AIRCRAFT MIX: The relative percentage of operations conducted at an airport by each of four classes of aircraft differentiated by gross takeoff weight and number of engines.

AIRCRAFT OPERATION: The airborne movement of aircraft in controlled or noncontrolled airport terminal areas and about a given en route fix or at other points where counts can be made. There are two types of operations - local and itinerant. An operation is counted for each landing and each departure, such that a touch-and-go flight is counted as two operations.

AIRCRAFT TYPES: An arbitrary classification system which identifies and groups aircraft having similar operational characteristics for the purpose of computing runway capacity.

AIRPLANE DESIGN GROUP (ADG): A classification of aircraft based on wingspan and tail height. When the aircraft wingspan and tail height fall in different groups, the higher group is used.

AIRPORT: An area of land or water that is used or intended to be used for the landing and taking off of aircraft, and includes its buildings and facilities, if any.

AIRPORT AVAILABLE FOR PUBLIC USE: An airport available for use by the public with or without a prior request.

AIRPORT ELEVATION: The highest point of an airport's usable runways, measured in feet above mean sea level.

AIRPORT LAYOUT PLAN (ALP): A scale drawing of existing and proposed airport facilities, their location on an airport, and the pertinent clearance and dimensional information required to demonstrate conformance with applicable standards.

AIRPORT MASTER PLAN (AMP): A long-range plan for development of an airport, including descriptions of the data and analyses on which the plan is based.

AIRPORT REFERENCE CODE (ARC): A coding system used to relate airport design criteria to the operational and physical characteristics of the airplanes intended to operate at an airport.

AIRPORT REFERENCE POINT (ARP): The latitude and longitude of the approximate center of the airport.

AIRPORT SURVEILLANCE RADAR (ASR): Short-range radar used by local air traffic control for handling terminal area aircraft traffic.

AIRPORT USE AGREEMENT: Legal contract for the air carriers' use of the airport and leases for use of terminal facilities.

AIR TAXI/AIR CHARTER OPERATION: Includes operations which are not major air carrier operations, but which are performed in revenue service, on aircraft with fewer than 60 seats. This includes carriage of passengers in unscheduled, on-demand operations; and cargo operations. Also includes operations of some corporate aircraft carrying passengers in unscheduled, on-demand operations.

ALSF-1: Approach Light System with Sequence Flasher Lights

ALS: Approach Light System

AMBIENT NOISE: All encompassing noise associated with a given environment, being usually a composite of sounds from many sources near and far.

AMBIENT NOISE LEVEL: The level of noise that is all encompassing within a given environment for which a single source cannot be determined. It is usually a composite of sounds from many and varied sources near to and far from the receiver.

ANCLUC: Airport Noise and Compatible Land Use Control plan; an FAA sponsored land use compatibility planning program preceding Part 150 Airport Noise Compatibility Program.

APPROACH CONTROL SERVICE: Air traffic control service provided by a terminal area traffic control facility for arriving and departing IFR aircraft and, on occasion, VFR aircraft.

APPROACH FIX: The point from or over which final approach (IFR) to an airport is executed.

APPROACH PROTECTION EASEMENT: A form of easement which both conveys all of the rights of an avigation easement and sets specified limitations on the type of land uses allowed to be developed on the property.

APPROACH SPEED: The recommended speed contained in aircraft manuals used by pilots when making an approach to landing. This speed will vary for different segments of an approach as well as for aircraft weight and configuration.

APPROACH SLOPE: Imaginary areas extending out and away from the approach ends of runways which are to be kept clear of obstructions.

APPROACH SURFACE: An element of the airport imaginary surfaces, longitudinally centered on the extended runway centerline, extending upward and outward from the end of the primary surface at a designated slope.

APRON: A defined area on an airport or heliport intended to accommodate aircraft for purposes of loading or unloading passengers or cargo, refueling, parking, or maintenance. With regard to seaplanes, a ramp is used for access to the apron from the water.

AREA NAVIGATION (RNAV): A method of navigation that permits aircraft operations on any desired course within the coverage or stationed-reference navigation systems or within the limits of self-contained system capability.

ARFF: Aircraft Rescue and Fire-Fighting

ARTS-III: Automated Radar Terminal Service - Phase III. A terminal facility in the air traffic control system using air ground communications and radar intelligence to detect and display pertinent data such as flight identification, altitude and position of aircraft operating in the terminal area.

ASDA: Accelerate Stop Distance Available

ASOS: Automated Surface Observing System

ASV: Annual Service Volume - a reasonable estimate of the airfield's annual capacity.

ATCT: Airport Traffic Control Tower

ATC: Air Traffic Control

B

BASED AIRCRAFT: An aircraft permanently stationed at the airport, usually by some form of agreement between the aircraft owner and airport management.

BEST MANAGEMENT PRACTICES OR BMP: A term used commonly to define the physical or behavioral practices that ensure environmental protection)

BLAST FENCE: A barrier used to divert or dissipate jet blast or propeller wash.

BUILDING RESTRICTION LINE (BRL): A BRL is an imaginary line which identifies suitable locations for development on an airport.

BUSINESS JET: Any of a type of turbine powered aircraft carrying six or more passengers and weighing less than approximately 90,000 pounds gross takeoff weight.

C

CAT I: Category I Instrument Landing System. An instrument approach or approach and landing with a Height Above Threshold (HATh) or minimum descent altitude not lower than 200 feet and with either a visibility not less than ½ statute mile, or a runway visual range not less than 1800 feet.

CAT II: Category II Instrument Landing System. An instrument approach or approach and landing with a Height Above Threshold (HATh) lower than 200 feet but not lower than 100 feet and a runway visual range not less than 1200 feet.

CAT III: Category III Instrument Landing System. An instrument approach or approach and landing with a Height Above Threshold (HATh) lower than 100 feet, or no HATh, or a runway visual range less than 1200 feet.

CEILING: Height above the earth's surface to the lowest layer of clouds or obscuring phenomena. (AIM)

CENTER'S AREA: The specified airspace within which an air route traffic control center provides air traffic control and advisory service.

CHARTER OPERATION: Defined by the FAA as being a type of Air Taxi operation typically above 60 seats non-scheduled to include vacation tour groups and non-scheduled air freight operations.

CIRCLING APPROACH: A maneuver initiated by a pilot to align an aircraft with a runway for landing when a straight-in instrument approach is not possible. This maneuver requires ATC clearance and that the pilot establishes visual reference to the airport.

CL: Centerline

CLEARWAY: A defined rectangular area beyond the end of a runway cleared or suitable for use in lieu of runway to satisfy takeoff distance requirements.

COMM.: Communications

COMMERCIAL ACTIVITIES: Airport related activities which may offer a facility, service or commodity for sale, hire or profit. Examples of commodities for sale are: food, lodging, entertainment, real estate, petroleum products, parts and equipment. Examples of services are: flight training, charter flights, maintenance, aircraft storage and tie down.

COMMERCIAL OPERATOR: A person who, for compensation or hire, engages in the carriage by aircraft in air commerce of persons or property, other than as an air carrier.

COMMERCIAL SERVICE AIRPORT: A public airport which received scheduled passenger service and enplanes annually 2,500 or more passengers.

COMMUTER AIRLINES: A category of airline classified according to the type of aircraft used (maximum of 60 seats) and their operating frequency (at least five scheduled round trip flights per week between two or more points).

CONICAL SURFACE: An imaginary surface extending upward and outward from the periphery of the horizontal surface at a slope of 20 to 1 for a horizontal distance of 4,000 feet.

CONCESSION AGREEMENT: An agreement between the airport and a concession regarding the conduct of business on airport property.

CONNECTION: A passenger who boards an aircraft directly after deplaning from another flight. On-line single carrier connections involve flights of the same carrier, while interline or off-line connections involve flights of two different carriers. This term can also be applied to freight shipments.

CONTROLLED AREA: Airspace within which some or all aircraft may be subject to air traffic control.

CONTROL TOWER: A central operations facility in the terminal air traffic control system consisting of a tower cab structure (including an associated IFR room if radar equipped) using air/ground communications and/or radar, visual signaling and other devices to provide safe and expeditious movement of terminal air traffic.

CONTROLLED AIRSPACE: An airspace of defined dimensions within which air traffic control service is provided to IFR flights and to VFR flights in accordance with the airspace classification, Class A, Class B, etc. CROSSWIND RUNWAY - A runway aligned at an angle to the prevailing wind which allows use of an airport when crosswind conditions on the primary runway would otherwise restrict use.

D

DAY-NIGHT AVERAGE SOUND LEVEL (DNL): The noise metric adopted by the U.S. Environmental Protection Agency for measurement of environmental noise. It represents the average daytime noise level during a 24-hour day, measured in decibels and adjusted to account for the lower tolerance of people to noise during nighttime periods.

DECIBEL (dB): A unit measuring the magnitude of a sound, equal to the logarithm of the ratio of the intensity of the sound to the intensity of an arbitrarily chosen standard sound, specifically a sound just barely audible to an unimpaired human ear. For environmental noise from aircraft and other transportation sources, an A-weighted sound level (sometimes abbreviated dBA) is normally used. The A-weighting scale adjusts the values of different sound frequencies to approximate the auditory sensitivity of the human ear.

DECISION HEIGHT (DH): With respect to the operation of aircraft, this means the height at which a decision must be made, using an ILS or PAR instrument approach, to either continue the approach or to execute a missed approach.

DECLARED DISTANCES: The distances the airport owner declares available for the airplane's takeoff run, takeoff distance, accelerate-stop distance, and landing distance requirements. The distances are:

- *Takeoff run available (TORA):* The runway length declared available and suitable for the ground run of an aircraft taking off;

- *Takeoff distance available (TODA):* The TORA plus the length of any remaining runway or clearway beyond the far end of the TORA; the full length of TODA may need to be reduced because of obstacles in the departure area;

- *Accelerate-stop distance available (ASDA):* The runway plus stopway length declared available and suitable for the acceleration and deceleration of an airplane aborting a takeoff; and

- *Landing distance available (LDA):* The runway length declared available and suitable for a landing airplane.

DEED NOTICE: A formal statement added to the legal description of a deed to a property and on any subdivision map. As used in airport land use planning, a deed notice would state that the property is subject to aircraft over flights. Deed notices are used as a form of buyer notification to ensure that those who are particularly sensitive to aircraft over flights can avoid moving to the affected areas.

DEMAND: The actual number of persons, aircraft or vehicles currently using a facility if that facility is operating at or below capacity or the number of persons, aircraft or vehicles who want to use the facility when the facility is operating above capacity.

DENSITY OF USE: As used in airport land use planning, the term refers to the number of dwelling units per gross acre for residential land uses or the number of people per acre with regard to other land uses.

DEPLANEMENT: Any passenger getting off an arriving aircraft at an airport. Can be both a terminating and connecting passenger. Also applies to freight shipments.

DESIGNATED BODY: A local government entity, such as a regional planning agency or a county planning commission, chosen by the county board of supervisors and the selection committee of city mayors to act in the capacity of an airport land use commission.

DISPLACED THRESHOLD: A landing threshold that is located at a point on the runway other than the designated beginning of the runway (see Threshold).

DISTANCE MEASURING EQUIPMENT (DME): An electronic installation established with either a VOR or ILS to provide distance information from the facility to pilots by reception of electronic signals. It measures, in nautical miles, the distance of an aircraft from a NAVAID.

DUAL-TANDEM: The main landing gear consists of four wheels under each wing. Dual-Tandem landing gear is typically used on multi-engine aircraft weighing over 200,000 pounds.

DUAL-WHEEL: The main landing gear consists of two wheels under each wing. Dual-wheel landing gear is typically used on multi-engine aircraft weighing between 20,000 pounds up to 200,000 pounds.

E

EASEMENT: A less than fee title transfer of real property rights from the property owner to the holder of the easement.

ENROUTE: The route of flight from point of departure to point of destination, including intermediate stops (excludes local operations).

ENROUTE AIRSPACE: Controlled airspace above and/or adjacent to terminal airspace.

EQUIVALENT SOUND LEVEL (LEQ): The level of constant sound which, in the given situation and time period, has the same average sound energy as does a time varying sound.

EXPERIMENTAL AIRCRAFT ASSOCIATION: A not-for-profit organization operated exclusively for educational, recreational, and charitable purposes drawing upon the surrounding community for its membership and activities which include youth programs and public services.

F

F&E: Facilities and Equipment Programming – FAA

FAR PART 36: A regulation establishing noise certification standards for aircraft.

FAR PART 77: A regulation establishing standards for determining obstructions to navigable airspace.

FAR PART 77 SURFACES: Imaginary airspace surfaces established with relation to each runway of an airport. There are five types of surfaces: (1) primary; (2) approach; (3) transitional; (4) horizontal; and (5) conical.

FAR PART 91-GENRAL OPERATING AND FLIGHT RULES: This Federal Aviation Regulation (FAR) prescribes rules governing the operation of aircraft with the US.

FAR PART 139-CERTIFICATION AND OPERATIONS: Land airports serving certain air carriers. The regulation governs the certification and operation of land airports which serve any scheduled or unscheduled passenger operation of an air carrier that conducted with an aircraft having and seating a capacity of more than 30 passengers.

FAR PART 150: The Aviation Safety and Noise Abatement Act of 1979 require the FAA to establish regulations that set forth national standards for identifying airport noise and land-use incompatibilities and to develop programs to eliminate them.

FEDERAL AIRWAYS: See Low Altitude Airways.

FEDERAL AVIATION ADMINISTRATION (FAA): The U.S. government agency which is responsible for ensuring the safe and efficient use of the nation's airports and airspace.

FEDERAL AVIATION REGULATIONS (FAR): Regulations formally issued by the FAA to regulate air commerce.

FINAL APPROACH: The flight path of an aircraft which is inbound to an airport on a final instrument approach course, beginning at the final approach fix or point and extending to the airport or the point where a circle-to-land maneuver or a missed approach is executed.

FINDINGS: Legally relevant sub conclusions which expose a government agency's mode of analysis of facts, regulations, and policies, and which bridge the analytical gap between raw data and ultimate decision.

FIXED BASE OPERATOR (FBO): A business which operates at an airport and provides aircraft services to the general public, including but not limited to sale of fuel and oil; aircraft sales, rental, maintenance, and repair; parking and tie-down or storage of aircraft; flight training; air taxi/charter operations; and specialty services, such as instrument and avionics maintenance, painting, overhaul, aerial application, aerial photography, aerial hoists, or pipeline patrol.

FLEET MIX: The proportion of aircraft types or models expected to operate at an airport.

FLIGHT SERVICE STATION (FSS): A facility operated by the FAA to provide flight assistance service.

FRACTIONAL AIRCRAFT OWNERSHIP: An aircraft ownership system that is based on a user paying an annual fee to an aircraft leasing company for access to a varied selection of corporate aircraft types. Aircraft operating fees are also paid for the specific type of aircraft and the number of hours flown.

FRANGIBLE NAVAID: A navigational aid (NAVAID) which retains its structural integrity and stiffness up to a designated maximum load, but on impact from a greater load, breaks, distorts, or yields in such a manner as to present the minimum hazard to aircraft. The term NAVAID includes electrical and visual air navigational aids, lights, signs, and associated supporting equipment.

FUEL FLOWAGE FEES: Fees levied by the airport operator per gallon of aviation gasoline and jet fuel sold at the airport.

FY: Fiscal Year

G

GENERAL AVIATION: That portion of civil aviation which encompasses all facets of aviation except air carriers.

GLIDE SLOPE (GS): An electronic signal radiated by a component of an ILS to provide vertical guidance for aircraft during approach and landing.

GLOBAL POSITIONING SYSTEM (GPS): A satellite based radio positioning, navigation, and time transfer system developed and used by the U.S. Department of Defense. This technology may eventually become the principal system for air navigation throughout the world.

H

HANGAR: In this report hangars are classified as individual or conventional. Individual hangars are designed to accommodate a single aircraft and may be portable, "T", or rectangular hangars. These are assumed to accommodate smaller, personal use aircraft. Individual hangars may be constructed in groups that results in a larger structure, however, the individual hangar spaces are counted separately. Conventional hangars are larger structures designed to accommodate several aircraft in an open bay(s) and for the purposes of this report are assumed to house turboprop and business jet aircraft. Conventional hangars are often occupied by an FBO.

HELIPAD: A small, designated area, usually with a prepared surface, on a heliport, airport, landing/takeoff area, apron/ramp, or movement area used for takeoff, landing, or parking of helicopters.

HELIPORT: A site used for the landing and taking off of helicopters which consists of a takeoff and landing area, helipad/helideck, approach departure paths, heliport imaginary surfaces, a functioning wind cone, and sufficient lighting.

HIGH ALTITUDE AIRWAYS: See Jet Routes.

HIRL: High Intensity Runway Lights.

HITL: High Intensity Taxiway Lighting

HOLDING: A predetermined maneuver which keeps an aircraft within a specified airspace while awaiting further clearance.

HORIZONTAL SURFACE: An imaginary surface constituting a horizontal plane 150 feet above the airport elevation.

I

IMAGINARY SURFACE: An area established in relation to the airport and to each runway consistent with FAR Part 77 in which any object extending above these imaginary surfaces is, by definition, an obstruction.

INFILL: Development which takes place on vacant property largely surrounded by existing development, especially development which is similar in character.

INTEGRATED NOISE MODEL (INM): A computer-based airport noise exposure modeling program.

INSTRUMENT APPROACH PROCEDURE: A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually. It is prescribed and approved for a specific airport by competent authority (refer to Nonprecision Approach Procedure and Precision Approach Procedures).

INSTRUMENT FLIGHT RULES (IFR): Rules governing the procedures for conducting instrument flight. Generally, IFR applies when meteorological conditions with a ceiling below 1,000 feet or visibility of less than 3 miles prevail.

INSTRUMENT LANDING SYSTEM (ILS): A precision instrument approach system which normally consists of the following electronic components and visual aids: (1) localizer; (2) Glide Slope; (3) Outer Marker; (4) Middle Marker; (5) Approach Lights.

INSTRUMENT OPERATION: An aircraft operation in accordance with an IFR flight plan or an operation where IFR separation between aircraft is provided by a terminal control facility.

INSTRUMENT RUNWAY: A runway equipped with electronic and visual navigation aids for which a precision or nonprecision approach procedure having straight in landing minimums has been approved.

INTERNATIONAL OPERATIONS: Aircraft operations performed by air carriers engaged in scheduled international service.

ITINERANT OPERATIONS: All aircraft arrivals and departures other than local operations.

J

JET ROUTES: A route designed to serve aircraft operating from 18,000 feet MSL up to and including flight level 450.

L

LARGE AIRPLANE: An airplane of more than 12,500 pounds maximum certificated takeoff weight.

LAT: Latitude

LDA: Localizer Type Directional Aid; Landing Distance Available

LDN: Day-Night Average Sound Level. The 24-hour average sound level, in decibels, from midnight to midnight, obtained after the addition of ten decibels to sound levels for periods between 10 p.m. and 7 a.m.

LENGTH OF HAUL: The non-stop airline route distance from a particular airport.

LEVEL OF SERVICE: An arbitrary but standardized index of the relative service provided by a transportation facility.

LIMITED PART 139-OPERATING CERTIFICATE: A certificate issued under the FAR Part 139 for the operation of an airport serving unscheduled air carrier operations.

LIRL: Low Intensity Runway Lighting

LITL: Low Intensity Taxiway Lighting

LOAD FACTOR: Ratio of the number of passenger miles to the available seat miles flown by an airline representing the proportion of aircraft seating capacity that is actually sold and utilized. Load factors are also referred to in air cargo and can be determined by weight or volume.

LOCALIZER (LOC): The component of an ILS which provides course guidance to the runway.

LOCAL OPERATION: Operations performed by aircraft which: (a) operate in the local traffic pattern or within the sight of the tower; (b) are known to be departing for, or arriving from, flight in local practice areas located within a 20-mile radius of the control tower, or (c) execute simulated instrument approaches or low passes at the airport.

LOM: Compass locator at an outer marker (part of an ILS). Also called COMLO.

LONG: Longitude

LOW ALTITUDE AIRWAYS: Air routes below 18,000 feet MSL. They are referred to as Federal Airways.

LRR: Long-Range Radar

M

MALS: Medium Intensity Approach Light System

MALSF: Medium Intensity Approach Light System with sequence flashing lights.

MALSR: MALS with Runway Alignment Indicator Lights (RAIL)

MAJOR AIRLINES: Major airlines are airlines with gross operating revenues during any calendar year of more than $1 billion; national airlines gross between $100 million and $1 billion; and regional airlines gross under $100 million.

MARKER BEACON: An electronic navigation facility which transmits a fan or bone shaped radiation pattern. When received by compatible airborne equipment they indicate to the pilot that he is passing over the facility. Two to three beacons are used to advise pilots of their position during an ILS approach. MGW - Maximum Gross Weight

MILITARY OPERATION: An aircraft operation conducted by either a fixed-wing or rotor-wing military aircraft.

MINIMUM DESCENT ALTITUDE (MDA): The lowest altitude, expressed in feet above mean sea level, to which descent is authorized on final approach or during circling-to-land maneuvering in execution of a standard instrument approach procedure where no electronic glide slope is provided.

MIRL: Medium Intensity Runway Lighting

MISSED APPROACH: A prescribed procedure to be followed by aircraft that cannot complete an attempted landing at an airport.

MITL: Medium Intensity Taxiway Lighting

MLS: Microwave Landing System

MM: Middle Marker (part of an ILS)

MOA: Military Operations Area

MODAL SPLIT: The distribution of trips among competing travel modes, such as walk, auto, bus, etc.

MODE: A particular form or method of travel such as walk, auto, carpool, bus, rapid transit, etc.

MOVEMENT: Synonymous with the term operation, i.e., a takeoff or a landing.

MSL: Mean Sea Level

N

NA: Not applicable

NAS: NATIONAL AIRSPACE SYSTEM - The common system or air navigation and air traffic encompassing communications facilities, air navigation facilities, airways, controlled airspace, special use airspace and flight procedures authorized by Federal Aviation Regulations for domestic and international aviation.

NATIONAL TRANSPORTATION SAFETY BOARD (NTSB): The U.S. government agency responsible for investigating transportation accidents and incidents.

NAVIGATIONAL AID (NAVAID): Any visual or electronic device airborne or on the surface which provides point to point guidance information or position data to aircraft in flight.

NDB: NON-DIRECTIONAL BEACON: An electronic ground station transmitting in all directions in the L/MF frequency spectrum; provides azimuth guidance to aircraft equipped with direction finder receivers. These facilities are often established with ILS outer markers to provide transition guidance to the ILS system.

NEPA: National Environmental Policy Act

NM: Nautical Mile

NOISE ABATEMENT: A procedure for the operation of aircraft at an airport which minimizes the impact of noise on the environs of the airport.

NOISE CONTOURS: Continuous lines of equal noise level usually drawn around a noise source, such as an airport or highway. The lines are generally drawn in 5-decibel increments so that they resemble elevation contours in topographic maps.

NOISE EXPOSURE MAP: A scaled, geographic depiction of an airport, its noise contours and surrounding area.

NOISE LEVEL REDUCTION (NLR): The amount of noise level reduction achieved through incorporation of noise attenuation (between outdoor and indoor levels) in the design and construction of a structure.

NONCONFORMING USE: An existing land use which does not conform to subsequently adopted or amended zoning or other land use development standards.

NONPRECISION APPROACH PROCEDURE: A standard instrument approach procedure in which no electronic glide slope is provided.

NONPRECISION INSTRUMENT RUNWAY: A runway with an approved or planned straight in instrument approach procedure which has no existing or planned precision instrument approach procedure.

NPI: Non-Precision Instrument Runway

NPIAS: National Plan of Integrated Airport Systems

O

OBSTRUCTION: Any object of natural growth, terrain, or permanent or temporary construction or alteration, including equipment or materials used therein, the height of which exceeds the standard established in Subpart C of Federal Aviation Regulations Part 77, Objects Affecting Navigable Airspace.

OFZ: Obstacle free zone

OM: Outer Marker (part of an ILS)

OPERATION: An aircraft arrival at or departure from an airport.

OUTER FIX: A point in the destination terminal area from which aircraft are cleared to the approach fix or final approach course.

OVER FLIGHT: Any distinctly visible and audible passage of an aircraft in flight, not necessarily directly overhead.

OVER FLIGHT EASEMENT: An easement which describes the right to overfly the property above a specified surface and includes the right to subject the property to noise, vibrations, fumes and emissions. An over flight easement is used primarily as a form of buyer notification.

OVER FLIGHT ZONE: The area(s) where aircraft maneuver to enter or leave the traffic pattern, typically defined by the FAR Part 77 horizontal surface.

P

PAPI: Precision Approach Path Indicator

PAR: Precision Approach Radar

PEAK HOUR FACTOR: The ratio of the average flow rate during the peak hour to the highest short-term (say 15 minutes) rate within the peak hour.

PEAK HOUR PERCENTAGE: The percentage of total daily trips or traffic occurring in the highest or "peak" hour. Frequently confused with Peak Hour Factor.

PEAKING OPERATION: Peak hour aircraft operational projections are required to determine the peak period capacity of a runway system, as well as for determining the size of the various functional areas of a passenger terminal.

PI: Precision Instrument Runway marking.

POSITIVE CONTROL: The separation of all air traffic within designated airspace by air traffic control.

PRECISION APPROACH: A standard instrument approach procedure in which an electronic glide slope/glide path is provided; e.g., ILS/MLS and PAR.

PRECISION INSTRUMENT RUNWAY: A runway with an existing or planned precision instrument approach procedure.

PRIMARY RUNWAY: The runway on which the majority of operations take place. On large, busy airports, there may be two or more parallel primary runways.

PRIMARY SURFACE: An area longitudinally centered on a runway with a width ranging from 250 to 1000 feet and extending 200 feet beyond the end of a paved runway.

PROHIBITED AREA: Airspace of defined dimensions identified by an area on the surface of the earth within flight is prohibited.

PU: Publicly owned airport. An airport that is open to the general public with or without a prior request to use the airport.

PUBLIC-USE AIRPORT: An airport that is open to the general public and typically included in FAA NPIAS. Airport can be owned publicly or privately.

PRIVATE-USE AIRPORT: An airport that is used by private users only and not open to the general public. Airport is typically privately owned and is not eligible for federal funding.

PVC: Poor visibility and ceiling.

PVT: Privately owned airport.

Q

QUEUE: A line of pedestrians or vehicles waiting to be served.

R

RADAR SEPARATION: Radar spacing of aircraft in accordance with established minima.

RAIL: Runway Alignment Indicator Lights

RCAG: Remote Center Air/Ground Communications

REIL: Runway End Identification Lights

RELIEVER AIRPORT: An airport designated as having the function of relieving congestion at a commercial service airport and providing more general aviation access to the overall community.

RESTRICTED AREAS: Airspace of defined dimensions identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions.

REVENUE BONDS: Bonds which are payable solely from the revenues derived from the operation of a facility which was constructed or acquired with the proceeds of the bonds.

RNAV: See Area Navigation.

ROFA: Runway Object Free Area

ROTATING BEACON: A visual NAVAID displaying flashes of white and/or colored light used to indicate location of an airport.

ROTORCRAFT: A heavier-than-air aircraft that depends principally for its support in flight on the lift generated by one or more rotors.

RUNWAY BLAST PAD: A surface adjacent to the ends of runways provided to reduce the erosive effect of jet blast and propeller wash.

RUNWAY DESIGN CODE: A code signifying the design standards to which the runway is to be built.

RUNWAY END IDENTIFIER LIGHTS (REIL): Two synchronized flashing lights, one on each side of the runway threshold, which provide rapid and positive identification of the approach end of a particular runway.

RUNWAY PROTECTION ZONE (RPZ): An area at ground level prior to the threshold or beyond the runway end to enhance the safety and protection of people and property on the ground

RUNWAY SAFETY AREA (RSA): A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway.

RVR: Runway Visual Range

RVV: Runway Visibility Value

RW: Runway

S

SAFETY ZONE: For the purpose of airport land use planning, an area near an airport in which land use restrictions are established to protect the safety of the public from potential aircraft accidents.

SALS: Short Approach Light System

SDF: Simplified Directional Facility landing aid providing final approach course.

SEGMENTED CIRCLE: An airport aid identifying the traffic pattern direction.

SEPARATION MINIMA: The minimum longitudinal, lateral, or vertical distances by which aircraft are spaced through the application of air traffic control procedures.

SHOULDER: An area adjacent to the edge of paved runways, taxiways, or aprons providing a transition between the pavement and the adjacent surface; support for aircraft running off the pavement; enhanced drainage; and blast protection.

SINGLE-EVENT NOISE: As used herein, the noise from an individual aircraft operation or over flight.

SMALL AIRPLANE: An airplane of 12,500 pounds or less maximum certificated takeoff weight. (Airport Design AC)

SOCIOECONOMIC: Data pertaining to the population and economic characteristics of a region.

SOUND EXPOSURE LEVEL (SEL): A time integrated metric (i.e., continuously summed over a time period) which quantifies the total energy in the A-weighted sound level measured during a transient noise event. The time period for this measurement is generally taken to be that between the moments when the A-weighted sound level is 10 dB below the maximum.

SSALF: Simplified Short Approach Light System with Sequence Flashing lights.

SSALS: Simplified Short Approach Light System.

SSALR: Simplified Short Approach Light System with Runway Alignment Indicator Lights (RAIL)

STRAIGHT-IN INSTRUMENT APPROACH: An instrument approach wherein a final approach is begun without first having executed a procedure turn; it is not necessarily completed with a straight-in landing or made to straight-in landing weather minimums. (AIM)

STANDARD LAND USE CODING MANUAL (SLUCM): A standard system for identifying and coding land use activities published by the U.S. Department of Housing and Urban Development and the Federal Highway Administration.

STRAIGHT-IN APPROACH: A descent in an approved procedure in which the final approach course alignment and descent gradient permits authorization of straight-in landing minimums.

STOL: Short Takeoff and Landing

STOVL: Short Takeoff Vertical Landing

SYSTEM PLAN: A representative of the aviation facilities required to meet the immediate and future air transportation needs and to achieve the overall goals.

T

TAF- TERMINAL AREA FORECAST: An annual FAA forecast of aviation activity throughout the US used in the FAA's planning and decision making. The TAF is a subset of approximately 900 airports in the National Plan of Integrated Airport Systems (NPIAS) database the contains over 4000 airports.

TAKING: Government appropriation of private land for which compensation must be paid as required by the First Amendment of the U.S. Constitution. It is not essential that there be physical seizure or appropriation for a taking to occur, only that the government action directly interferes with or substantially disturbs the owner's right to use and enjoyment of the property.

TAXILANE (TL): The portion of the aircraft parking area used for access between taxiways and aircraft parking positions.

TAXIWAY (TW): A defined path established for the taxiing of aircraft from one part of an airport to another.

TAXIWAY SAFETY AREA (TSA): A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an airplane unintentionally departing the taxiway.

TDZ: Touchdown Zone

TERMINAL AIRSPACE: The controlled airspace normally associated with aircraft departure and arrival patterns to/from airports within a terminal system and between adjacent terminal systems in which tower enroute air traffic control service is provided.

TERMINAL CONTROL AREA (TCA): This consists of controlled airspace extending upward from the surface or higher to specified altitudes within which all aircraft are subject to positive air traffic control procedures.

TERMINAL INSTRUMENT PROCEDURES (TERPS): Procedures for instrument approach and departure of aircraft to and from civil and military airports. There are four types of terminal instrument procedures: precision approach, nonprecision approach, circling, and departure.

T-HANGAR: A T-shaped aircraft hangar that provides shelter for a single airplane.

THRESHOLD (TH): The beginning of that portion of the runway usable for landing. In some instances the landing threshold may be displaced. (see Displaced Threshold)

THRESHOLD LIGHTS: Fixed green lights arranged symmetrically left and right of the runway centerline, identifying the runway end.

TODA: Takeoff Distance Available

TORA: Takeoff Run Available

TOUCH-AND-GO OPERATION: An operation in which the aircraft lands and begins takeoff roll without stopping.

TRAFFIC PATTERN: The traffic flow that is prescribed for aircraft landing at, taxiing on, and taking off from an airport. The usual components of a traffic pattern are upwind leg, crosswind leg, downwind leg and final approach.

TRANSIENT OPERATIONS: See Itinerant Operations.

TRANSITIONAL SURFACE: An element of the imaginary surfaces extending outward at right angles to the runway centerline and from the sides of the primary and approach surfaces to where they intersect the horizontal and conical surfaces.

U

UHF: Ultra High Frequency

UNICOM: Radio communications station which provides pilots with pertinent airport information (winds, weather, etc.) at specific airports.

UTILITY RUNWAY: A runway that is constructed for and intended to be used by propeller driven aircraft of 12,500 pounds maximum gross weight or less.

V

VASI: Visual Approach Slope Indicator providing visual glide path.

VASI-2: Two Box Visual Approach Slope Indicator

VASI-4: Four Box Visual Approach Slope Indicator

VECTOR: A heading issued to an aircraft to provide navigational guidance by radar.

VERTICAL FLIGHT: Aircraft flight operations by vertical lift aircraft. Typically, vertical lift aircraft include helicopters, tilt rotors, ducted-fan vehicles, and directed-thrust type propulsion systems.

VISUAL APPROACH: An approach where the pilot must use visual reference to the runway for landing under VFR conditions.

VISUAL FLIGHT RULES (VFR): Rules that govern the procedures for conducting flight under visual conditions. VFR applies when meteorological conditions are equal to or greater than the specified minimum, generally, a 1,000-foot ceiling and 3-mile visibility.

VISUAL RUNWAY: A runway intended solely for the operation of aircraft using visual approach procedures, with no straight in instrument approach procedure and no instrument designation indicated on a FAA approved airport layout plan or by any planning document submitted to the FAA by competent authority.

VFR AIRCRAFT: An aircraft conducting flight in accordance with Visual Flight Rules.

VHF: Very High Frequency

VOR - Very High Frequency Omni-directional Range: A ground-based radio (electronic) navigation aid transmitting radials in all directions in the VHF frequency spectrum; provides azimuth guidance to pilots by reception of electronic signals.

VORTAC: Co-located VOR and TACAN.

V/STOL: Vertical/Short Takeoff and Landing

VTOL: Vertical Takeoff and Landing (includes, but is not limited to, helicopters).

W

WARNING AREA: Airspace which may contain hazards to non-participating aircraft in international airspace.

WIND CONE (WINDSOCK): Conical wind directional indicator.

WIND TEE: A visual device used to advise pilots about wind direction at an airport.

Y

YEARLY DAY-NIGHT AVERAGE SOUND LEVEL (LDN): The 24-hour average sound level, in decibels, for the period from midnight to midnight, obtained after the addition of ten decibels to sound levels for the periods between 10 p.m. and 7 a.m. the following day, and averaged over a span of one year.

Z

ZONING: A police power measure, enacted primarily by units of local government, in which the community is divided into districts or zones within which permitted and special uses are established, as are regulations governing lot size, building bulk, placement, and other development standards. Requirements vary from district to district, but they must be uniform within districts. A zoning ordinance consists of two parts: the text and a map.

Appendix B

July 2017

Washington State
Department of Transportation

WASP
Washington Aviation System Plan

WASHINGTON AVIATION SYSTEM PLAN

Memorandum

Re: Emerging Issues Paper
Aerospace Manufacturing

This technical memorandum summarizes information for Washington state system airports regarding aerospace manufacturing industry activity in the state, and identifies opportunities for airports to petition commercial and general aviation aerospace manufacturers to establish operations on airport properties.

Introduction

The State of Washington is a global leader in the aerospace industry and has been since the beginning of the aviation age in the early 20th century. Boeing Company's incorporation in the region in 1916 has grown into an industry which drives economic growth and employment throughout the state. As of 2012, there were an estimated 175 aerospace businesses and an additional 1,175 aerospace-related businesses in Washington, generating an estimated $51.2 billion in revenues, and accounting for approximately 132,500 jobs[1].

While Boeing Commercial represents a large majority of aerospace activity in the state (95 percent of revenue, and 64 percent of aerospace related jobs), these aerospace businesses include representation throughout the entire supply chain of aircraft manufacturing, including air frames, avionics, navigational systems, composites, tooling, and maintenance.

This document identifies where aerospace manufacturers are located across the state and in proximity to airports in the State of Washington airport system, as well as identifying what airports can do to position themselves for commercial and general aviation aerospace manufacturers to establish operations at their facilities.

Washington's Aerospace Sector

The aerospace sector in Washington is very diverse in its business types and also their location. As shown in **Figure 1**, the majority of aerospace related companies are located around Puget Sound but many are also clustered around Spokane in the eastern part of the state as well. The locations of Washington's airports are also depicted in relation to these aerospace firms. **Figure 2** illustrates the location, size and type of aerospace establishments in the state.

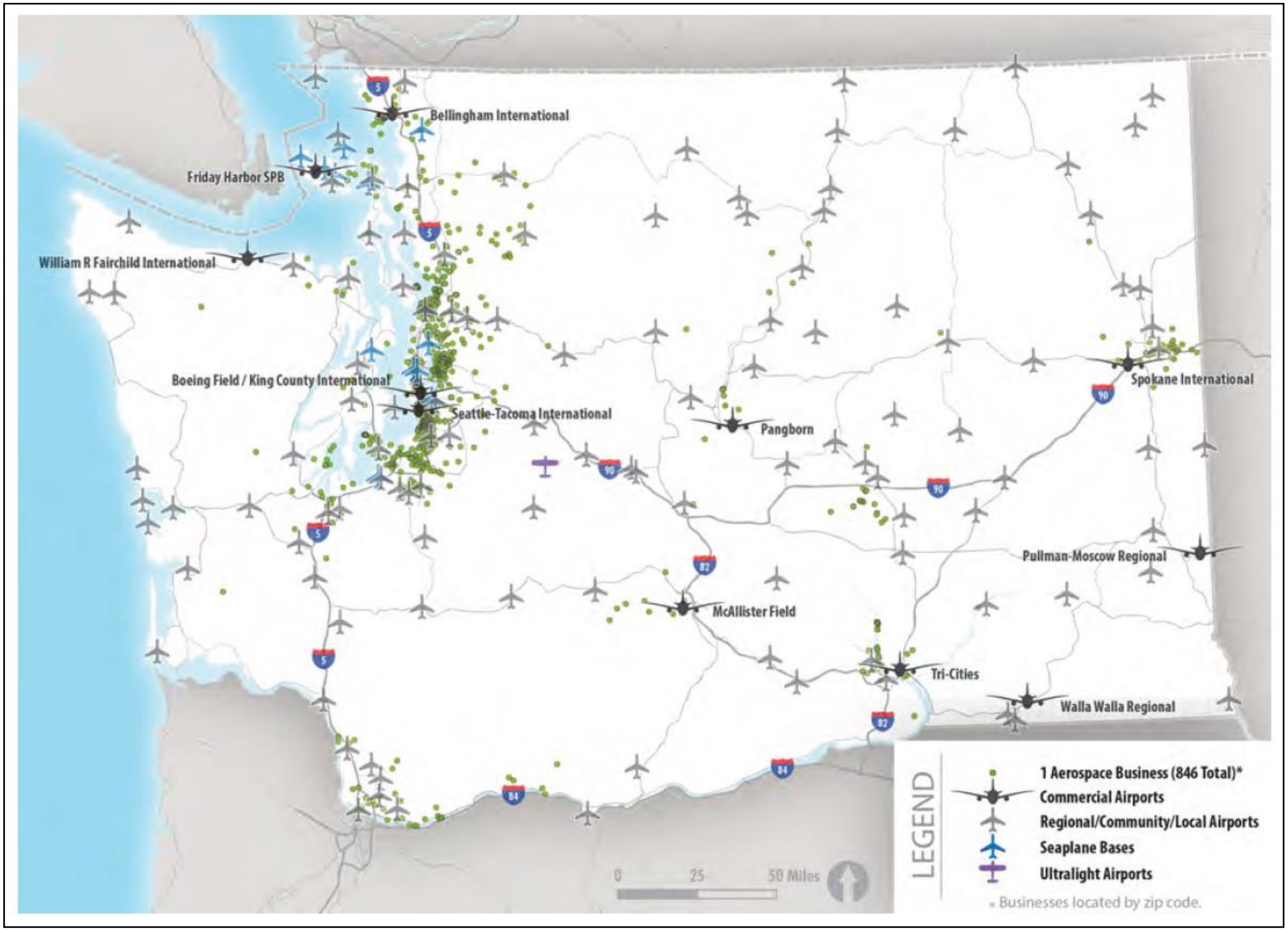
As part of the WASP study, airports were surveyed and asked if the following manufacturing occurred at the airport:

- Aircraft Manufacturing
- Unmanned Aircraft Systems (UAS) manufacturing/research

These aerospace supporting airports are identified in **Figure 3**.

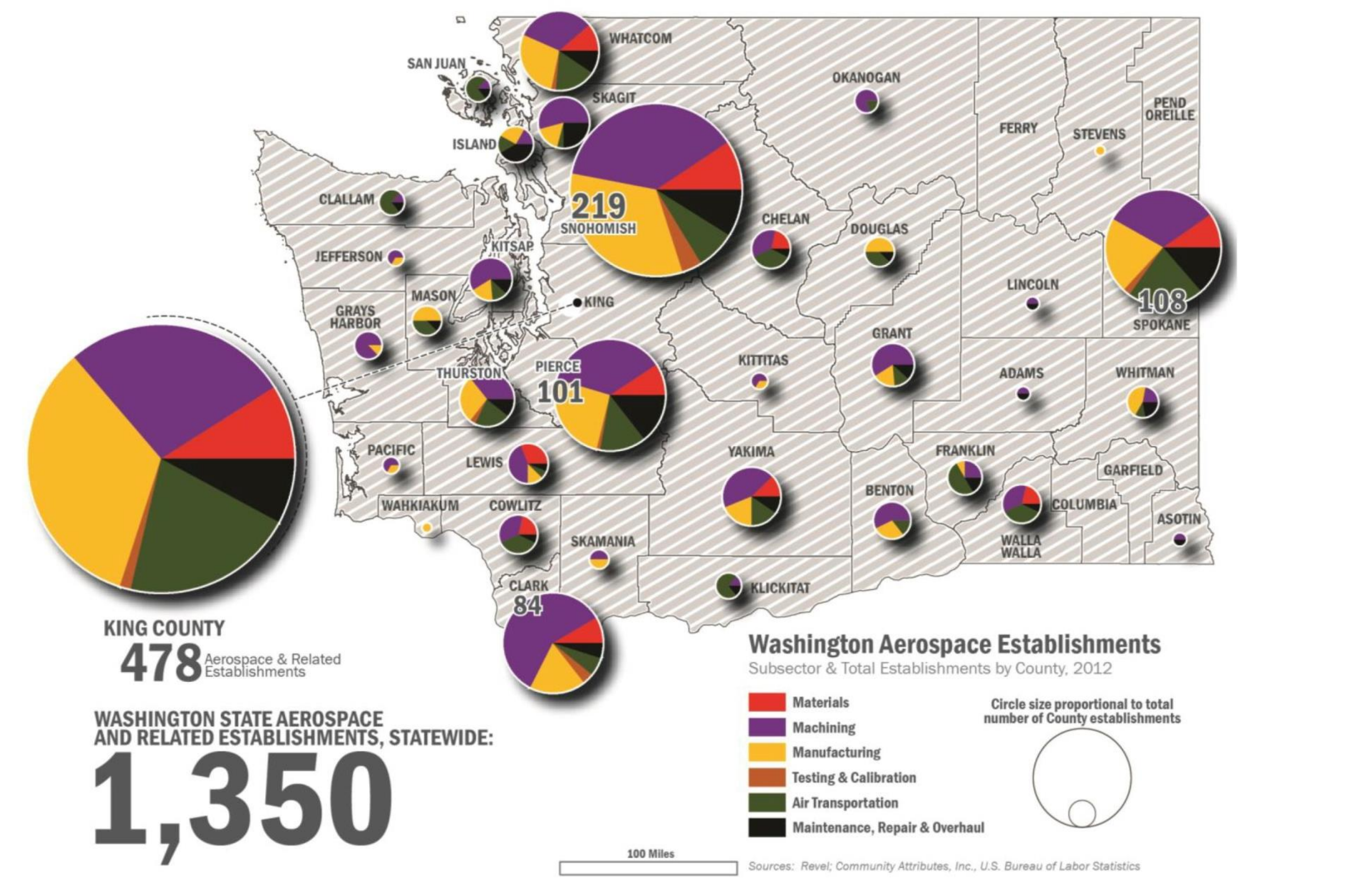
[1] Washington State Aerospace Industry, Economic Impact Study, November 2013. Prepared by Community Attributes, Inc.

Figure 1 – Aerospace Business Locations within Washington's Airport System



Source: USA Aerospace Business Directory

Figure 2 – Aerospace Manufacturing Subsector Breakout

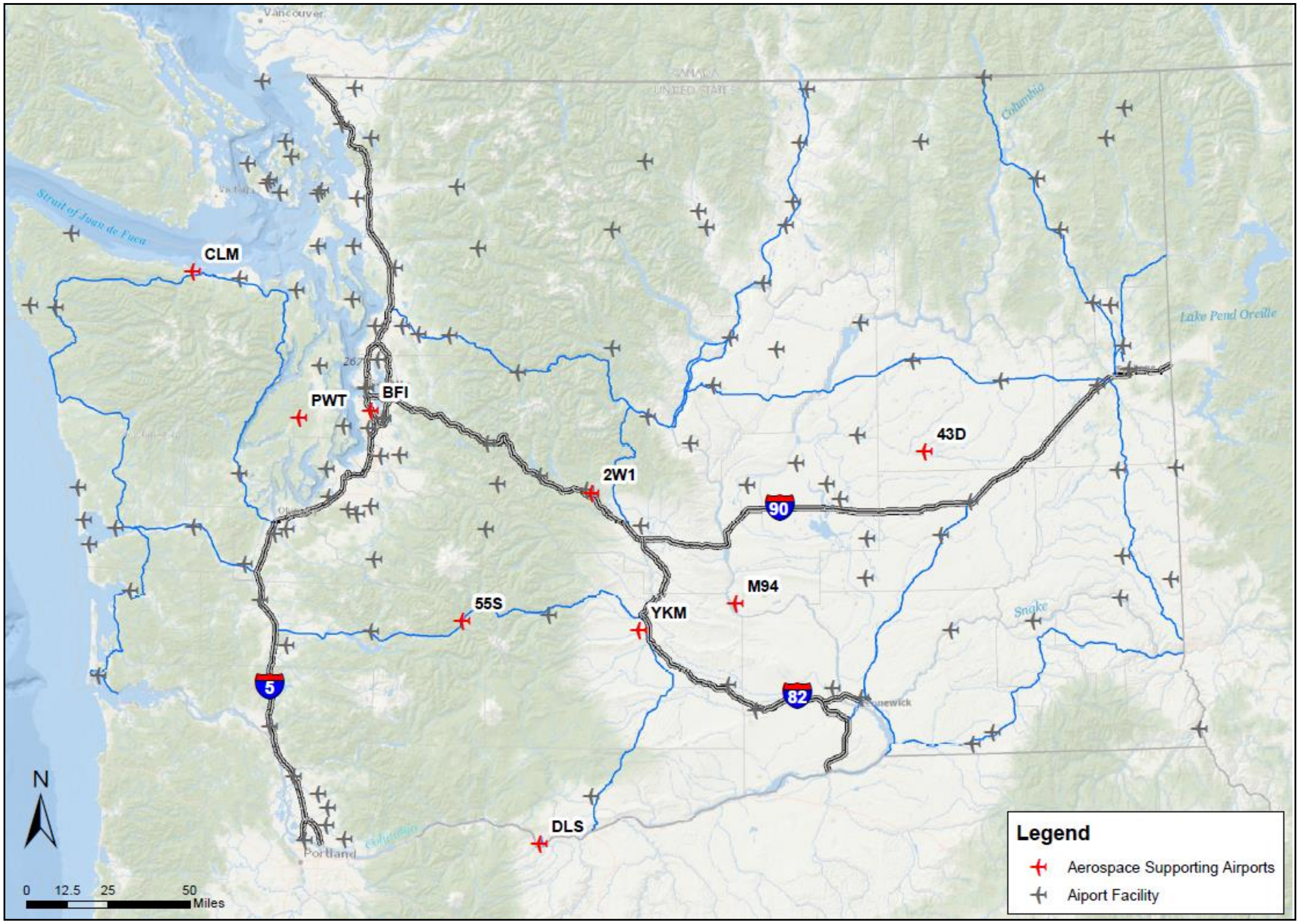


Sources: Revel Consulting; Community Attributes Inc.; U.S. Bureau of Labor Statistics; Washington State Employment Security Department.

Source: Washington Aerospace Partnership, Economic Impact Study, November 2013.

WASHINGTON AVIATION SYSTEM PLAN

Figure 3 – Aerospace Supporting Airports



Source: WSP|Parsons Brinckerhoff, 2016.

Positioning/Partnerships

There are several ways for airports and local jurisdictions to position themselves to attract aerospace manufacturing companies to establish operations at their facilities. The State of Washington currently provides multiple tax incentives as a tool to support Washington's aerospace sector. These incentives are mainly in the form of preferential rates and tax credits for the state business and occupation (B&O) tax. Local jurisdictions can further add to these incentives through local tax breaks or additional incentives at the municipal and county levels to make their facility more attractive to prospective manufacturing companies.

Infrastructure improvements at airports to make sites ready for development are another option to attract prospective aerospace manufacturing companies. This can include runway access, transportation infrastructure, utility infrastructure, etc. In conjunction with infrastructure improvements, airport operators and the associated local permitting agencies can setup fast track permitting processes for large developments to streamline the approval process.

Partnering with local universities and colleges to develop aviation, aerospace, manufacturing, and aviation maintenance classes and programs can also increase opportunities for airports. Having a local labor pool with access to applicable training capabilities near to a potential facility can increase the desirability of an airport seeking to attract aerospace manufacturers.

Workforce Development

Washington State has created a strategy to encourage the growth and satisfaction of the aerospace industry in Washington. A major part of that strategy is the ability to develop a strong workforce locally. Technically-skilled employees are in high-demand in the aerospace industry and are providing the industry the necessary measures they need to compete to be able to stay in Washington.

The efforts to develop programs that offer the job training and technical skills requested by the aerospace industry have expanded rapidly in response to need, funding and incentives provided by Washington State. Universities, community colleges, technical schools and apprenticeship programs have increased their focus and abilities to produce the workforce needed to the industry. Examples of the organizations and their expansions are described below.

Training Centers

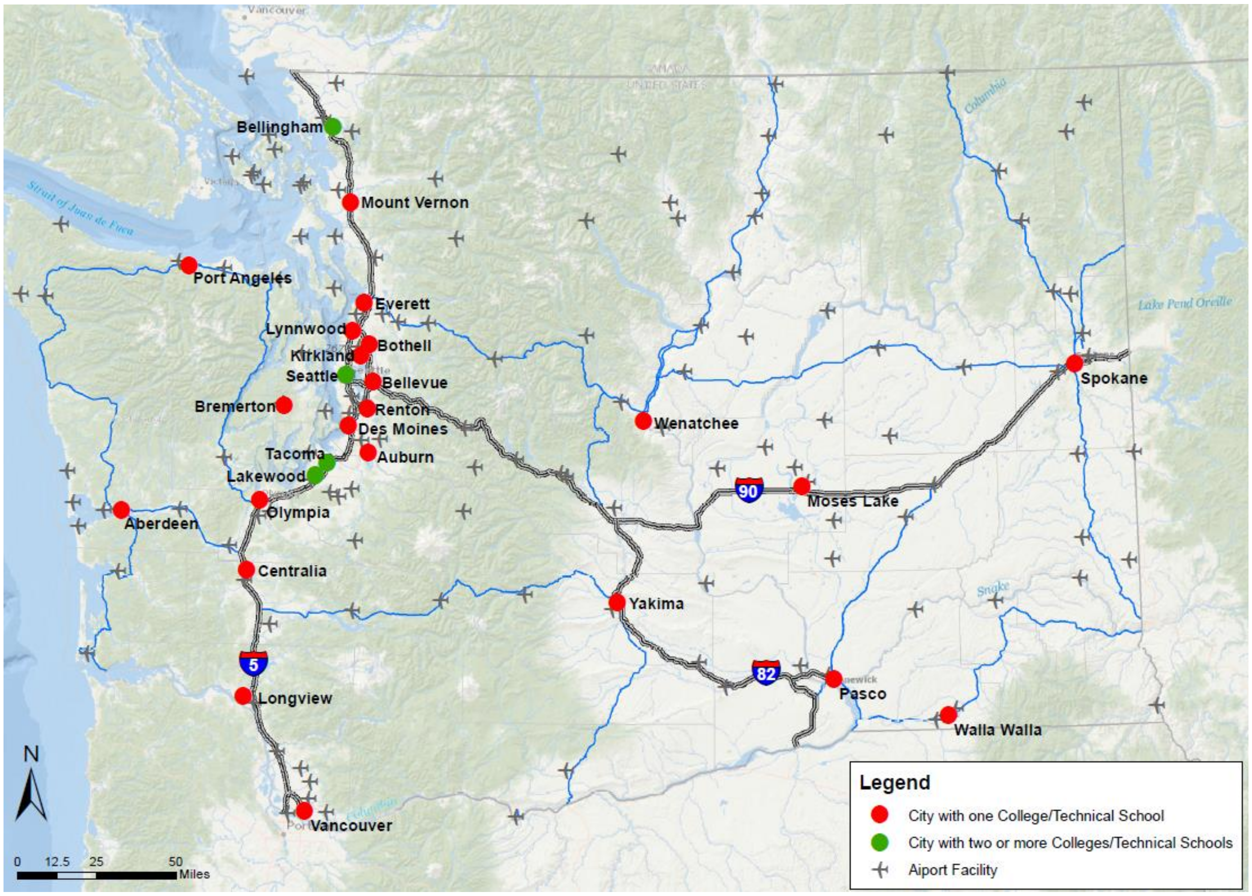
The Washington Aerospace Training & Research (WATR) Center was created in June 2010. The center has developed a 12 week program that focuses on the exact skills individuals need to enter the workforce. The educational programs offered prepare students for the high-demand aerospace jobs in the shortest amount of time possible. The Center works alongside Edmonds Community College to provide college credit and Certificates of Completion to further each student's development and open the doors for aerospace and manufacturing careers.

The Washington Manufacturing Advanced Training Institute (WMATI) has been a recent expansion of the WATR Center. The training institute is focused on developing higher-level skills that Boeing and other manufacturing companies need to give them the competitive edge in the industry. Having the institute local saves companies from spending money to send their employees abroad for this type of training.

Community Colleges & Technical Schools

State and Federal funding has been distributed to many technical and community colleges. These schools were chosen because of their focus on training for aerospace jobs in Washington. Community Colleges have historically served to provide training for local industries, and this funding will allow these Washington schools to continue providing training to the aerospace industry. These 22 "Workforce Development Centers" are located across the state at or near airports, as depicted on **Figure 4**.

Figure 4 – Workforce Development Centers



Source: Center of Excellence for Aerospace & Advanced Manufacturing
WSP|Parsons Brinckerhoff, 2016.

The workforce centers include aerospace courses or training in:

- Machining
- Electronics
- Engineering
- Material Science
- Aviation/Aerospace
- Composites
- Design
- Mechanical
- Manufacturing

Community Colleges in Spokane have responded to Washington's desire to grow the aerospace industry. They have expanded and created many degrees/certificates available within the aerospace industry. Many of these educational additions are rare and not available in other areas around the country. This program will draw in other manufacturing businesses to the state looking for this trained local workforce. They have adapted the motto of "If we don't have it, we will make it available for you."

The Advanced Manufacturing Training & Education Center (AMTEC) at Everett Community College has also expanded in response to Washington's industry strategy. AMTEC is expanding in space and programs/classes. They will add 17,000 additional square feet to their current space to provide more classrooms and a new Mechatronics program. Everett with AMTEC prides itself on providing students a "work-ready" lifestyle. They work closely with manufacturing partners to have industry credentials and prepping students for the work environment they will be entering. AMTEC has had close interaction with Boeing and other employers to validate their classes and training programs. Unique training models attract many students to the school, including partners with manufacturing programs, live production lines, and workforce development continuing education programs.

The other colleges provided funding are expanding and adapting to the industry needs in these ways and their own as well. The schools have become more responsive to the needs of the workforce/employment. They have developed desired relationships between the industry and the education. The education has been adjusted to be industry driven; skills wanted from the industry have come straight from the companies into the classrooms. Not only individuals and technology can be innovative, but now education can as well. An example of this is the schools ability to change its traditional scheduling. Several schools have adapted programs that can be started quarterly. Instead of a student having to wait a semester or even a year to obtain technical skills needed in the workforce, they are able to join programs on a quarterly schedule. This allows students and employees flexibility and sends newly trained workers into the workforce at a more rapid pace to meet the demand of the industry.

High Schools
Washington State is changing the culture, and putting a manufacturing job in a new and positive light early on. There is now technical curriculum beginning in high schools. Common skills sets are being taught and allowing students to choose a manufacturing career path. Adding this step early on allows quick advancement into the industry and a focused academic path. The WATR center is partnering with high schools providing a program to move individuals quickly from the high school curriculum into their training and out into the workforce. Students can complete 8 hours of training in high school and put in two months of training at the WATR Center and be prepared to the work in the industry. This rapid pace is exactly with companies are looking for to locally fulfill the high-demand of mid-level technically skilled jobs.

Summary
Providing a skilled labor force is key to maintaining Washington position as the aerospace center for the US. Expanding opportunities for aerospace manufacturing and the associated supply chain across the state at interested airports would benefit not only the airport but the community. Airport would benefit financially and be more self-sufficient, communities would benefit with additional skilled workers the economic impact this generates. The community and airports must collaborate and develop aerospace/aviation awareness, networking and mentoring opportunities. Airway Heights is a community in Spokane, near Spokane International Airport, that has developed an active program to encourage aerospace firms to locate in their community.

Memorandum

Re: Final Emerging Issues Paper
Aircraft Fuels

This technical memorandum summarizes recent trends in the aviation fuels market and potential opportunities and impacts for the State of Washington.

Introduction

The aviation fuels market could undergo significant changes and challenges in the near-term as commercial airlines upgrade existing aircraft with winglets, and weight reduction efforts to decrease fuel burn or replace older aircraft with more fuel-efficient models, leading to a reduction or flatting in fuel demand despite growth in overall plane movements. In addition the existing jet fuel market could gradually change as the military and airlines experiment with various bio-jet blends as a way to mitigate against jet fuel supply and price volatility concerns and in anticipation of potential biofuel blend requirements as politician's debate carbon policies and biofuels mandates.

In the general aviation market there is ongoing political, environmental, and industry pressure to continue the phase out of leaded AVGAS fuels. As a variety of alternatives are being introduced and considered, including engines designed to run on diesel or jet fuel and ongoing testing of varying grades of conventional unleaded motor gasoline (MOGAS) there are corresponding concerns with providing a wider range of fuel options at general aviation facilities..

This document identifies recent trends in the aviation fuels in the context of their potential impacts on infrastructure within the State of Washington airport system, and associated aeronautic and airport programs.

Industry Trends and Outlook

Current Fuels Market

The focus of the general petroleum products markets has largely been on the volatility in price and mitigation of those effects through tools such as fuel hedging and improvements in fleet efficiency. During periods of high fuel prices in the aviation sector there tends to be a reaction by both commercial and general aviation users that leads to reductions in overall consumption.

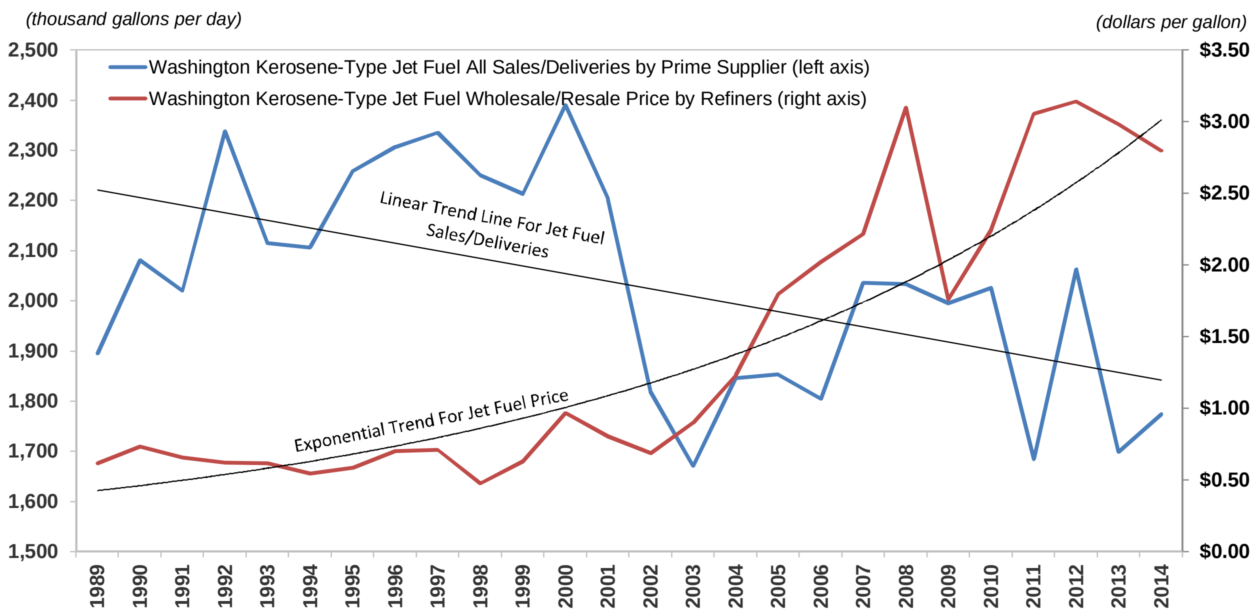
- **Commercial aviation:** airlines have increased ticket prices and/or reduced services and added fuel surcharges to the price of a ticket to offset increases in fuel prices[1]. Short term trends in higher fuel prices tend to also influence long term strategic decisions in which airlines incorporate aircraft fuel efficiency measures such as winglets, purchase more fuel efficient aircraft and/or discontinue services with less efficient and older aircraft, including regional jets[2].
- **General aviation:** private pilots tend to decrease their flying hours during periods of high fuel prices[3] and take additional measures such as request more direct routings, reduce their travel speeds, or when feasible switch to airports offering lower priced fuel or self-service options[4].

Price volatility and implications on demand

[1] Aaron Smith, *Fewer Flights, Higher Fares,* (New York: CNN Money, June 27, 2008).
[2] Scott McCartney, *A Prius With Wings vs. a Guzzler in the Clouds*, (New York: Wall Street Journal, August 12, 2010).
[3] Kamala Shetty, *Current and Historical Trends in General Aviation in the United States,* (Boston: MIT International Center for Air Transportation (ICAT), 2012)
[4] National Business Aviation Association. *General Aviation Industry Hurting During Economic Downturn,* https://www.nbaa.org/advocacy/issues/economic-downturn/high-fuel-prices.php, (July 16, 2008).

Since the late 1980s through 1999 jet fuel prices in the US and Washington state were fairly stable in nominal terms and declining in real terms which, combined with general economic growth, led to fairly constant increases in jet fuel demand as seen in *Figure 1*. As prices increased in the 2000s and the commercial airline industry dealt with the aftermath of the 2001 terrorist attacks, over-expansion of capacity, and the great recession in 2008, demand decreased and remained at relatively low levels compared with the late 1990's. Recent reductions in jet fuel prices and general economic expansion has led to a recent uptick in demand but overall levels remain close to 20 percent below levels in the 1990's.

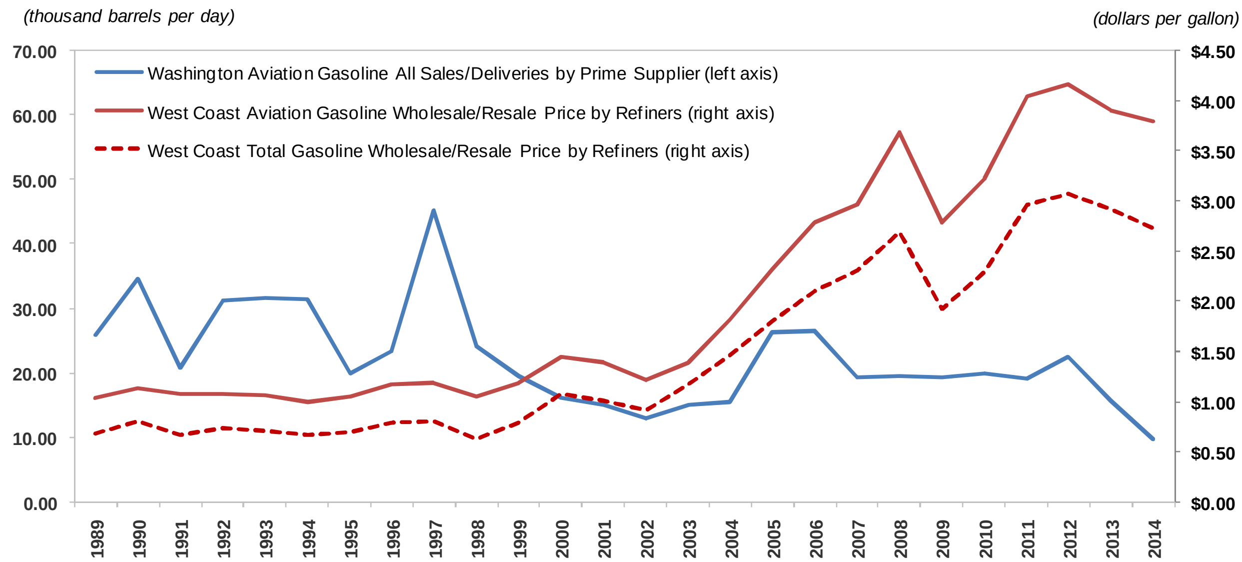
Figure 1: Washington State Annual Jet Fuel Demand and Prices



Data Source: U.S. Department of Energy - Energy Information Administration (EIA), 2015

As shown in *Figure 2* aviation gasoline sales in Washington appear to be slightly more price elastic in comparison with jet fuel sales, with the historical growth in prices leading to a parallel decrease in demand. In addition the trend towards alternative fuels such as unleaded motor gasoline (MOGAS), diesel, and jet fuel use in the general aviation sector could be starting to have a material impact on leaded aviation gasoline sales. ***The increasing delta in gasoline prices and aviation gasoline prices are primarily due to tightening supply of leaded products and increasing regulations on the distribution of leaded fuels*** which has led to an increase in the price differential from a premium of $0.30-$0.40 per gallon through 2004 growing to $1.00 per gallon in 2008, where it has remained since. In addition some MOGAS volumes are being transferred directly by individuals using items such as self-fill fuel cans and containers to aircraft at smaller general aviation and private airport facilities, and are therefore difficult to track and quantify.

Figure 2: Washington Annual Aviation Gasoline Demand and West Coast Prices

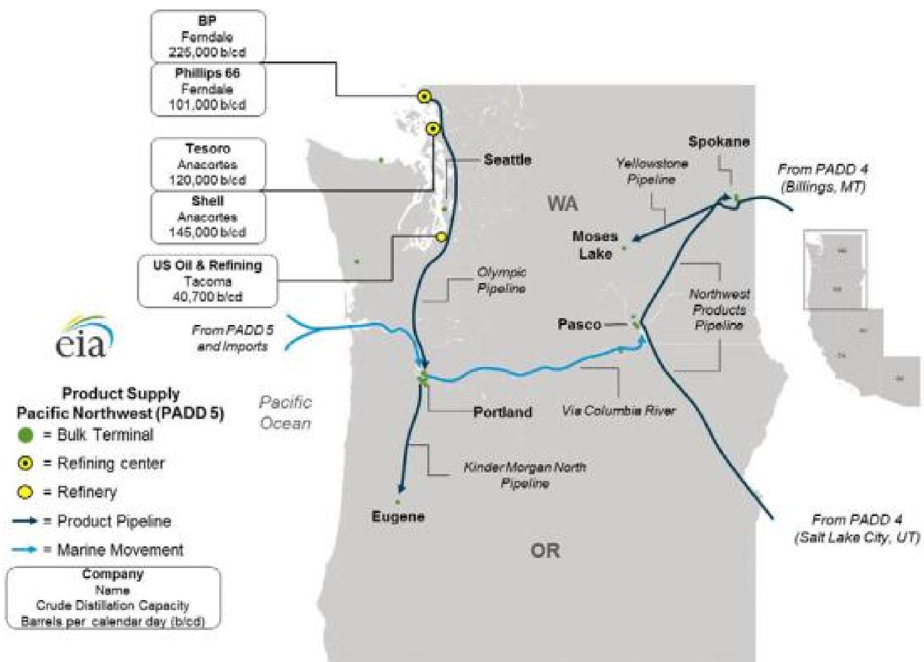


Data Source: U.S. Department of Energy - Energy Information Administration (EIA), 2015

Trends in oil product distribution and prices

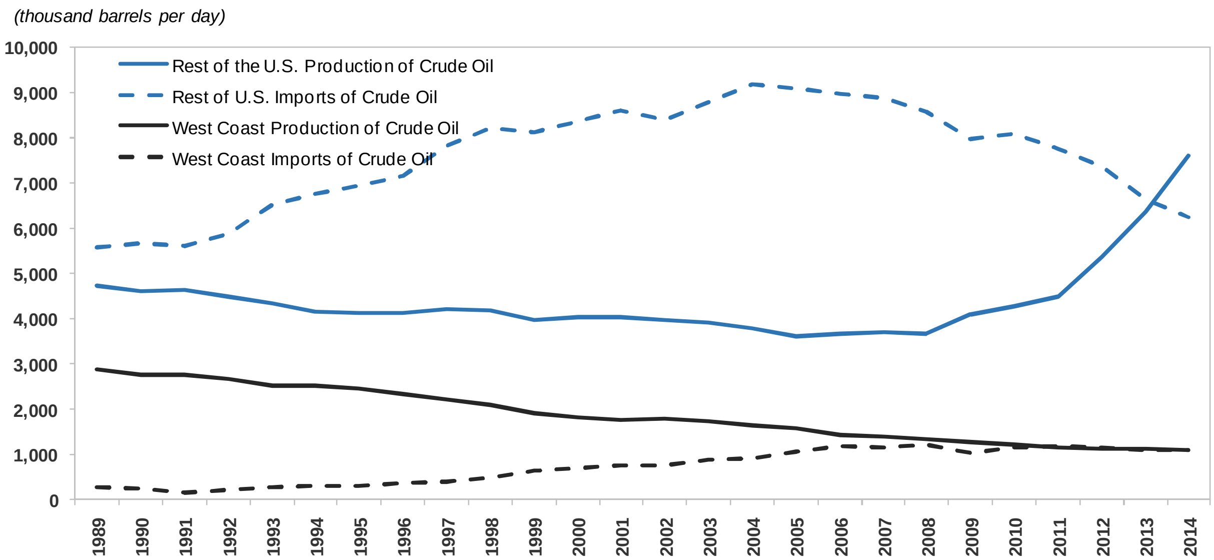
In terms of both crude oil supply to refineries and the supply of refined petroleum products to the end user, the U.S. West Coast is geographically isolated from the rest of the United States with limited pipeline or economically viable vessel connections to the refining centers in the Midwest and Gulf Coast. This results in an inability of West Coast producers and distributors to quickly adjust production and supply to align with demand using surplus crude or product from the rest of the United States, and exposes the West Coast to price fluctuations in the highly volatile Pacific Basin which includes emerging economies such as China and India. *Figure **3***3 shows the primary refineries in the Pacific Northwest and product pipelines. In 2014 jet fuel movements from the Mountain States to Eastern Washington and Oregon was less than one one-hundredth of a percent of total annual demand.

Figure 3: Pacific Northwest Product Supply (U.S. Energy Information Administration, 2015)



Most of the product supplied to the Washington market is sourced from larger refineries in Ferndale and Anacortes with additional supply coming from U.S. Oil and Refining's smaller facility in Tacoma which, with a direct link to the McChord Air Force base provides most of the military volumes of Jet Fuel in the region. The refineries in the region are primarily supplied by imported crude and while the rest of the country has benefited from recent decreases in crude market prices, generally attributed to growth in domestic unconventional crude production, the effect has been less noticeable on the West Coast where production, specifically in Alaska and California has contributed to a long term decline in the region as shown in *Figure 4*. With declines in local production on the West Coast there have been some increases in supply from the rest of the country using rail, but the primary offset has been through increased foreign imports. ***This increased reliance on foreign imports on the West Coast and the Washington refineries has contributed to the higher general prices on the West Coast compared to the rest of the U.S. and higher resulting price volatility.***

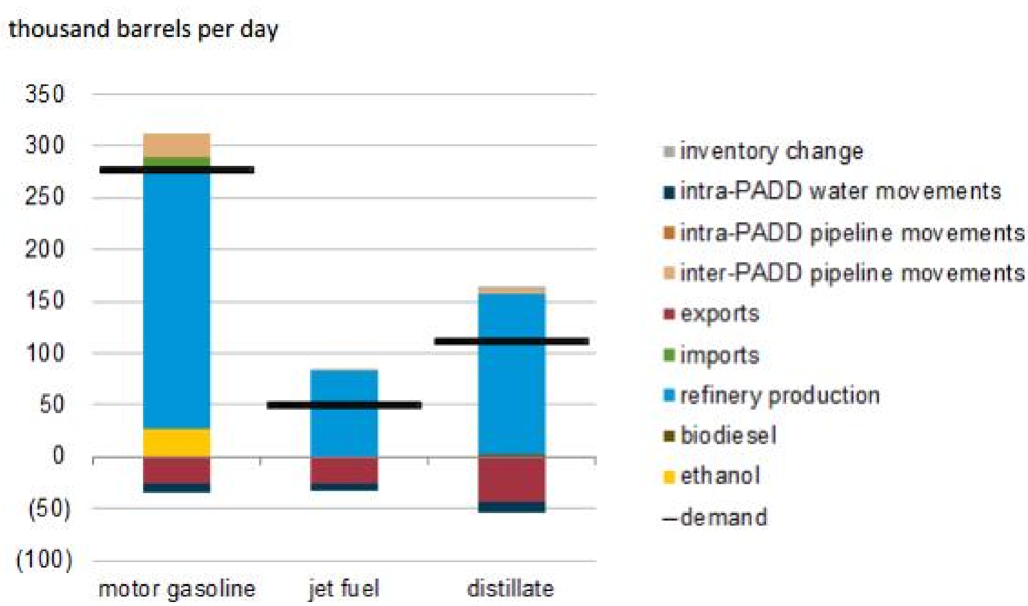
Figure 4: U.S. Annual Crude Oil Production and Imports by Region



Data Source: U.S. Department of Energy - Energy Information Administration (EIA), 2015

Refinery product yields in the Pacific Northwest as shown in **Figure** 5 are similar to the West Coast as a whole, with all types of gasoline's (AVGAS and MOGAS) accounting for 46.5 percent of production, jet fuel 17 percent, other distillates (primarily diesel) 23 percent and the remaining 13.5 percent attributed to residual fuel oil, petrochemical feedstocks and other products such as asphalt and petroleum coke. The primary difference with refinery yields in the rest of the country is in the higher percentages of jet fuel at 17 percent for the West Coast compared to a national average of 10 percent, with the difference accounted for in higher production yields for other distillates.

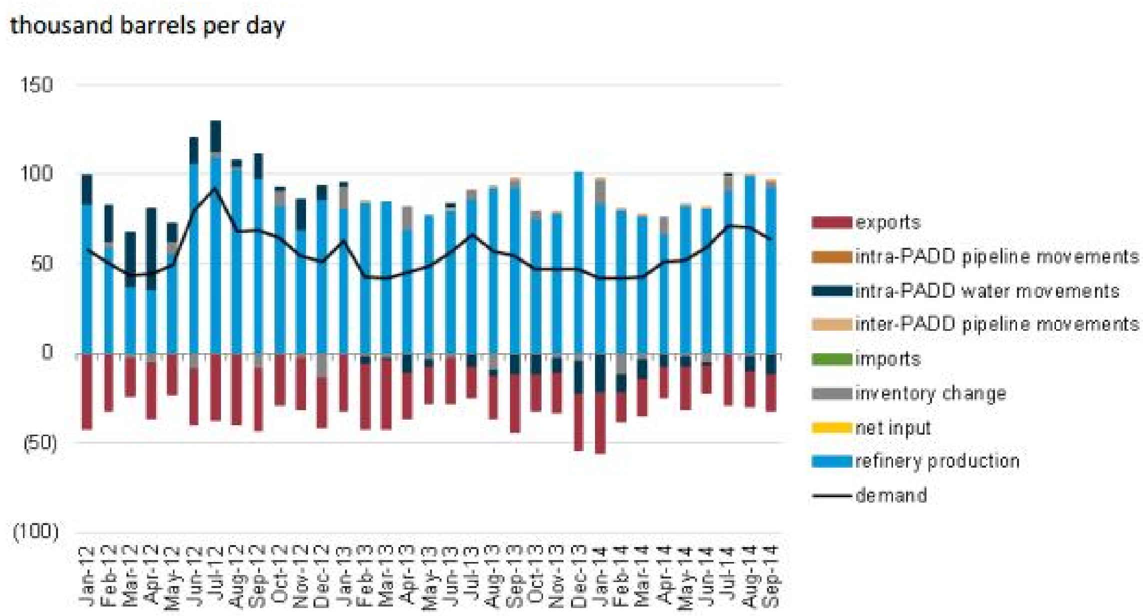
Figure 5: Pacific Northwest Product Supply (U.S. Energy Information Administration, 2015)



Source: Stillwater Associates analysis of U.S. Department of Energy - Energy Information Administration (EIA), 2015, PADD = Petroleum Administration for Defense Districts which are used to aggregate the U.S. states into 5 districts for data reporting and market analysis.

Although jet fuel production in the Pacific Northwest is higher than demand the region's refineries also export significant volumes, primarily to airports in British Columbia, Western Mexico, and occasional shipments to Northeast Asia and Latin America. In the past this has led to a slight imbalance in supply that was supplemented by production from California refineries, primarily via shipments directly to the Portland area. With flattening demand for all types of gasoline, refiners in the west coast have invested in upgrades to increase production of higher priced distillates, including jet fuel, leading to refinery yields of jet fuel increasing from 16.4 percent in 2009 to 17.3 percent in 2014. The increase in jet fuel yields, specifically in Washington State has led to a reversal in which ***the state's refineries now export jet fuel to other states in the region*** (*Figure* 6), including California, Alaska, and Hawaii. This surplus of production indicates that the refineries in the region are adequately prepared to deal with future increases in demand.

Figure 6: Pacific Northwest Jet Fuel Supply



Source: Stillwater Associates analysis of U.S. Department of Energy - Energy Information Administration (EIA), 2015, PADD = Petroleum Administration for Defense Districts which are used to aggregate the U.S. states into 5 districts for data reporting and market analysis.

The leaded AVGAS market continues to be primarily supplied by the local refineries in Washington State, however with continued decline in demand, and recent growth in unleaded gasoline demand for auto use along with prices ***there will be increased pressure on the refiners to decrease or completely stop production of AVGAS.*** Decreasing production will likely continue to put upward pressure on end-user prices which will likely help to accelerate trends towards alternative fuels. The trend in alternative general aviation fuels has led to growth in alternative distribution of fuels including self-service fuel stations, which tend to offer fuel at up to $1.00 less than full-service options. Other trends include some MOGAS volumes being transferred directly by individuals using items such as self-fill fuel cans and containers to aircraft at smaller general aviation and private airport facilities, in addition to the risk of fuel contamination, this trend represents a safety risk at smaller airports associated to flammable product spills and exposure to vapors. Some airports and fuel suppliers have helped decrease this risk by offering fuel trailers that are an inexpensive alternative to permanent facilities and may be an ideal stop-gap until demand justifies the transition of existing AVGAS storage and pumps with MOGAS.

Mitigation of market price and supply factors

Both commercial and general aviation fuel users will continue to look for ways to decrease exposure to volatile fuel prices. ***In addition to investments in new and more efficient aircraft and engine technologies, continued work is being done to approve alternative fuels for use in existing aircraft*** (covered in the next section). Commercial airlines have increasing experience with fuel hedging strategies that have led to mixed results depending on actual market prices with airlines losing or gaining billions depending on the price(s) they hedged at the volume of those hedges[5]. Delta Airlines took fuel supply one step further by purchasing the Trainer refinery in Pennsylvania in 2012 (operated under Monroe Energy LLC), while the purchase helped guarantee supply and provide product pricing control, it exposes Delta to fluctuations in crude prices and refining margins[6]. Global airline alliances, specifically STAR Alliance members, have also pursued joint fuel purchases to take advantage of economies of scale and possible better contract deals with fuel suppliers at primary hub airports.

For general aviation users, future mitigation of exposure to volatile fuel prices will likely be similar to current trends with private pilots focusing on more direct routings, flying at slower speeds to reduce fuel consumption, cut back on flying hours, tinkering with fuel, and refueling at airports with the cheapest available fuel.

Market Developments in Fuels

Aviation gasoline (AVGAS) 100LL has been the most commonly used fuel by piston aircrafts in the US general aviation fleet. ***However, it remains the only leaded fuel used in US transportation today. Due to its harmful environmental impact, 100LL is being phased out by the Federal Aviation Administration (FAA) to be replaced by new unleaded fuel for general aviation by 2018***[7].

There are several reasons why MOGAS could be argued as a potential long-term replacement for the 100LL AVGAS. MOGAS was approved by the FAA as aviation fuel in 1982, and is already being used in general aviation. According to a recent study, about 80% of the current US general aviation piston engine fleet is capable of using, or obtaining the Supplemental Type Certificate (STC) to use MOGAS[8]. MOGAS is $1.14 cheaper than 100LL AVGAS, using the nationwide average across 3651 Fixed Based Operators (FBO)[9]. MOGAS is unleaded and thus satisfies one of the main reasons 100LL is being replaced.

There are industry concerns regarding the present supply of MOGAS. The Federal Renewable Fuel Standard program mandated addition of Ethanol to Autogas[10], making it undesirable for use in aviation[11]. There are some industry concerns regarding Ethanol possibly causing engine damage potentially as a result of the absorption of water. However, Ethanol-free MOGAS is still available at about 120 airports and from many distributors in the US[12]. Autogas is already distributed in large volumes by fuel pipelines, and can be transported from fuel terminals to airports via conventional fuel trucks[13]. There are also concerns over insurance and liability, as oil

[5] N.B., *Fuel Hedging and Airlines,* (Washington D.C.: The Economist, January 19, 2008).
[6] Linda Loyd, *Delta Profits from Trainer Refinery, Lower Fuel Costs,* (Philadelphia: Philadelphia Inquirer, April 17, 2015)
[7] https://www.faa.gov/about/initiatives/avgas/
[8] http://generalaviationnews.com/2012/07/12/new-study-shows-autogas-can-power-80-of-piston-aircraft/
[9] https://www.airnav.com/fuel/report.html
[10] http://www3.epa.gov/otaq/fuels/renewablefuels/
[11] Petersen Aviation Inc., http://www.autofuelstc.com/
[12] http://www.flyunleaded.com/airports.php
[13] http://generalaviationnews.com/2014/01/19/avfuel-eaa-and-mogas/

refiners do not approve the use of MOGAS for aviation, making it difficult to obtain aviation products liability insurance for its use[14]. ***Safety statistics are on MOGAS' side though, with an excellent safety record based on the 35,000 general aviation aircraft currently with the STC to run MOGAS***[15,16].

Swift Fuels has recently announced market release of the unleaded Octane 94 (Mon94) AVGAS at the 2015 Oshkosh Air venture[17]. Swift's Mon-94 AVGAS is expected to be compatible with aircraft that require lower-octane fuel. Aircraft with MOGAS STCs can already use this fuel, while those that require AVGAS can purchase the necessary STC to switch to the unleaded Mon-94. The Mon-94 AVGAS is derived from premium gasoline components but customized for the aviation specific standards, making it a commercially insurable aviation fuel. Mon-94 is expected to be cheaper than the 100LL, currently selling for $4-$4.25 by FBOs at airports that currently serve the fuel[18].

However, Mon-94 AVGAS is not going to be a single fuel alternative to the 100LL AVGAS. Swift Fuels is also working on a Mon-102 unleaded AVGAS, as part of the FAA's Piston Aviation Fuel Initiative (PAFI) program[19]. This fuel is still under evaluation by the FAA, and could serve as a fleet-wide replacement of the 100LL.

Due to their considerable cost advantages over gasoline engines, diesel engines may have found their way in the European aviation fleet, but their presence and use in the general aviation market in the US is still in its infancy[20]. Diesel engines are compatible with Jet fuel, which is less expensive than AVGAS. However, a fleet-wide switch from gasoline to diesel engines could be a difficult alternative compared to the other options discussed above to face the eventual shift away from the 100LL.

In addition to concerns over the lead content of the 100LL AVGAS, Sulphur has also been studied as a contender for mitigating its harmful environmental impact[21]. According to a recent study at the Massachusetts Institute of Technology, desulphurization of jet fuel would improve air quality and reduce 1000-4000 global deaths annually. However, the technology would cost the aviation industry $1-4 billion per year, which equates to an increase in the fuel cost by about 2%. The study also found that desulphurization would reduce the formation of cooling Sulphate particles that offsets global warming[22]. The authors point out that the costs and benefits of desulphurization of jet fuel are quite even in their analysis.

Washington State Market Outlook

The Washington State Transportation Revenue Forecast Council projects continued growth in aircraft registration and fuel tax revenue through Fiscal Year (FY) 2027 in their September 2015 forecasts[23]. Aircraft registration, which was up a quarter of a percent in 2015, is expected to grow by half a percent through the end of the forecast horizon in FY 2027.

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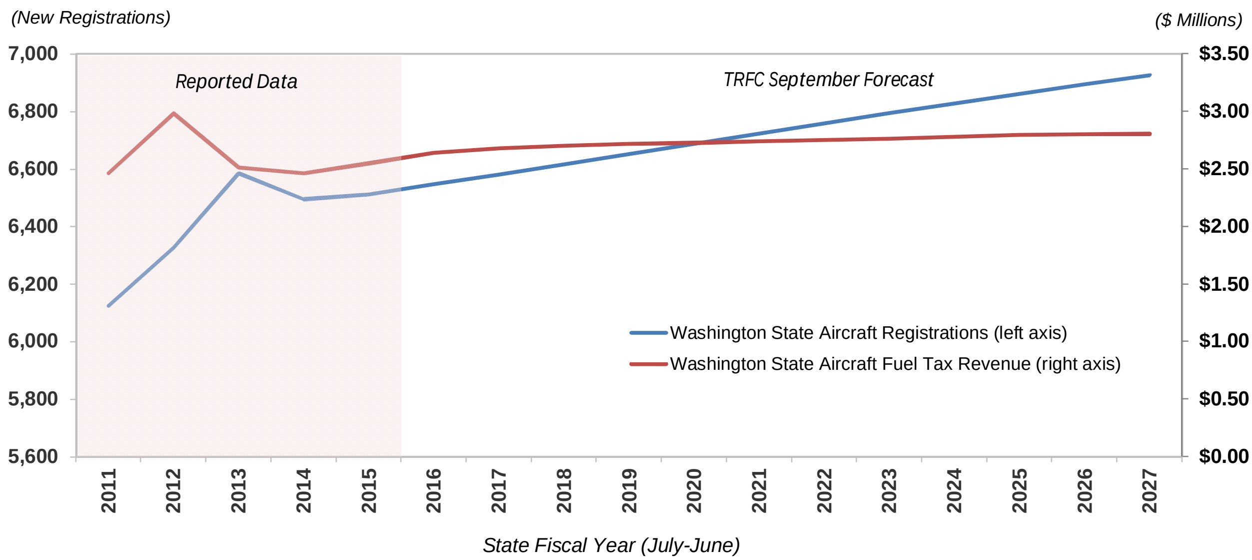
14 http://generalaviationnews.com/2013/09/30/the-mogas-debate/
15 http://generalaviationnews.com/2011/03/16/10-mogas-myths/
16 Petersen Aviation, http://www.autofuelstc.com/
17 http://www.aopa.org/News-and-Video/All-News/2015/July/23/Swift-Fuels-to-offer-94-MON-avgas
18 http://www.avweb.com/podcast/Podcast-Swift-Fuels-Chris-DAcosta-on-the-Road-to-a-100LL-Replacement-224588-1.html
19 https://www.faa.gov/about/initiatives/avgas/media/media/PAFI_White_Paper.pdf
20 http://www.flyingmag.com/aircraft/diesel-aircraft-engines-revolution?page=0,0
21 Environmental Cost-Benefit Analysis of Ultra-Low Sulphur in Jet Fuel, Barrett et al, Partner, Partnership for Air Transportation Noise and Emissions Reduction, Massachusetts Institute of Technology.
22 http://www.rsc.org/chemistryworld/2012/05/ultra-low-sulfur-jet-fuel-radar
23 Washington State Transportation Revenue Forecast Council, *September 2015 Forecast Detailed Forecast Tables Volume II,* (Olympia: Office of Financial Management, September 24, 2015).

Figure 7: Washington State Aircraft Registration and Fuel Sales Forecast from September TRFC Report



Source: Washington State Transportation Revenue Forecast Council September 2015 Volume II

Aircraft fuel tax revenue, a proxy for aircraft fuel sales, was 3.6 percent higher in FY 2015 and is expected to maintain similar growth in 2016 as existing aircraft owners increase their flying time; afterwards growth is expected to slow to around half a percent through the end of the forecast horizon.

The reduction in growth in projected fuel sales will likely be the result of a combination of effects including continued improvements in aircraft efficiency, higher fuel prices, transition to alternative fuels that can be directly supplied (such as diesel and MOGAS) and slower growth in overall general aviation private aircraft registrations.

Carbon Taxes

A largely unknown factor is future carbon emissions regulations and taxation. The state of Washington is a member of the Western Climate Initiative, an agreement between Arizona, California, New Mexico, Oregon, British Columbia, Ontario, Quebec and Manitoba to "develop regional targets for reducing greenhouse gas emissions, participating in multi-state registry to track and manage greenhouse gas emissions in the region, and develop a market-based program to reach the target" (Western Climate Initiative Website – westernclimateinitiative.org). California instituted a cap-and-trade plan while British Columbia initiated a carbon tax in 2008. Washington Governor Inslee has come out in support of policies similar to California to institute a cap-and-trade program[24], which has not received strong political backing, while various individuals and organizations are endorsing a voter initiative I-732 in support of carbon taxes[25]. Experiences in California and British Columbia have seen an equivalent increase in the price of petroleum based fuels of $0.10 per gallon and $0.20-$0.30 per gallon respectively[26]. It is difficult to measure how much of this price increase is passed to the end user as some of the costs could be captured in lower refiner or distribution margins or through tax incentives meant to offset carbon costs for

[24] Jeff Spross, *Washington State is Gearing up a System to cut its Carbon Emissions,* (Seattle: Think Progressive, July 30, 2014).
[25] Jim Brunner, *Carbon-tax Initiative Divides Environmentalists,* (Seattle: Seattle Times, July 25, 2015).
[26] Alan Durning and Yoram Bauman, *17 Things to Know about California's Carbon Cap,* (Seattle: Sightline Daily, May 22, 2014).

producers who invest in technologies that reduce carbon emissions. In the cap-and-trade market some producers may end up profiting from the market by buying credits at lower current prices and selling them in future years if the prices of credits increase. ***Based on existing experience, the impact on prices due to carbon policies will likely be minimal in comparison to general economic factors and fluctuations in global and regional market prices for jet fuel and leaded AVGAS.***

Commercial airlines and the military have started to test alternative non-carbon intensive fuel such as bio-jet fuels made from used cooking oils, fats, and jatropha. Companies including Honeywell-UOP, Imperium Renewables, Neste Oil, Dynamic Fuels, Shell have produced bio-jet made from various types of feedstock that has been distributed by oil companies and SkyNRG for various commercial test flights. ***Over 35 airlines have participated in bio-jet test flights as of 2013.*** In Seattle, Alaska Airlines, and regional subsidiary Horizon Air, have led the effort through the use of 20 percent bio-jet made from cooking oil and meet product waste 80 percent conventional jet fuel blend in scheduled flights between Seattle and Washington DC and Seattle and Portland respectively[27]. The bio-jet and blended fuel was supplied to the aircraft by EPIC Aviation using dedicated and separate fueling infrastructure. In 2015 Alaska Airlines announced additional bio-jet test flights using bio-jet produced through Washington State University led Northwest Advanced Renewable Alliance. The 1,000 gallons of bio-jet will be produced using a feedstock of residual treetops and branches[28].

Although over 1,000 flights have been conducted with various blends of bio-jet, the technology is still being developed and proven, and the economics of bio-jet are relatively unknown. The production of bio-jet is similar to that of bio-diesel in terms of feedstock and manufacturing, which should provide a basis for assessing potential price differentials and performance compared to conventional fuels. However, the price elasticity of demand for jet fuel in comparison to diesel needs to be understood further, along with potential government financial incentives for the use of bio-jet. Unlike bio-diesel, which often receives a fuel tax exemption, conventional jet fuel is not taxed on international flights, and the tax on domestic flights remains relatively low, which will reduce the incentive to switch. Depending on the implementation of a potential carbon policy in Washington State and the associated costs and incentives, it is difficult to determine the potential impact on statewide demand for products.

In terms of general aviation, the same questions on performance and product standardization are being discussed along with testing to assess the potential for use of ethanol in AVGAS and MOGAS and bio-diesel in diesel fuels. Tests to date have proven inconclusive, and ongoing research is being conducted to assess the risk in use of both unleaded gasoline and gasoline blended with other octane enhancers.

Anticipated Impacts on Infrastructure Needs

Several of the industry trends outlined above would have potential impacts on refueling infrastructure requirements at airports. The increase in use of fuels such as MOGAS, diesel, and bio-jet could all require additional investments and oversight.

Fuel Supply and Distribution

Standard jet fuel will continue to be the primary fuel in the commercial aviation sector with some potential growth in bio-jet depending on pricing, carbon policy, and blend mandates. ***In the general aviation sector the price premiums for AVGAS over conventional gasoline, and continued reduction in availability of AVGAS will support the continued trend towards alternative fuels such as MOGAS, diesel and jet fuel.***

[27] Alaska Airlines, *Alaska Airlines Launching Biofuel-Powered Commercial Services in the United States,* (Seattle: Alaska Airlines, November 11, 2011).
[28] Washington State University, *Alaska Airlines Plans Biofuel Test Flight in WSU Partnership,* (Seattle, WSU News, June 3, 2015).

Current infrastructure for the production and distribution of jet fuel in Washington state should be adequate to handle future demand. Current demand still remains 20 percent below historic high levels indicating that ***the current infrastructure should be sufficient to handle a full rebound in the market which isn't projected until well after 2027-2028***. However, given the continued route growth by Delta Airlines and Alaska Airlines, who both maintain hubs at Seattle-Tacoma International Airport, there could be accelerated growth in fuel demand over what was previously forecasted. As such it will be important to monitor both airlines growth strategies to determine if and when expansion of on-site fuel farms may be necessary. Refinery production in the Pacific Northwest is also adequate to handle significant local growth in jet fuel demand with opportunity to divert foreign exports and shipments to other West Coast markets as required.

Depending on future carbon policy, fuel pricing, and technological acceptance, bio-jet may gradually be blended into the primary jet fuel supply, but until that time bio-jet will likely be used on a limited basis for demonstration flights or on specific test routes. Similar to ethanol and bio-diesel, bio-jet will likely be available for blending at the rack or on-site at the airport fueling facilities rather than at the refinery. This will help to avoid contamination of the primary jet fuel supply and blending downstream of the refinery, simplifying the process for assessing credits and meeting any specific bio-fuel blend mandates - if they are implemented. A majority of the jet fuel demand in Washington State is centered on military bases and Seattle-Tacoma International airport, which are directly supplied by the U.S. Oil and Refining facility in Tacoma and the BP Cherry Point refinery respectively via pipeline to onsite fuel farms. As such the opportunities for blending at offsite terminal facilities are minimal and if there were to be any blend mandates or trends towards increased use of bio-jet additional segregated distribution would be required. This would most likely be conducted by dedicated rail or truck deliveries in Washington State.

In the general aviation sector there is a risk of further reductions in production and primary supply of AVGAS to the market as the EPA increases pressure to remove lead and higher prices reduce demand for AVGAS and encourage transition to alternative fuels. There are only a limited number of global producers of Tetra Ethyl Lead (TEL), none in the United States, with Innospec in the UK being the primary supplier to the U.S. market. There are also three facilities in China that represent an increasing share of the global market, specifically the west coast of the United States. The two refineries on the West Coast that produce AVGAS are both in California and include the ExxonMobil facility in Torrance and the Chevron facility in Richmond. Given the limited number of suppliers of TEL and finished AVGAS, a further closure of a facility, discontinued production, or extended outage could have a significant impact on AVGAS prices and supply in Washington State. In addition the high cost of maintaining dedicated parallel infrastructure for the distribution of AVGAS or the extensive cleaning of equipment used in the handling of AVGAS for use with other petroleum products has become less economical as demand for AVGAS declines***. It is likely that with further reductions in demand, both the production and supply infrastructure for AVGAS, will be reduced or diverted to other products.***

As AVGAS is a relatively small share of the overall gasoline market, further shifts to MOGAS use in the general aviation sector would likely not have a significant impact on overall production and infrastructure in Washington State. However, there could be a significant challenge in providing MOGAS that is not blended with mandated ethanol if there are continued technological concerns with using blended MOGAS in aircraft engines. Providing unblended MOGAS will likely still require dedicated infrastructure downstream of the refinery gate, including pipelines, trucks, and terminals. ***A transition to diesel fuels will have a similar challenge in providing diesel that hasn't been blended with mandated volumes of bio-diesel and ensuring supply hasn't been contaminated with bio-fuel blends.***

Fuel Storage

Jet fuel storage capacity at Seattle-Tacoma International Airport is thought to be sufficient to handle near term demand, which will remain below historical highs. However, continued strong route growth by Alaska Airlines and Delta Airlines could accelerate the need for expanding storage and fueling facilities. It is expected that any further gate expansions will include fuel hydrant systems for direct supply.

Depending on future carbon policy, market prices, and bio-fuels blend mandates there could be growth in bio-jet consumption which would likely require dedicated parallel storage infrastructure, which could be accommodated by fuel trucks until volumes justify the building of more permanent terminal facilities and fuel hydrant infrastructure, at which point a standard market blend will likely have been established permitting full transition of the existing infrastructure to a Jet fuel bio-jet blend.

General aviation presents a more specific problem in that volumes tend to be small and some airports are relatively isolated and far from primary supply terminals. ***Continued changes in the market that lead to a combination of alternative fuels could require fuel storage infrastructure to handle AVGAS, MOGAS, diesel, and jet fuel.*** As of 2011, 94 airports in Washington State offered MOGAS, and only Pangborn Memorial airport outside of Wenatchee had a listed fuel tank capacity. Similarly 94 airports in Washington State offered AVGAS 80LL, and only Grant County International had a listed fuel tank

Figure 8: Alternative Fuel Supply Systems (Aviation Pros)

capacity. The primary fuel offered is 100LL, with 99 airports offering the fuel and 61 of those with listed fuel tank capacity. Until alternative fuels demand justifies the transition of existing storage infrastructure to a specific fuel, parallel systems will be required. As seen in *Figure* 8 companies such as Aviation Pros and U-Fuel offer lower cost self-service equipment solutions starting at $35,000, this is compared to $400,000 or more for underground storage and pumps with a 20,000 gallon tank.

Figure 9: Mobile Fueler (Quality Fuel Trailers)

Other low cost options include fuel trailers (as shown above in *Figure* 9) that don't require a fixed location or significant capital investment and can be used as a short term solution until demand justifies more significant investments. Fuel trailers are becoming increasingly common at general aviation airports where multiple fuels are supplied but volumes don't justify investments in parallel infrastructure.

Summary

Airports and airport authorities face significant challenges in anticipating future fuel demand and increasingly, fuel types. While commercial aviation will still primarily rely on jet fuel, there is potential for growth in the bio-jet market to mitigate increases in prices related to carbon policies or blend mandates. However, either one would likely lead to widespread demand for jet fuel blended with bio-jet that could be accommodated with transition of existing infrastructure.

A greater challenge will be in general aviation and AVGAS supply. ***As the price differential between AVGAS and MOGAS, diesel, and jet fuel increases there will be increasing demand for access to those alternative fuels.*** Furthermore if one or more of the existing AVGAS suppliers were to stop producing AVGAS due to unfavorable margins and regulatory pressure to stop producing leaded fuels, there would be an immediate price impact that would lead to accelerated demand for a transition to an alternative fuel. ***Which alternative fuel is used will largely depend on turnover of the existing aircraft fleet and what products are being offered on the market. The most straightforward solution would be a transition to unleaded MOGAS but there are ongoing questions related to performance and safety that still require resolution before a large scale transition to MOGAS.*** Likewise the development of diesel engines (that burn diesel or jet fuel) could require the addition of two more fuel types at an increasing number of general aviation facilities. A cost effective means for addressing this challenge could be to invest in more temporary assets such as fuel trailers or above-ground self-service facilities until the industry has adapted a primary AVGAS alternative at which point existing permanent AVGAS infrastructure could be converted to handling that fuel.

As part of the WASP, WSDOT Aviation convened working groups to discuss aviation issues. A working group was established to discuss Aircraft Fuels. This group recommended the following actions be considered:

POLICY CONSIDERATION: The FAA and manufacturers should fund aircraft power plant recertification where required (regarding the new no-lead aviation gasoline).

POLICY CONSIDERATION: WSDOT should develop an outreach program to address/communicate the safety and benefits of MOGAS.

POLICY CONSIDERATION: WSDOT should support the FAA's lower octane No Lead AVGAS. Context – Products such as MON-94 are not refined locally and the distribution channel is problematic. The working group recommends that WSDOT work with the manufacturer/distributors to obtain the fuel, and airport sponsors to support fuel dispensing.

POLICY CONSIDERATION: The FAA should support the certification of Auto-fuel for aviation use.

POLICY CONSIDERATION: WSDOT should work with the FAA and WSU to educate the aviation community on bio jet fuel.

POLICY CONSIDERATION: WSDOT should promote options for dispensing MOGAS:

- Promote small systems of MOGAS
- Provide support guidance and educational information to airports
- Conduct education outreach to pilots.

POLICY CONSIDERATION: WSDOT should conduct pilot training to update pilots on various issues and listen to pilot concerns (These are related to goals of education and WSDOT should coordinate this effort with WPA similar to other statewide workshops).

Memorandum

Re: Final Emerging Issues Paper
Aircraft Innovation

This technical memorandum summarizes recent trends in aerospace manufacturing innovation and potential impacts on the State of Washington.

Introduction

New aircraft entering the civilian aviation marketplace are increasingly likely to have unique operating characteristics due to innovation within the aerospace manufacturing industry. While new aircraft types and models have continuously been introduced into the marketplace since the beginning of the aviation age in the 20th century, recent trends in innovation within the experimental, light sport and normal category aircraft may have an infrastructure impact on airports within the Washington state system over the next 20 years.

This document identifies recent trends in the aerospace manufacturing industry in the context of aircraft innovation, and their potential impacts on infrastructure within the State of Washington airport system, and associated aeronautic and airport programs.

Industry Trends and Outlook

Alternative Fuels/Power Plants

Aircraft manufacturers have begun to make significant progress towards alternative fuel and power sources for general aviation aircraft.

Figure 1 - Airbus EFan Electric Aircraft

Development of aircraft using an electric motor instead of an internal combustion engine has been ongoing since the 1970s. Currently, electrically powered aircraft are primarily experimental or demonstration aircraft, however advances in lightweight motors and more powerful batteries will enhance the feasibility of electric aircraft. Several companies in Europe and the United States are developing electric powered aircraft for commercial use. Industry transition to electric propulsion may begin with trainers emerging over the next few years, followed by personal VTOL aircraft, and commercial grade platforms in the mid-term.


Figure 2 - Diesel Powerplant

The declining availability of Avgas in the United States along with the increasing environmental concerns and regulation of leaded fuels has driven innovation in fuel types and engine types. In addition to being cheaper than Avgas, motor fuel (such as Mogas and gasoline), and jet fuel (such as road diesel or Jet-A) are widely available for use by GA aircraft provided their engines are capable of using them. Over the past few years, several companies have developed new aircraft engines which can run on Mogas. Some engines are widely used, Rotax being one example. Additionally, other manufacturers have developed diesel engines which burn jet fuel. Cessna Aircraft has already developed at least two aircraft types with a diesel engine option: the Turbo 172 Skyhawk JT-A[1], and the 182 Skylane JT-A (although orders for this aircraft were halted in May 2015)[2].

Aviation biofuels are also beginning to enter the marketplace as an alternative fuel source. Biofuels have been approved for commercial use in aircraft since 2011, and have started to see limited use on commercial flights, primarily in Europe and Asia.

Innovative Experimental and Light Sport Aircraft

Light sport aircraft (LSA) are small, simple-to-operate, easy-to-fly aircraft that in the United States are generally classified as having a maximum gross takeoff weight of 1,320 pounds and a maximum level flight speed of 138 mph among other criteria.

Figure 3 - ICON Special Light Sport Aircraft

Two types of experimental and light sport aircraft are being developed with the potential to impact infrastructure at airports: the roadable LSA, and autogyro/tiltrotor/VTOL aircraft.

Roadable LSAs combine flying capabilities of an aircraft with a vehicle capable of being driven as an automobile. While roadable aircraft have been contemplated and constructed since the 1930s, they have not enjoyed commercial success and acceptance. Current efforts to bring a roadable LSA to market in the United States is typified by the Terrafugia Transition. The Transition has been under development since 2006, with anticipated first customer delivery scheduled for mid 2016. The Transition has a specified takeoff roll of 1,700 feet, a 100 mph cruise speed and 400 mile range in flight, and can reach ground speeds between 65 and 70 mph on the road[3].

Figure 4 - Terrafugia Roadable LSA

Autogyros or gyrocopters are a type of rotorcraft with a propeller to generate thrust, and an unpowered rotor to provide lift. Autogyros are not true VTOL (vertical take-off and landing) aircraft because most gyrocopters require a runway for takeoff and cannot hover since the rotor blades are not powered. Autogyros have been developed since the 1920s, but similar to roadable LSAs have not enjoyed widespread commercial success. Currently, autogyros are mainly used by military and law enforcement agencies because of their lower cost to purchase and operate compared with standard helicopters.

Figure 5 - Sportcopter SCII

Figure 6 - Agustawestland AW609 Tiltrotor

Tiltrotor aircraft combine the vertical take-off and landing capabilities of a helicopter with the fixed-wing operation of conventional aircraft. The most recognizable tiltrotor aircraft currently is the Bell Boeing V-22 Osprey, which first entered service in the United States Marine Corps in the 2000s. Civilian tiltrotor aircraft are in development, such as the AgustaWestland AW609. The AW609 has flown as a prototype since 2003. FAA certification of the AW609 is anticipated in 2017 at the earliest. The AW609 is designed to be a true VTOL aircraft, with a maximum cruise speed of 275

[1] The Wichita Eagle, *Manufacturers making progress with diesel-powered airplane engines*, http://www.kansas.com/news/business/aviation/article2102433.html, September 13, 2014.

[2] http://www.aopa.org/News-and-Video/All-News/2015/May/14/Cessna-not-accepting-182-JT-A-orders

[3] Terrafugia Transition Aircraft, http://www.terrafugia.com/aircraft/transition, accessed September 2015.

knots, and range up to 700 nautical miles with standard fuel tanks[4]. Tiltrotor aircraft, like the AW609, are being marketed for corporate use as the quickest method to travel point-to-point, avoiding potential congestion between an airport and one's destination by flying directly to a city center. Tiltrotors also would provide additional mobility options and flexibility for oil and gas operators and other resource development in hard to reach and offshore environments.

Figure 7 - Agustawestland Project Zero

Other General Aviation Aircraft

Very light jets (VLJs) are small jets, seating less than 10 passengers that cost substantially less than business jet aircraft. VLJs have a maximum takeoff weight (MTOW) of less than 10,000 pounds, and are able to use short, general aviation runways. This new category of aircraft includes the Cessna Mustang, Embraer Phenom, and the in development HondaJet, among others.

Figure 8 - Eclipse 550 VLJ

The current VLJ market consists of a new small offering in the established corporate market. Buyers include corporate flight departments, fractional and charter aircraft operators, and wealthy individuals. In the early 2000s, market interest in VLJs was considerably higher. However delays in development of one of the first and at the time most popular VLJ, the Eclipse 500, followed by Eclipse declaring bankruptcy in 2008, combined with the reduced demand following the economic crisis in 2008, caused VLJ demand to reduce significantly.

Figure 9 - Commercial Drone

The development of unmanned aerial systems (UAS) has accelerated over the last five years. Civilian uses of UAS are rapidly becoming more pronounced as the FAA develops and refines operating and certification criteria for this class of aircraft. UAS can be designed around multiple platforms. For example, UAS exist in fixed-wing configurations, VTOL/helicopter configurations, and hybrid combinations. Sizes of these aircraft also vary wildly, from microdrones that that be carried by their owner by hand to military drones such as the MQ-9 Reaper with a wingspan of 65 feet.

Commercial Aircraft

Trends in innovation for upcoming commercial aircraft appear to be focused primarily on reducing operating costs for the airlines by developing more efficient aircraft. This will be done by increasing aircraft wingspans and/or improved aerodynamics, decreasing aircraft weight through use of composite materials, and improved engine technologies to reduce fuel comsumption.

[4] AgustaWestland AW609 TiltRotor brochure, http://www.agustawestland.com/documents/17633750/26143301/body_AW609.pdf, accessed September 15, 2015


Figure 10 – Boeing 737 MAX

Two aircraft in development by Boeing, the 737 MAX and the 777X, are scheduled for deployment between now and 2020. The 737 MAX incorporates Boeing's Advanced Technology winglet with a split tip to improve aerodynamics and fuel consumption rates, while simultaneously keeping the aircraft's wingspan below 118 feet[5]. This keeps the newest 737 series aircraft within the FAA's Airplane Design Group III, which will not require changes to airfield geometry at airport's design to handle this aircraft's predecessors.

The Boeing 777X features a larger wingspan and improved engines to improve efficiency over the current 777 models in service. The 777X will be nearly 23 feet wider than the 777-300ER, but is anticipated to feature folded wingtips as a standard, which will allow the 777X to use the same airport gates and airfield facilities as the current 777 series aircraft[6].


Figure 11 - Courtesy Eric Paciano/California

Cruise-Efficient Short Takeoff and Landing (CESTOL) is an aircraft design concept that may increase capacity and reduce emissions. The future CESTOL aircraft is envisioned to have the size, range and speed to be operationally and economically competitive in substantial markets, justifying a large civil CESTOL fleet. These aircraft could serve large hub airports, satellite airports and local regional airports. They will leverage fuel-efficient, low-noise and low-emission technologies and operating procedures, and will operate in steeper descent/approach and takeoff/climb profiles, on runways used by conventional jet aircraft as well as shorter runways[7].

Anticipated Impacts on Infrastructure Needs

Several of the industry trends outlined above would have potential impacts on infrastructure needs at airports. The development of aircraft using alternative fuels or power sources, such as Mogas, road diesel, and electric motors is one such trend.

As electric powered aircraft emerge, the infrastructure need becomes how to recharge, or exchange batteries, for these aircraft while they are parked on an apron or in hangars. While aircraft parked in hangars would more than likely be able to recharge through the hangar's electrical outlets, aircraft parked on tie-down aprons would not be able to recharge given current infrastructure layouts. The parallel with ground vehicles would be electric charging stations being deployed in city centers for hybrid and electric vehicles to recharge while parked. For commercial operations, including flight training, high amperage, fast chargers, or battery exchange may be needed to support short turn times. Also, battery exchange may require a secure location for battery storage and charging. Similar systems for itinerant aircraft parked at aprons, or increased accommodations for these aircraft in hangars with electrical outlets would be required should these types of aircraft come to market in any significant numbers.

[5] 737 MAX Design Highlights, http://www.boeing.com/commercial/737max/#/design-highlights, accessed November 2015.

[6] Boeing 777X Technical Specs, http://www.boeing.com/commercial/777x/#/technical-specs, accessed November 2015.

[7] CESTOL Impact on U.S. Airport Network Operations, International Powered Lift Conference, London, UK, July 2008; http://thehill.com/images/stories/whitepapers/pdf/Sensis_IPLC_08_Couluris.pdf

With its declining availability, more and more general aviation aircraft currently using Avgas will likely see a transition to a new fleet of small aircraft using engines capable of using non Avgas fuel sources, such as Mogas, diesel, or Jet-A fuels. The effect on infrastructure needs at airports would likely be a combination of changes in types of fuels being offered and the amount of space needed for airport fuel farms at general aviation airports. Typically, fuel tank considerations for GA airports are currently discussed in terms of number of tanks and gallons of Avgas and Jet-A available. Depending on how the aviation market responds to all the factors and options surrounding the Avgas availability trend, a combination of additional fuel options beyond Avgas and Jet-A (such as Mogas and diesel), and increases in Jet-A storage (to account for increasing number of aircraft engines capable of processing Jet-A fuel).

Roadable LSAs impact on infrastructure needs at GA airports would likely be limited to access concerns between the airport's runway/taxiway system and the public roadway system. Parking and maneuverability concerns for a roadable LSA would be small due to their dimensions in both aircraft and ground vehicle modes being of a similar size to standard small fixed-wing aircraft and a passenger automobile, respectively. Access concerns would be applicable mainly to itinerant roadable LSAs seeking to leave the secure area of an airport's airfield environment to enter the ground transportation network. Since access to/from the airfield is typically gated and secure for larger GA airports, access in and out of the perimeter is restricted. Should roadable LSAs become more prolific this access challenge would need to be addressed.

Increasing numbers, varied designs and sizes of autogyros, rotorcraft, and tiltrotor aircraft present potentially the largest infrastructure impact for general aviation airports. Currently, with few exceptions, the large majority of based and itinerant aircraft at airports are fixed-wing, utilizing the runway and taxiway system to arrive and depart. Layouts and configurations of facilities with a more pronounced share of rotorcraft/VTOL operations are appreciably different than standard airports accommodating fixed-wing aircraft.

Two examples of this are Boulder City Municipal Airport (BVU) in Boulder City, Nevada, and Grand Canyon National Park Airport (GCN) in Grand Canyon, Arizona. Both airports have significant amounts of helicopter operations due to the tour activity related to their proximity to Grand Canyon National Park. At BVU, a large percentage of the main parking apron is devoted to rotorcraft operations for two of the airport's fixed base operators (FBO). At GCN, the two main helicopter tour operators are located in areas not connected to the airport's runway/taxiway/apron system. In both cases, there are operational challenges due to the increased interaction of fixed-wing aircraft operations and helicopter operations, although this is more pronounced at BVU given the centralized location of the helicopter parking apron in relation to the rest of the apron and the airport's three runways.

Increasing availability and use of autogyros, rotorcraft, and tiltrotor aircraft would potentially drive a need for additional areas devoted for heliport/helipad purposes. While combining these areas with existing infrastructure devoted to fixed-wing parking and taxiing areas is possible, depending on the number and operations of rotorcraft at a facility in comparison to fixed-wing aircraft and operations it may prove advantageous and ultimately safer to separate these uses to different areas of an airport. Additionally, tiltrotor aircraft present challenges in terms of providing hangars at their base airport. Tiltrotor aircraft, like the V-22 Osprey and the ASW609 mentioned above, have their rotors in the elevated horizontal position while parked on aprons or in hangars. The hangar dimensions to house this type of aircraft is significantly different when compared with a fixed-wing aircraft of similar size and use. For example, the wingspan of the ASW609 is 35.4 feet, but when the two rotor lengths are included, the total width of the aircraft is approximately 56 feet at a height above ground greater than most aircraft handling a similar number of passengers.

Potential infrastructure needs related to the VLJ aircraft category are primarily focused on runway length. While these aircraft may be capable of take-offs and landings on runways with less than 5,000 feet in length, most corporate flight departments require aircraft operations be conducted on runways of at least 5,000 feet. Since the development of the VLJ market of aircraft is focused on corporate operators and fractional ownership companies (such as NetJets), airports seeking to accommodate these aircraft need a primary runway length of at least 5,000 feet for corporate jet operators to consider using that facility.

General aviation airports that currently do not have a 5,000-foot primary runway and seek to accommodate a VLJ type aircraft or larger business jet aircraft face a parallel infrastructure need in addition to runway length. Most airports with primary runways less than 5,000 feet in length typically fall into the FAA Airport Reference Code (ARC) category of B-II or lower. Should the design aircraft of an airport change from a prop or turboprop aircraft to a jet aircraft due to increases in activity from VLJ or larger business jets, an airport's ARC would likely increase into a C-I or C-II category. FAA runway design standards significantly increase in several elements between A/B-I or A/B-II ARC categories and the C-I and C-II categories. **Table 1** shows changes in some of these elements between an ARC B-II standard and an ARC C-II standard.

Table 1: Runway Design Standards Comparison

Design Criteria/Element	ARC B-II Standard	ARC C-II Standard
Runway Width	75	100
Runway Safety Area (Length Beyond Runway End x Width)	300 x 150	1,000 x 500
Runway Object Free Area (Length Beyond Runway End x Width)	300 x 500	1,000 x 800
Runway Centerline to:		
Parallel Taxiway/Taxilane Centerline	240	300
Aircraft Parking Area	250	400

Notes:
1) All distances in feet
2) Runway design standards for runways with not lower than ¾-statute mile visibility

Source: FAA Advisory Circular 150/5300-13A, Change 1, *Airport Design*

Summary

Several categories of new aircraft have the potential to enter the civilian aviation marketplace over the next 20 years. In the general aviation marketplace, these innovations currently appear to focus on alternative fuel and power sources, experimental and light sport aircraft, increasing use of various rotorcraft designs (such as gyrocopters, tiltrotors), aircraft with VTOL capabilities, a VLJ corporate market, and the explosion of UAS usage. Each of these categories has the potential to impact infrastructure and infrastructure needs at airports within the State of Washington airport system in various ways.

The first impact is on fueling and power infrastructure. The declining availability in Avgas nationwide and the trend transitioning smaller GA aircraft to non-Avgas sources of fuel has the potential to increase the availability of Jet-A fuel on airports and the introduction of additional fuel options, such as diesel and Mogas. This means additional fuel tanks and/or larger fuel tanks at airport fuel farms. Should electric powered aircraft development accelerate, charging capability for aircraft parked at apron tie-downs will drive need for additional infrastructure.

While experimental and light sport aircraft have continued to increase in popularity in the aviation community, these aircraft typically do not create unusual impacts to infrastructure at an airport beyond the need for apron and hangar space. The development of roadable LSAs, however, would introduce the need to address access issues between the runway/taxiway system and the ground transportation network due to security perimeters at most airports.

Increasing numbers, varied designs and sizes of autogyros, rotorcraft, and tiltrotor aircraft present potentially the largest infrastructure impact for general aviation airports. These aircraft would drive a need for additional areas devoted for heliport/helipad purposes. Additionally, tiltrotor aircraft present challenges in terms of hangar areas, apron space, and dimensions not currently applicable to fixed-wing aircraft.

Finally, infrastructure needs related to VLJ aircraft are focused on runway length and FAA airfield design criteria. VLJ aircraft may be capable of take-offs and landings on runways with less than 5,000 feet in length, most corporate flight departments require aircraft operations be conducted on runways of at least 5,000 feet. Significant increases in FAA safety areas around runways occur once general aviation airports begin accommodating larger amounts of jet activity to the point where an airport's runway and taxiway infrastructure needs to be designed to serve jet aircraft.

As part of the WASP, WSDOT Aviation convened working groups to discuss aviation issues. A working group was established to discuss Aircraft Fuels. This group recommended the following actions be considered:

POLICY CONSIDERATION: WSDOT should reconsider the aviation system and expand it to include heliports and future 'droneports'.

POLICY CONSIDERATION: WSDOT should meet with city councils and similar forms of government to discuss a possible increase in heliports and droneports and related zoning and ordinance topics.

POLICY CONSIDERATION: WSDOT should continue to promote and encourage aeronautics and aerospace innovation.

POLICY CONSIDERATION: WSDOT should continue to monitor the evolution of VTOL aircraft and possible future modal connections at road interchanges and park-and-rides.

POLICY CONSIDERATION: WSDOT should host working groups to explore possible future infrastructure needs associated with aircraft innovation, and possible revision of SCIP and Airport Aid grant programs.

POLICY CONSIDERATION: The FAA should change the light sport weight limit from 1320 lbs. to 1600 lbs. (related more to aircraft innovation than fuel)

Memorandum

Re: **Final Emerging Issues Paper**
Contract Tower Funding Challenges

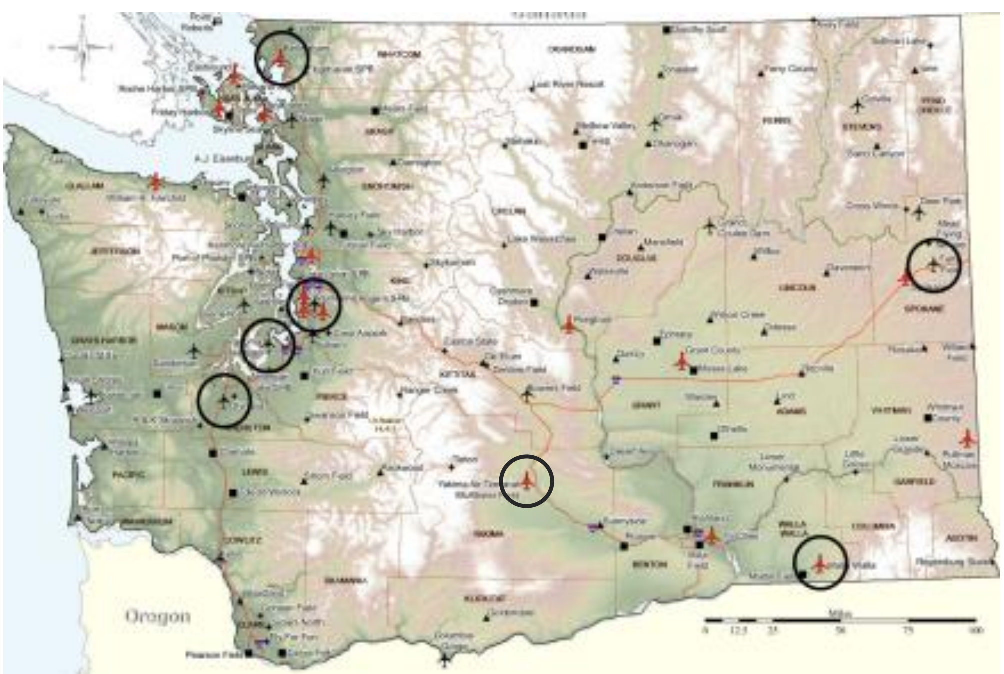
This technical memorandum summarizes funding challenges related to contract air traffic control (ATC) towers and the impacts of these challenges on the State of Washington.

Introduction

An Air Traffic Control (ATC) tower is a facility that uses air/ground communications, visual signaling, and other devices to provide services to aircraft operating in the vicinity of an airport or on the movement area of an airport.[1] Prior to 1982, civil ATC towers were operated solely by FAA personnel. In 1982 the FAA initiated the FAA Contract Tower (FCT) Program where ATC services were contracted to the private sector at numerous visual flight rule (VFR) airports throughout the United States and its territories.

In 2014, there were 264 FAA operated towers and 252 contract towers in the United States. Of the 252 contract towers, Washington State has seven currently in the Program:

1. Bellingham International (BLI)
2. Felts Field-Spokane (SFF)
3. Olympia (OLM)
4. Renton (RNT)
5. Tacoma Narrows (TIW)
6. Walla Walla Regional (ALW) (Cost Sharing Program)
7. Yakima (YKM)

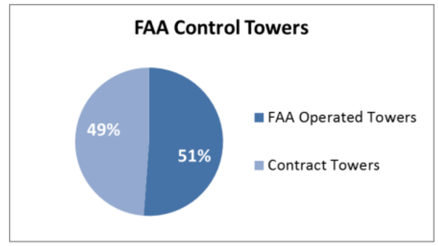


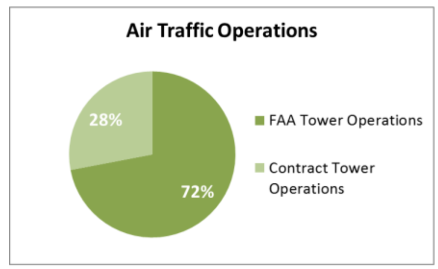
[1] FAA Order 7210.54B FAA Contract Tower Operations and Administration, 2006

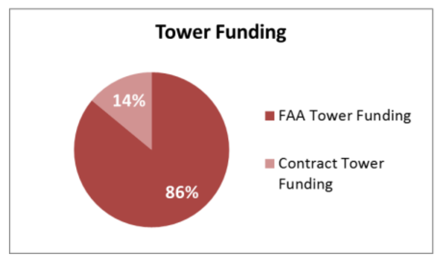
With fluctuations in national aviation policy, fluctuations in the economy, and as technology advancements are achieved, there are several issues surrounding the long-term future of the FCT Program. Issues regarding contract towers include funding, eligibility to be in the FCT Program, opposition to the Program, future support of the Program, and strategies to address significant changes to the Program including emerging ATC technologies. The following provides a brief synopsis of these topics.

Funding of the FCT Program

The FCT Program is a partnership between the FAA, local governments and the private sector and is intended to provide the same quality of ATC services to aviation users at a substantially reduced cost to taxpayers. The U.S. Contract Tower Association (USCTA), which is an affiliated organization of the American Association of Airport Executives (AAAE), estimated in 2014 that the 252 contract towers (out of the total 516 towers including FAA) handled 28 percent of all ATC tower operations in the U.S. but only accounted for 14 percent of the FAA's overall budget allocated to tower operations.[2] In 2012, the U.S. Department of Transportation Inspector General's audit of the Program concluded that 'FAA contract towers continue to provide cost-effective and safe air traffic control services and operate at a lower cost than similar FAA-operated towers'.[3]







Contract towers can be fully funded by the FAA or operated on a cost-sharing basis with the airport sponsor. The level of cost-sharing is dependent on an FAA benefit/cost analysis.[4] As of July 2015, 16 of the 252 contract towers were in the cost-sharing program (including Walla Walla Regional Airport). The program is intended to allow airports to achieve accelerated deployment of eligible facilities or equipment, and to help expand aviation infrastructure. In 2014, the cost-share program established a maximum local contribution of 20 percent.[5]

The FCT Program is funded by annual DOT/FAA appropriations. In 2015, $149 million of dedicated funding was appropriated for the FCT Program and cost-share program. However, the cost-share program is set by Congressional statute, an important distinction. As of August 2015, the draft 2016 fiscal year federal budget includes $154.4 million to fund the Program. Congress is set to readdress the appropriations for the FAA budget in 2016.

Contract Tower Eligibility Requirements

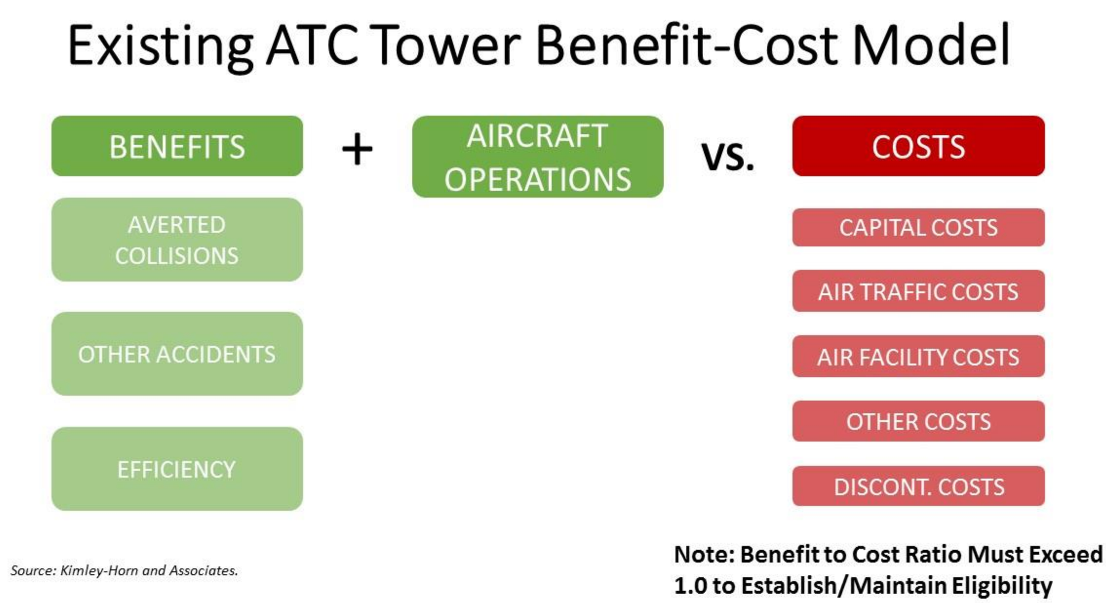
The FAA has authority to establish or discontinue ATC tower service when activity levels or other safety considerations merit such action. The qualification criteria for candidate sites is established in 14 CFR Part 170 "Establishment and Discontinuance Criteria for Air Traffic Control Services and Navigational Facilities." For an airport to qualify for an ATC tower, the following must be met:[6]

1. The airport must be open to and available for use by the public as defined in the Airport and Airway Improvement Act of 1982;
2. The airport must be part of the National Plan of Integrated Airport Systems (NPIAS);

[2] U.S. Contract Tower Association, Newsletter, July 2015
[3] U.S. Dept. of Transportation, Office of Inspector General, "Contract Towers Continue To Provide Cost-Effective and Safe Air Traffic Services, but Improved Oversight of the Program Is Needed", November 5, 2012, https://www.oig.dot.gov/library-item/28865
[4] U.S. Contract Tower Association, website accessed 8/18/15, http://www.contracttower.org/
[5] U.S. Contract Tower Association, 2014 Annual Report
[6] 14 CFR Part 170 "Establishment and Discontinuance Criteria for Air Traffic Control Services and Navigational Facilities.", January 2014

3. The airport owners must have entered into appropriate assurances and covenants to guarantee that the airport will continue in operation for a long enough period to permit the amortization of the control tower investment;
4. The FAA must be furnished appropriate land without cost for construction of the control tower; and
5. The airport must provide a benefit-cost ratio greater than 1.0 when comparing the ATC tower's life cycle benefits to its life cycle costs (benefits/costs ≥ 1.0). The benefit cost analysis considers site specific activity forecasts and calculates benefits as prevented collisions, prevented accidents and reduced flying time. Life cycle costs include staffing, maintenance, equipment, supplies, facilities, equipment, and start-up costs.

Meeting these criteria does not guarantee that an airport will receive an ATC tower – it just makes it an eligible site. If an airport meets these criteria, an airport sponsor can request to establish a contract tower. The FAA can either elect to pay for the service in its entirety, or enter into a cost-sharing agreement with the sponsor, depending on the results of the benefit-cost analysis that is required to be computed. The benefit-cost model considers benefits such as preventing accidents or collisions and the number of operations compared to the costs required to operate the ATC tower and the ratio must exceed 1.0.



The FAA indicates that the agency provides benefit-cost ratios every other year for both fully funded FAA towers as well as cost-share towers to identify any potential changes in funding. Should an existing ATC tower's benefit-cost ratio drop below 1.0 for its remaining life, service and/or FAA funding can be discontinued. The only exception to this criteria is if the closure of a tower would be against the national interest of the U.S. These national interest considerations include:

- Significant threats to national security as determined by the FAA in consultation with the Department of Defense or the Department of Homeland Security;
- Significant, adverse economic impact that is beyond the impact on a local community;
- Significant impact on multi-state transportation, communication or banking/financial networks; and
- The extent to which an airport currently served by a contract tower is a critical diversionary airport to a large hub.

It is important to recognize that the FAA conducts the official benefit-cost analysis, not the airport. For new start ATC towers, they must meet the establishment criteria previously identified. For existing ATC towers, the FAA has periodically provided benefit-cost ratios (although not since about 2009). It is estimated that the result of the FAA updating its cost-benefit calculations will lead to significant increases in the number of ATC towers enrolling in the cost-sharing program.

Opposition to the FCT Program

Opposition to the FCT Program has been expressed by the National Air Traffic Controllers Association (NATCA) for several reasons including:[7]

- Increasing costs and overstated cost savings of the Program
- Level of safety, security and controller experience provided by contract towers
- Government control versus private entity management of the Program
- Application of contract towers at commercial service airports as compared to general aviation airports

These issues have been strongly refuted by USCTA stating that private contractors have the same level of professional training and have greater flexibility in meeting the operational needs of the various individual facilities. The USCTA states that contractors can utilize part-time controllers, assign controllers to more than one facility, and adjust staffing to reflect seasonal variations in traffic. They assert that this level of flexibility and efficiency is not available to FAA controllers. They also emphasize that the FAA provides continuous oversight and monitoring of the contract towers and that all contract controllers are certified by the agency. A contributing factor to the lower operational costs achieved by contractors is that most contract employees have previously been trained as air traffic controllers and funds are not required to move people to higher level ATC facilities. It should be noted that Washington State membership of the USCTA includes one representative from the Washington Airport Management Association, two from the City of Renton, two from Spokane International Airport, two from Walla Walla Regional Airport, one from the Port of Bellingham, and one from Olympia Regional Airport.[8]

While NATCA has representation at approximately 75 FCT towers[9], their opposition to the FCT Program has spanned many years and is mainly intended to bring those controllers back into the federal sector. It is NATCA's position that all ATC facilities operate under the same supervised structure and that the FCT Program could jeopardize the safety and efficiency of the air traffic monitoring system.

In 1994 NATCA filed suit against the FAA challenging the agency's 1993 privatization of 115 low-activity air traffic control towers. The case had been traveling back and forth between the district court and the appellate court until August 2011 when the U.S. Court of Appeals for the Sixth Circuit[10] affirmed a lower court opinion that dismissed the lawsuit and held both that NATCA lacks standing and that the FAA has authority to contract for these services.

Further support for the FCT Program came in 2012, when the U.S. DOT Office of the Inspector General issued an audit report where they found "that contract towers continue to provide air traffic control services at a lower cost than similar FAA towers. On average, a contract tower costs about $1.5 million less to operate than a comparable FAA tower, mainly due to lower staffing and salary levels. In addition, contract towers had a lower number and rate of safety incidents compared to similar FAA towers, and users remain strongly supportive of the Program."[11]

Threats to FCT Program and Future Considerations

[7] U.S. Contract Tower Association, http://www.contracttower.org/ContractTowerMythsFacts.doc
[8] U.S. Contract Tower Association, website, accessed 8/18/15, http://www.contracttower.org/ctamembr.html
[9] National Air Traffic Controllers Association website, accessed 8/18/15, http://www.natca.org/who_we_are.aspx?zone=Who%20We%20Are&pID=489
[10] http://www.ca6.uscourts.gov/opinions.pdf/11a0220p-06.pdf, accessed 8/18/15
[11] U.S. Dept. of Transportation, Office of Inspector General, "Contract Towers Continue To Provide Cost-Effective and Safe Air Traffic Services, but Improved Oversight of the Program Is Needed", 2012, https://www.oig.dot.gov/library-item/28865

A possible threat to the FCT Program includes potential changes to the program's participation requirements that could prevent new towers from entering the system, remove existing contract towers from the Program, or shift the financial burden to the communities who may not be able to afford it. There are moves within the aviation industry urging FAA to reform its current benefit-cost analysis process to a new process to help ensure the long-term sustainability of this Program. In June 2015, the Chief Operating Office of the FAA's Air Traffic Organization briefed the USCTA that the agency is in the process of updating their benefit-cost model and until that process is complete, they are waiting to admit new towers into the program. However, the FAA had already decided to add one new contract tower in Aurora, Oregon, bringing the total number of contract towers to 253.[12] According to the FAA's Office of Policy, International Affairs, and Environment 2015 Business Plan, the agency identified having a revised benefit-cost criteria as a "core initiative" to be completed by September 30, 2015.[13] As of November 2015, a new benefit-cost model has not been published.

Another potential threat to the Program is the U.S. House of Representatives proposed version of the FAA 2016 reauthorization bill (the "Aviation Innovation Reform & Reauthorization Act") which includes the establishment of an independent, "non-profit ATC Corporation" to operate the nation's ATC system. The industry, including the USCTA, AAAE, National Business Aircraft Association (NBAA), and others fear that there is insufficient protection of the FCT Program within this proposed legislation. Some believe that if the current FCT service contracts are transferred to an ATC Corporation, those contracts could be cancelled at any time and towers could be closed without any congressional oversight or review. Congress will readdress this issue before final passage in 2016.

In April 2015, the FAA executed new, five-year ATC service contracts to three incumbent contractors – RVA, Midwest ATC, and Serco. An unanticipated element of these agreements was that the FAA included a clause that would allow the cancellation of the contracts up to 30 days after they went into effect.

With an appropriation required to maintain the FAA budget, including the ATC towers, the threat of losing federal funding and having to close contract towers is always a concern. This concern was nearly realized in 2013 when the FAA was required to meet a $637 million target savings under the mandatory "sequester". Sequestration is a process that automatically cuts the federal budget across most federal departments and agencies. As part of this sequester, the FAA notified 149 airports across the country that federal funding for their contract towers would end in mid-June 2013. These were considered by the FAA to be "lower activity" ATC towers which cumulatively handled less than 3 percent of the commercial aircraft operations and less than 1 percent of the passengers. The sequester did not affect the 16 towers in the cost-sharing program as Congress sets aside funds for these airports each year. Communities still had the option to keep their towers open if they were able to provide the necessary funding. These closures were estimated to result in a savings of $33 million to the FAA. The towers at Tacoma Narrows (TIW), Olympia (OLM), Renton (RNT), Felts Field (SFF), and Yakima (YKM) were on this list in 2013.

The sequester also resulted in the temporary furlough of 47,000 FAA employees, including ATC controllers. This action spurred objections from many lawmakers, communities and aviation industry groups citing degradation of safety, reduced access, and increased flight delay as the adverse impacts. Congress responded with the passage of the "Reducing Flight Delays Act of 2013" (Public Law 113-9) which allowed the FAA to transfer funds to its operating budget to keep the contract towers open and un-furlough the other FAA controllers. This did not, however, relieve the FAA of their $637 million target savings, it just allowed them to better manage where the budget cuts were made. It was decided that the majority of the cuts would come from the Airport Improvement Program (AIP), which meant less funding for AIP grants to support airport development.

[12] U.S. Contract Tower Association, Newsletter, July 2015
[13] FAA Website, accessed 8/18/15, http://www.faa.gov/about/plans_reports/media/2015/apl_business_plan.pdf

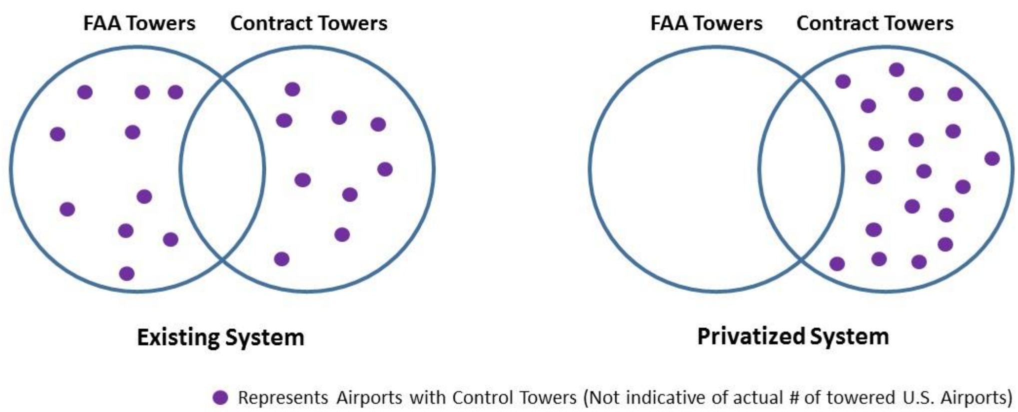
Strategies for Future ATC Services

Air Traffic Control Privatization

In 2015, members of the House Transportation and Infrastructure Committee started discussions regarding privatizing air traffic control services currently provided by FAA. The reasoning provided is to separate the FAA's regulatory duties from those of providing ATC services to remove the services from the appropriations process that has previously resulted in sequestration, furloughs, and other challenges that result from this politically charged process. It has also been suggested that a "federally chartered, fully independent not-for-profit corporation to operate and modernize our ATC services" would create "operating efficiencies, and…annual savings" according to a speech given by Representative Bill Shuster (R-Pa.) to the Aero Club of Washington in June 2015.

Approximately 50 other countries have privatized ATC services, including Canada that are paid for by user fees. The opposition to privatized ATC services is concerned with the fee structure and what that might mean to smaller aircraft and communities that do not have commercial airline service. The primary impact attributed to a change in tower operations to a privatized facility would be that the local community would assume responsibility to fully fund the tower's operation. Non-federal towers are still regulated, but not funded by the FAA.

Existing vs. Privatized ATC Tower Categorization



Source: Kimley-Horn and Associates.

Remote ATC Tower Technology

With growth in technology and stagnating opportunities for airports to receive ATC services from the FAA, even through the FCT Program, other options are being tested and sought after. One such option is a remote ATC tower concept. Also referred to as "virtual towers", the basic concept is to provide ATC services at an airport from a remote control room with video-sensor type surveillance equipment instead of *out-of-the-window* views from a traditional ATC tower. The objective is to provide consistent, high-quality ATC services in a more efficient and cost effective manner. The video equipment provides real-time imagery of the runway, airfield and nearby airspace on large monitors providing a 360-degree virtual view to the controllers. In addition to the live video feed, the controllers have all the same air traffic management computer systems as they would in a local control tower including voice communication, meteorological data, and flight plans.

Source: Saab Solutions, Sweden First in the World with Remotely Operated Air Traffic Management, April 21, 2015, http://saabgroup.com/Media/news-press/news/2015-04/sweden-first-in-the-world-with-remotely-operated-air-traffic-management/

Source: Saab Solutions, Sweden First in the World with Remotely Operated Air Traffic Management, April 21, 2015, http://saabgroup.com/Media/news-press/news/2015-04/sweden-first-in-the-world-with-remotely-operated-air-traffic-management/

The first operational remote tower system was developed by Saab Corporation and manages traffic at two connected airports in northern Sweden. Saab is in the process developing similar systems for an airport in Australia and two in Norway.[14] In 2015, Saab was also contracted by the Irish Aviation Authority to develop a Remote Tower Centre at Dublin Airport that would control remote tower installations and operations at Cork and Shannon Airport.[15]

Within the United States, Saab is partnering with the State of Virginia's SATSLab, and Leesburg Executive Airport (JYO) to demonstrate and evaluate this technology for implementation at busy general aviation airports within the U.S. This is the first U.S. airport to field-test this technology during regular activity. The testing began in August 2015 and is scheduled to continue until mid-2016.[16] Initially, the test serves only in an observation mode. If the testing goes well and the FAA approves, the next step would be to allow the traffic to be controlled from the remote tower. FAA Administrator Michael Huerta mentioned the upcoming demonstration project in Leesburg during House testimony on March 3rd, 2015. He told Congress members that "If the results are promising, this is something that I want to move out very aggressively on—because it holds great potential to address the need [for new control towers]."[17]

Summary of Impacts on Washington Airport System and Recommended Actions

FAA forecasts predict that the number of aircraft operations at U.S. airports with VFR towers will increase from 9.6 million in 2013 to 10.6 million in 2035.[18] This represents an average annual growth rate of 0.4 percent. Similarly the FAA forecasts activity at Washington State airports with VFR control towers to increase from 286,000 to 339,000 operations, at an average annual rate of 0.8 percent – twice that of the nation as a whole. With this anticipated increase in activity, maintaining effective ATC service for travelers and pilots should be considered an important policy decision.

Annual appropriations to fund the FCT Program, potential changes to the Program's cost-benefit calculation, and the proposed change to a non-profit ATC Corporation all present threats to long-term sustainability or continuation of contract control towers as they are operated today. The threat is most

[14] SAAB website, http://saab.com/security/air-traffic-management/air-traffic-management/remote-tower/, accessed August 2015
[15] International Airport Review, http://www.internationalairportreview.com/19700/airport-news/iaa-signs-remote-tower-system-contract-with-saab/, accessed August 30, 2015
[16] City of Leesburg, http://www.leesburgva.gov/government/departments/airport/remote-air-traffic-control-tower, Accessed August 28, 2015
[17] U.S. Contract Tower Association, July 2015 Newsletter, http://www.contracttower.org/ctaannual/July2015newsletter2.pdf
[18] FAA Terminal Area Forecasts, http://taf.faa.gov/, accessed 9/2/15

apparent to those communities that have lower activity towers and strained financial resources. Acknowledging that both commercial service and general aviation airports are a vital resource in supporting economic vitality, the closure of any ATC tower has the potential to adversely affect that airport's use. While there are many airports that operate safely and efficiently without ATC towers, many times the operators of high-performance, corporate type aircraft and especially airlines providing commercial service, prefer to operate at towered airports that have ability to manage the traffic between differing aircraft types. Without towers, these airports may see a reduction in activity by these operators, which may be significant to the economy in terms of business support and accessibility. As the technology continues to evolve, and pending adoption by the FAA, the establishment of remote tower systems has the potential to expand ATC service to non-towered airports within the U.S. It also has the potential to reduce operating cost for those airports currently providing traditional FAA or contract tower services.

As part of the WASP, WSDOT Aviation convened working groups to discuss aviation issues. A working group was established to discuss contract towers. This group recommended the following actions be considered:

POLICY CONSIDERATION: WSDOT should identify airports at risk for losing FAA-manned towers and potentially being downgraded to a contract tower as a result of the revised cost-benefit analysis, and those at risk to be eliminated from the contract tower program.

POLICY CONSIDERATION: The FAA should consider remotely monitored ATC services as an alternative to the cost-sharing program or keeping existing airports uncontrolled/unmonitored. Furthermore, the FAA should explain the cost savings of remote towers versus the potential impacts and limitations on airport performance and increased risk to air safety.

POLICY CONSIDERATION: While the overall impacts of new FAA policies toward ATC towers and funding have yet to be fully understood, Washington State airports should work with groups such as the U.S. Contract Tower Association (USCTA) and the American Association of Airport Executives (AAAE) to develop strategies to continue to operate in a safe, efficient manner that benefits all airports and the communities they serve.

Memorandum

Re: Final Emerging Issues Paper
Decline in General Aviation Activity

This technical memorandum summarizes the decline of General Aviation (GA) and its impacts on the State of Washington.

Introduction

General aviation (GA) encompasses all aviation-related activity except that which is classified by the Federal Aviation Administration (FAA) as military or scheduled air service. GA aircraft include individually-owned aircraft, as well as those used for flight training, medical transport, corporate charters, agricultural operations, and other non-scheduled air service purposes. According to the General Aviation Manufacturer's Association (GAMA), in 2014, the GA industry supported $219 billion in total economic output in the United States and 1.1 million jobs.

In its *2014 General Aviation Statistical Databook & 2015 Industry Outlook*, GAMA also identified the State of Washington ranking 6th in the U.S. in terms of GA's total Gross Domestic Product (GDP) impact per capita, and 10th in terms of total jobs attributable to GA. As of December 31, 2014, the State of Washington had 18,665 certified pilots, 6,052 of which were certified as private aircraft pilots. [1]

This document identifies recent trends in the GA industry such as increasing costs of aircraft ownership, aircraft technological requirements, among others, and their impacts on activity in the State of Washington and the U.S. as a whole. Examples of initiatives that aim to increase the pilot population and make flying more affordable are also examined.

Industry Trends and Outlook

Although the number of active aircraft in the U.S. GA fleet and GA operations have decreased significantly in recent years, the FAA estimates in its *Aerospace Forecast 2015-2035* that total GA hours flown increased slightly from 2013 to 2014. Overall, the GA industry has seen noteworthy decreases in the number of fleet aircraft, hours flown, fuel consumption, and operations in recent years. Between 2000 and 2014, GA operations on the national level have declined at an average annual rate of 3.3 percent. According to the FAA, much of this decline can be attributed to economic conditions and fuel prices. These conditions include both the U.S. and global economic downturn that began in 2008-2009 as well as the general costs of ownership and operation of aircraft such as maintenance, storage, etc.

Fuel Costs

Typically, the most measureable and significant cost associated with GA aircraft ownership is the price of fuel. According to the U.S. Energy Information Administration, both the cost of 100LL aviation gas (AvGas) and Jet have decreased between 2012 and 2014 following significant increases in 2010 and 2011. **Table 1** shows the average annual retail price of Jet A and 100LL AvGas from 2000 to 2014. Although these figures are not adjusted for inflation, the cost of both types of fuel has more than tripled between 2000 and 2014.

Table 1: Historical U.S. Aviation Gas and Jet Fuel Prices

Year	U.S. Aviation Gasoline Retail Sales by Refiners ($ per Gallon)	% Change Previous Year	U.S. Jet Fuel Retail Sales by Refiners ($ per Gallon)	% Change Previous Year
2000	1.31		0.85	
2001	1.32	1.3%	0.72	-14.7%

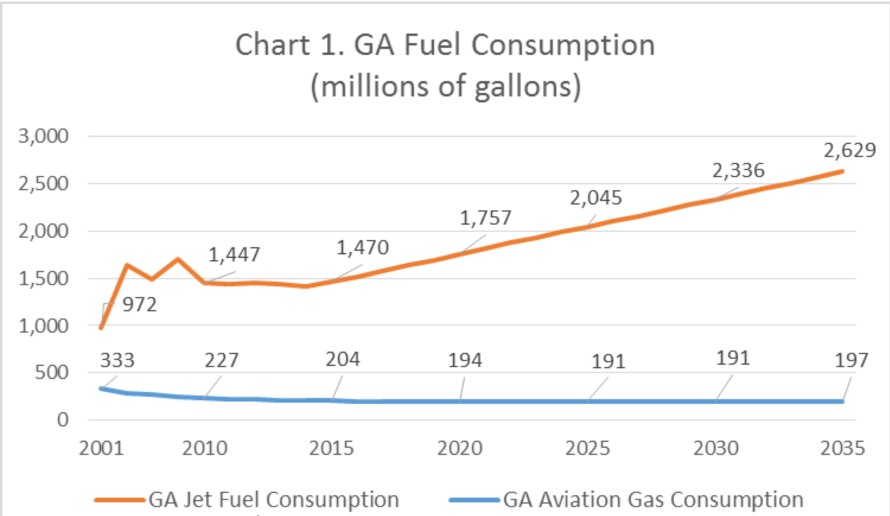
[1] Federal Aviation Administration.

2002	1.29	-2.6%	0.69	-5.4%
2003	1.49	15.9%	0.83	20.6%
2004	1.82	21.8%	1.15	39.3%
2005	2.23	22.6%	1.71	48.6%
2006	2.68	20.2%	1.92	12.3%
2007	2.85	6.2%	2.13	10.9%
2008	3.27	14.9%	2.96	39.2%
2009	2.44	-25.4%	1.66	-44.0%
2010	3.03	24.0%	2.15	29.2%
2011	3.80	25.6%	3.00	39.8%
2012	3.97	4.4%	3.06	2.0%
2013	3.93	-1.0%	2.92	-4.4%
2014	3.99	1.4%	2.70	-7.8%

Source: US Energy Information Administration.

In its *Aerospace Forecast 2015-2035*, the FAA projects Jet fuel prices to increase 2.4% annually from 2014 through 2035, which generally follows the U.S. rate of inflation. This projection suggests that the rapid increase of fuel prices between 2000 and the 2010-2014 period is not likely to be repeated in the long-term. The FAA does not forecast the price of 100LL AvGas, however, it is working with the Environmental Protection Agency (EPA) to replace leaded gas with cleaner burning alternative unleaded fuels. The timing and effect of such a change is unknown at this point.

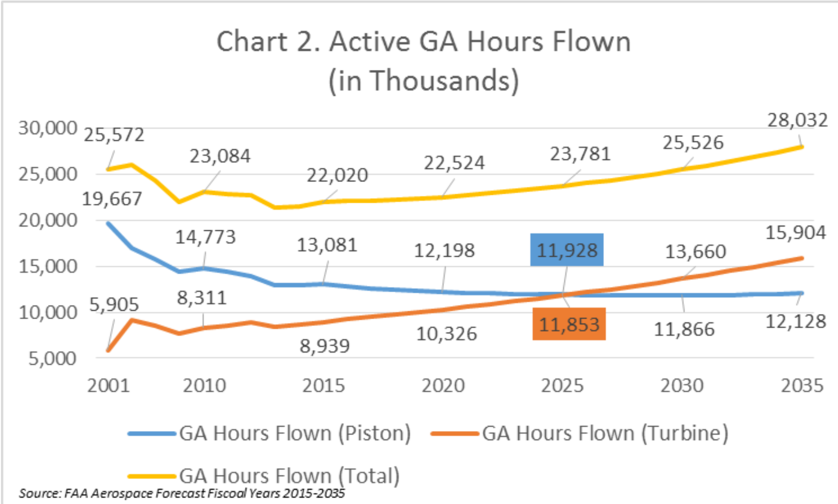
The FAA does, however, project that the total amount of fuel consumed by the U.S. civil aviation fleet is anticipated to increase 2.3% annually between 2014 and 2035. During that same projection period, total U.S. fleet GA fleet hours flown are anticipated to increase 1.4% annually, while GA operations are anticipated to increase approximately 0.4% annually.[2] Historical and projected fuel consumption for the U.S. general aviation fleet is shown in **Chart 1**.



Source: FAA Aerospace Forecast Fiscal Years 2015-2035

Historical and projected GA fleet hours flown are shown in **Chart 2**. The trend toward steady growth in fuel consumption but slower growth in hours flown and aircraft operations indicates an anticipated increase in the use of aircraft in the GA sector that use more fuel such as turbo-prop and jet aircraft.

[2] FAA Terminal Area Forecasts July 2015.

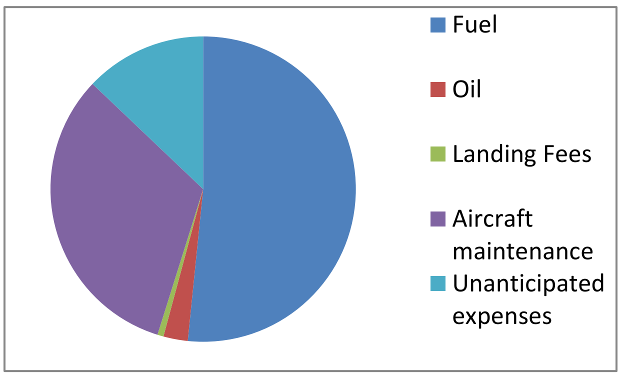


Aircraft Maintenance Costs

In addition to the cost of fuel, there are several types of maintenance costs associated with owning and operating an aircraft. Based on observations at several GA airports, it is not estimated that these expenses have increased as significantly or rapidly as the price of AvGas or Jet fuel. Incorporated into aircraft ownership is the cost of engine oil, regular maintenance inspections (avionics, instruments, etc.), engine overhauls, ramp tie-down or hangar fees, insurance, landing fees, and aircraft accessories. All of these elements impact the cost of aircraft ownership and at varying levels have contributed to the decline of overall GA activity.

According to the Aircraft Owners and Pilots Association (AOPA), the typical annual cost to operate a personal single-piston aircraft (the example provided is a 1975 Cessna 172 Skyhawk that flies 100 hours annually) is broken down accordingly[3]:

- Insurance - $1,200/year
- Hangar lease - $3,000/year
- Fuel - $40 per hour x 100 hours = $4,000/year
- Oil - $2 per hour x 100 hours = $200/year
- Landing Fees = $50/year
- Aircraft maintenance - $2,500/year
- Unanticipated expenses - $1,000/year
- **Total Annual cost/year = $11,950**



The cost of owning and operating an aircraft varies greatly depending on the number of hours flown, whether to store an aircraft in a hangar or on an apron tie-down, type of aircraft, and several other factors. However, according to the FAA, the most rapid decline in total GA hours flown between 2000 and 2014 occurred in 2008 and 2009 when many sectors of the U.S. economy experienced a significant downturn. This trend indicates that although the cost of owning and operating an aircraft is relatively expensive, there is reason to believe that GA activity will rebound as the U.S. economic outlook improves.

[3] AOPA Operating Cost Calculation - http://www.aopa.org/Pilot-Resources/Aircraft-Ownership/Tips-on-Buying-Used-Aircraft/Hypothetical-Operating-Cost-Calculation

Permitted Uses at Airports

Another impact in the GA community has been the FAA's stance on permitted uses for aircraft storage hangars at airports. In July 2014, the FAA issued a notice that specifically identified fabrication and assembly of "homebuilt aircraft" as being an aeronautical use when conducted in aircraft storage hangars at airports. Per the FAA,

> "While building an aircraft results in an aeronautical product, the FAA has not found all stages of the building process to be aeronautical for purposes of hangar use. A large part of the construction process can be and often is conducted off-airport. Only when the various components are assembled into a final functioning aircraft is access to the airfield necessary."[4]

The policy further identified that an airport sponsor would have the authority to designate some areas of an airport for non-aviation use with FAA approval, but that aeronautical facilities of that airport must be dedicated to use for aviation purposes.

The policy explicitly recognizes for the first time "final, active assembly" of aircraft as a protected aeronautical activity. Homebuilders in the past often found themselves unable to rent a hangar because their aircraft were not yet airworthy and their local airport required airworthiness as a prerequisite for hangar rental, which left the homebuilder in the awkward position of being unable to finish the aircraft and transport it to the airport for inspection and flight testing. This new policy eliminates that situation and codifies the aeronautical nature of homebuilding.

Anticipated Impacts of Automatic Dependent Surveillance-Broadcast (ADS-B)

ADS-B is a technology that supports the FAA's Next Generation Air Traffic Control System, or NextGen, which shifts identifying aircraft location and position from ground-based radar to satellite-derived positions. There are two primary types of ADS-B: ADS-B Out and ADS-B In.

ADS-B Out uses a combination of ground stations, aircraft avionics, and the satellite global positioning system (GPS), to provide air traffic controllers with an aircraft's position, altitude, airspeed, and other information critical to ensuring aircraft separation. Because it relies on satellites instead of ground-based radars, ADS-B Out improves the coverage and situational awareness of air traffic controllers, including tracking of aircraft while taxiing at airports with adequate surveillance equipment. The FAA has mandated that aircraft using most controlled airspace in the U.S. be equipped with ADS-B Out by 2020.

ADS-B In, which is optional, generally refers to transmission of weather and traffic information from ground stations into the cockpit, where it can be displayed on ADS-B In panel-mounted avionics or a tablet. The biggest advantage for GA aircraft is from ADS-B In as it allows aircraft to receive and interpret ADSB-Out data from other aircraft. This technology, however, imposes additional equipment and costs on the aircraft owner.[5]

According to AOPA, the cost of ADS-B equipment and installation for most GA aircraft in 2015 was approximately $5,000-$6,000. Due to the high cost, the FAA estimated that just 10 percent of the GA fleet was equipped for ADS-B Out at the end of the 2014 fiscal year. Technology has changed significantly since the FAA mandate was announced in 2010. The introduction of tablets and various applications have made it easier and less expensive to bring weather and other information into the cockpit. At the same time, innovations in the non-certified marketplace have changed the technological landscape. While these may not be solutions in themselves, it could be a strategic direction that could offer ADS-B Out equipage at a significantly lower cost.[6] It would be a great benefit to the general aviation community as a whole if currently non-certified technologies become acceptable substitutions for implementation of ADS-B. This potential cost-savings measure to pilots could reduce the number of aircraft being grounded that are not equipped

[4] EAA News Release, "FAA Releases New Hangar Use Policy". July 24, 2014.
[5] Florida Aviation System Plan – 2035.
[6] AOPA website: http://www.aopa.org/Advocacy/Air-Traffic-Services-,-a-,-Technology/Air-Traffic-Services-Brief-Automatic-Dependent-Surveillance-Broadcast-ADS-B

with certified technology or allow aircraft owners/operators to allocate those savings toward other maintenance costs or fuel.

Impact of Third Class Medical Certifications

In the U.S., medical certifications are required to obtain pilot privileges for a private, commercial, or airline transport license. Each certificate must be issued by a doctor approved by the FAA to a person deemed physically and mentally healthy. The three types of certifications are first class, second class, and third class.

First class certifications pertain to airline transport licenses, second class to commercial pilot licenses, and third class to GA licenses. A third class medical certification is valid for 60 months for pilots under age 40, and 24 months for applicants who are age 40 or older, although there has been a significant push to reform third class medical certification.

In July 2015, a medical reform amendment was added to the Senate Highway Bill in hopes to reform third class medical certification and allow some pilots to fly without the certificate. According to Mark Baker, president of AOPA, reformation of the third class medical certification system would save pilots and the FAA money, boost GA, and stimulate economic activity.[7] At the time that this document was prepared, the amendment had not yet been voted on.

Examples of Growth in GA Activity

Student Pilot License Extensions

Student pilots are important to GA and the aviation industry as a whole. Student pilot numbers had been in decline for many years, but in 2010 the FAA issued a rule that increased the duration of validity for student pilot certificates for pilots under the age of 40 from 36 months to 60 months. As a result, according to statistics compiled by the FAA's Mike Monroney Aeronautical Center, the number of student pilots at the end of 2010 increased by 64.8 percent, or approximately by 47,000 pilots, compared to calendar year end 2009. While the impact of the new rule on the long term trend in student pilots has yet to be fully determined, the number of student pilots slightly increased by 0.2 percent in 2014 from its 2013 level to 120,546. [8]

Reimagined Aircraft

In 2014, AOPA in conjunction with Aviat Aircraft started a program called, "Reimagined Aircraft" in order to allow existing pilots and potential ones an affordable option to fly. The program aims to allow more people the opportunity to fly and become engaged in aviation in ways that are more difficult through singular aircraft ownership.

The program refurbishes aircraft (initial models include the Cessna 150 and 152) and places them into a flying club, partnership, or flight school, and then can be owned and operated for approximately $65/hour, including fuel. According to AOPA's website, "The idea for Reimagined Aircraft grew out of a desire to take a comprehensive approach to growing the pilot population and reverse the rising costs and barriers to flying." Although the number of refurbished aircraft operating in the Reimagined Aircraft program is not yet known, it has the potential to successfully allow more people to fly without all of the costs of individual aircraft ownership.

Summary – Impacts on Washington General Aviation

The preceding sections identify trends that have contributed to a decline in GA-related activity in recent years. Though there has been a slow, steady decline in GA operations, hours flown, and active aircraft in the U.S. fleet since 2000, the economic volatility that occurred in the U.S. from 2008 through 2013 accelerated these declines. As economic stability is slowly being restored, the FAA projects slow, steady growth in the GA industry throughout 2035. The FAA's Aerospace Forecast anticipates volatility in the recreational sector and robust growth in business usage of general aviation. This is evident as the active

[7] http://www.examiner.com/article/medical-certificate-for-pilots-needs-a-reform

[8] FAA Aerospace Forecast Fiscal Years 2015-2035

general aviation piston fleet is projected to increase 0.4 percent annually between 2015 and 2035, compared to 2.4 percent annually for turbine aircraft during that same timeframe. Furthermore, active general aviation hours flown for piston aircraft is projected to decrease 0.5 percent annually from 2014 to 2015, while hours flown for turbine aircraft (turbo-prop and jet) are anticipated to increase 2.2 percent annually during that period. According to the FAA's Terminal Area Forecasts (TAF), growth in the number of GA operations in the State of Washington, however, is anticipated to be nearly three times the national rate. This is likely due to two factors.

The first is that the State of Washington has a disproportionately high number of based aircraft per capita compared with the rest of the U.S. According to the U.S. Census Bureau, the 2014 population of Washington State was 7,061,530 and the population of the U.S. was 318,857,056. Based on estimates identified in the most recent version of the FAA's TAF, there were 5,700 based aircraft in Washington, and 168,299 in the U.S. This translates into one aircraft owned for every 1,239 residents of Washington, and one for every 1,895 in the U.S.

The second factor that likely explains the justification for a healthy GA outlook in the State of Washington is its strong per capita income. The U.S. Census Bureau reported that the average income per person in 2014 for the State of Washington was $30,742 compared with $28,155 for the U.S. as a whole. This denotes a difference of over 9% in favor of Washington, which has the 11th highest per capita income of any state in the U.S.[9] As noted previously, the cost of owning and operating an aircraft is relatively expensive; therefore it is logical that locations with higher incomes would foster a greater propensity toward flying and aircraft ownership. The higher rate of per capita aircraft ownership in the State of Washington confirms this assumption.

Table 2: Comparison of Washington State and U.S. GA Operations

Year	State of WA GA Operations	Change	U.S. GA Operations	Change
2000	2,692,678		87,075,518	
2005	2,653,065	-1.5%	81,127,052	-6.8%
2006	2,572,998	-3.0%	80,150,000	-1.2%
2007	2,616,339	1.7%	80,216,778	0.1%
2008	2,665,594	1.9%	78,051,786	-2.7%
2009	2,558,616	-4.0%	73,630,294	-5.7%
2010	2,476,305	-3.2%	71,262,121	-3.2%
2011	2,415,940	-2.4%	69,930,768	-1.9%
2012	2,394,962	-0.9%	69,607,152	-0.5%
2013	2,316,929	-3.3%	68,838,612	-1.1%
2014*	2,356,006	1.7%	68,719,669	-0.2%
2015*	2,381,987	1.1%	68,963,282	0.4%
2020*	2,496,387	4.8%	70,288,206	1.9%
2025*	2,622,166	5.0%	71,707,396	2.0%
2030*	2,761,147	5.3%	73,237,746	2.1%
2035*	2,915,283	11.2%	74,892,671	4.4%
Change 2000-2015	*-310,691*	*-11.5%*	*-18,112,236*	*-20.8%*
Change 2015-2035	*533,296*	*22.4%*	*5,929,389*	*8.6%*

**Estimate*

Source: FAA Terminal Area Forecast - July 2015

9 U.S. Census Bureau American FactFinder

The FAA projects that the number of GA operations in the U.S. is anticipated to grow by 8.6% between 2015 and 2035 (0.4% annually). The FAA also forecasts that GA operations in the State of Washington will increase 22.4% during that same timeframe (1.1% annually). Although programs aimed to preserve the existing GA pilot base and to spur growth in the number of new pilots provide an added benefit, aircraft fuel and maintenance costs, medical certifications, ADS-B implementation, economic uncertainty, and other factors will likely curb some of this potential growth. It is anticipated that general aviation operations and activity as an industry in Washington will outperform the U.S. as a whole, however, a steady, more conservative increase is more realistic long-term.

Memorandum

Re: Final Emerging Issues Paper
General Aviation Infrastructure Funding Challenges

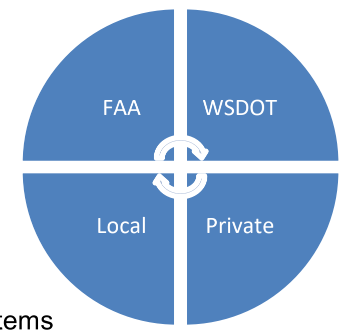
This technical memorandum summarizes general aviation (GA) infrastructure funding challenges and the impacts of these challenges on the State of Washington. It is important to recognize the significant efforts that have been undertaken related to infrastructure funding in recent years which are described below.

Introduction

Airports have significant funding needs to maintain existing infrastructure in a state of good repair as well as undergo facility improvements and expansions in order to better serve the aviation demands. These funding needs are on top of day-to-day operational requirements to keep the airport running. With constantly increasing costs and sometimes limited resources available to airports for capital infrastructure projects, airport owners and sponsors seek all available funding sources that offer both traditional and innovative solutions to funding challenges.

There are four traditional funding sources:

- Federal Aviation Administration (FAA)
- State agencies such as the Washington Department of Transportation (WSDOT)
- Local owners and sponsors such as cities, counties, and other political subdivisions
- Private



Airports that are included in the FAA's National Plan of Integrated Airport Systems (NPIAS) are eligible to receive federal funding for certain projects. In Washington State, funding is also provided to airports to assist with infrastructure needs, both to those airports that are included in the NPIAS and eligible for FAA funding as well as airports that do not receive federal funding. All airports require local resources to either match or outright fund infrastructure needs on their own. Many times private funding is used by the local owners and sponsors to supplement or partner with public funds to ensure a project's completion. Private sector funding can be used to develop projects such as hangars and other projects typically not eligible for other sources of funding but for which airport users have a need and revenue may be generated.

This paper focuses on the state and local challenges related to funding for airports, and discusses some potential solutions or strategies that could be considered to address the challenges. A primary source document for the identification of challenges and potential solutions is the WSDOT *Airport Investment Study* (also called Phase I, with the subsequent *Airport Investment Solutions Study* sometimes referred to as Phase II) including the Reference Guide produced for the project.

The *Airport Investment Study* was undertaken in 2014 by WSDOT to "understand historical federal and state funding levels, forecast likely future funds availability, identify the total statewide airport preservation and capital needs, and identify any potential gaps between forecast funding and needs." The study's 20-year estimate for statewide project needs at the 134 public-use airports was $3.6 billion. While federal and local funding will be used to meet some of this need, based on the study projections, an average of $12 million per year would be sought from the WSDOT Airport Aid Grant program to meet the projected requests. The 20-year average forecast for the WSDOT Airport Aid Program would likely only be able to provide approximately $1.4 million per year, leaving a significant shortfall in the money required to sustain the necessary preservation and development of the state's aviation system.

The *Airport Investment Solutions Study* focused on evaluation of potential solutions to the projected WSDOT Infrastructure challenges. The study identified thirty-three (33) preliminary solutions to address both funding and non-funding related implementation strategies. The solutions were categorized into the following: New Funding Sources; Refinements of Current Funding Programs; Revisions to Current Funding Sources; and Other Potential Solutions. The list below provides a complete list of the 33 solutions that were identified by category.

New Funding Sources (13 solutions)

- Alternative industry taxation Sources outside of aviation
- Utilize “Infrastructure Exchange” financing
- Corporate Sponsorships
- Public Private Partnerships (P3) project funding
- Establish a state passenger Facility Charge (PFC) head tax program
- Establish wide ranging state tax credits to airports
- Alternative taxing of airport operationally oriented uses
- Alternative taxing of on airport generated commercial activities
- Alternative taxing of the proportional value of transportation benefits derived
- Alternative economic development based consumption tax
- Establish a State sponsored revolving aviation infrastructure loan fund
- Establish a through the fence access fee structure
- Direct aviation administrative related fees

Refinements to Current Funding Programs (7 solutions)

- Realignment of current funding allocations
- Restructure the current State transportation and general funds
- Tiered airport aid funding
- Set self-sustaining fee requirements for airports receiving grant funding
- Reduce sales tax exemption for other construction
- State of Washington to petition to become an FAA block grant state
- Modify project screening and evaluation process t o allow for more project eligibility

Revisions to Current Funding Sources (6 solutions)

- Increase existing aviation taxation rates
- Airport Leasehold taxes to go directly into the aeronautics account
- Revise Fuel Tax Exemptions
- Modify and Improve the State aircraft excise tax program
- Utilizing other state and federal grant funding sources
- Eliminate Aircraft Registration Exemptions and Add new Registration Source(s)

Aviation System Revisions/Airport Management Best Practices (7 solutions)

- Promote establishment of commissions/airport authorities
- Leverage USDOT paving contracts at airports
- De-Federalize State airports for construction contracts
- Improve aviation educational/marketing and outreach programs
- Right size airport infrastructure

- Develop a Management Best Practices toolkit for state airports
- Investigate FAA funding best practices by region

Of these 33 solutions, ten (10) core study solutions were identified and recommended for performance analyses. These 10 solutions were those that scored highest against a set of screening and evaluation criteria to help ensure the solutions are "feasible, acceptable, suitable, distinguishable and complete." The 10 core solutions identified in the study are provided below. The solutions are not presented in any particular order. The following are the 10 core study solutions:

1. Public Private Partnerships (P3) – entails the full utilization of private sector funding for all types of revenue producing airport projects. This would involve the full range of P3 funding sources from full airport privatization to partial, facility-specific privatization;
2. Alternative Taxing of Airport Operationally Oriented Uses – state law that would allow for airport operational activities, such as licensed motor vehicles based at an airport, non-aviation fueling consumption, airport parking, and others, to be taxed or levied a fee, with proceeds going to the Aeronautics Account;
3. Alternative Economic Development Based Consumption Tax – would tie to existing local and statewide visitor based tax funding to leverage a share of tourist taxes;
4. Establish a State-Sponsored Revolving Aviation Infrastructure Loan Fund (SRF) – providing a pool of funds to initiate a low-rate loan fund that is applicable to either revenue funded or airport sponsor funded programs;
5. Realignment of Current Transportation Revenue Allocations – refines allocations of current State transportation-generated revenues with a direct nexus to the state aviation system to allow revenues to be reinvested to aviation capital needs in proportion to the benefit provided by aviation and air commerce;
6. Reallocate Airport Leasehold Tax to the Aeronautics Account – leasehold tax revenues would be routed to the State Aeronautics Account to fund aviation preservation and capital projects rather than being diverted to the General Fund;
7. Increase Select Aviation Tax Rates – increases in the current taxation program that goes into the State Aeronautics Account with a focus on taxes that currently support aviation and that would have a meaningful impact on the funding gap;
8. Revise Fuel Excise Tax Exemptions – reviewing and optimizing existing exemptions to create a more consistent aviation fuel excise tax base;
9. Modify the State Aircraft Excise Tax Program – revise the state excise tax program for aircraft by modifying legislation that established the current program and includes changing the Aeronautics Account revenue allocation from 10% to 100%; and
10. Develop a Best Management Practices (BMP) Guidebook/Toolkit for Airports – develop a tool kit mainly for non-self-sufficient GA airports that would help airports adopt the best practices that would better allow them to move towards self-sufficiency in their capital improvement programs.

Strategies for Implementing State Funding Solutions

The *Airport Investment Solutions Study* identified many possible solutions for providing infrastructure funding to Washington airports. All of the possible solutions will likely require coordination that starts with identification of a champion, which could be a group or a key individual that will take the lead in the efforts necessary for implementation. Most of the potential solutions require changes in state legislation or policies that will take political support for successful enactment. The list below identifies strategies that can be considered to support the implementation of some of these solutions:

- Support the continuation of the Advisory Committee membership from the *Airport Investment Solutions* Study or a similar group to continue the momentum developed during the study regarding the importance of finding state funding solutions to assist with the funding needs

- Solidify support from groups such as the Washington State Aviation Alliance (WSAA), Washington Pilots Association (WPA), the Washington Airport Management Association (WAMA), and/or the Washington State Community Airports Association (WSCAA) to help lobby the state legislature to vote in favor of legislation that supports one or more of the funding solutions
- Work with airport sponsors to identify aviation-supportive state legislators that could be requested to draft and support legislation for solutions that would benefit the airport system
- Build support from aviation-supportive officials to consider development of a task force or work group within the legislature to evaluate the top funding solutions, including consideration of fiscal analysis, that could be used to determine the potential solution that may receive the highest support in the full legislature

Non-Funding Solutions for Airport Infrastructure Funding Challenges

Recognizing that implementing a funding-based solution to address the infrastructure financial insufficiency will take time and considerable political will, and that some challenges can be met with solutions other than money, non-funding solutions were also considered. These solutions are largely dependent on changes to state policies and the state airport system's existing structure. Several of these solutions are discussed below.

Combining Multiple Airports under a Single Administration, Association, or Partnership

A possible non-funding solution to reduce costs to each individual airport sponsor, especially those small airports that have historically been unable to meet the financial requirements of continued capital investment or even ongoing maintenance, could be the implementation of regional airport system commissions or airport authorities or some other recognized organization. In some metropolitan areas that have several airports that support a region, consolidated governing agencies have been established that make funding and improvement decisions for the benefit of not just one airport, but for the benefit of the region as a whole. Examples of these regional commissions have been established in the following:

- Minneapolis (MN): Metropolitan Airports Commission with Minneapolis-St. Paul International Airport (commercial service) and six general aviation airports
- Nashville (TN): Metropolitan Nashville Airport Authority with Nashville International (commercial service) and John C. Tune (general aviation) Airports
- Brunswick (GA): Glynn County Airport Commission with Brunswick Golden Isles (commercial service) and McKinnon St. Simons Island (general aviation) airports

Other government entities such as counties or ports also have multiple airports under their jurisdiction that allows for sharing of resources and consideration of development across the system. The Port of Chelan County has both Pangborn Memorial Airport (also operated with Port of Douglas County) and Lake Chelan Airport, and Yavapai County (Arizona) has three general aviation airports under its control, Sedona, Bagdad, and Seligman. In addition to shared responsibility for Pangborn Memorial, the Port of Douglas County also has sole responsibility for the airports in Waterville and Mansfield.

Consolidation of roles and responsibilities often leads to greater efficiency of matters pertaining to airport governing, better prioritization of airport improvement projects, and provides an overall benefit to a region. The regional benefits and coordination of airport needs, contributions, and activities should be an integral part of regional planning efforts by the metropolitan planning organizations (MPOs) and regional transportation planning organizations (RTPOs), many of which are not aware of or engage with the airports within their jurisdictions. This first step of engagement in the regional planning efforts through coordination efforts could promote the concept of "operating groups" or entities for multiple airports as the activities and contributions of the airports are better understood.

Operating airports as a system would promote a more cohesive and standardized approach to oversight and management of the airports with the likelihood that the management functions would be maintained by a more experienced airport specialist. These specialists would understand the benefits of optimizing various aviation activities such as redundant flight schools and facilities including duplicating hangar development and considering availability in a regional or system context.

The development of these partnerships would require inter-local or jurisdictional agreements or memoranda of understanding that detail the operational, financial, and legal aspects of the relationship. It would be important that these partnerships provide a “win-win” for the participating agencies. It is possible that associations such as WAMA and/or WSCAA could help to evaluate the opportunities and challenges of such an agreement.

Reducing Infrastructure Standards at Non-NPIAS Airports

For airports that are not included in the NPIAS, the FAA standards can present an unrealistic standard that is not achievable, nor required. At this time, WSDOT only has airport design standards for state-managed airports (as documented in the *State-Managed Airport Handbook* dated February 2011) and performance objectives (including specific facility objectives by airport classification) that were established as part of the LATS study. A potential solution may be to develop a set of standards independent from the FAA that provide reduced requirements and increased flexibility for airport infrastructure at non-NPIAS airports. This would help reduce the amount of investment needed at these airports for capital projects to meet current FAA standards.

Allowing Washington Airports to Opt-Out of State System

Under Washington law, “any city, county, airport authority, political subdivision, federally recognized Indian tribe, public corporation, or person(s) that owns and operates, a public-use airport included in the Washington Aviation System Plan (WASP) is considered an eligible airport sponsor and may apply for WSDOT Airport Aid grant funds.” The Washington state Aviation System currently includes all publicly owned airports and does not provide for an airport to “opt-out” of the system. While opting out would make the airport ineligible to receive WSDOT Airport Aid grant funds, it would also reduce the need to meet grant assurances that can have financial implications, especially to small airports and their local government and community. These include compatible land-use planning, public hearings, pavement maintenance, environmental compliance, operations and maintenance, and many others. The effect of airports opting out and not providing funding would reduce the overall capital needs in the system but the exact impact of this potential solution has not been quantified.

Local Funding Solutions and Challenges

As costs of operating and maintaining airports get higher but funding available through State Aid grants remains the same, airports have to look for supplemental sources of funding to support additional projects. Local revenue sources fall into three categories: funds received from local agencies or municipalities; funds generated by the airport; and funds received from private sector sources.

Funding from Local Agencies or Municipalities

Funding that is provided to a local airport by a jurisdiction usually comes from local tax revenues. The challenge with this source of funding is that it is not always a set or continuous funding stream. First, the amount of money available is not reliable and can vary based on factors like the local economy and demographics of is residents. Further, airports seeking local funding must often compete with other local projects or community interests.[1] Municipal councils or governments might choose to allocate funding to projects that are more visible in the community or that directly and noticeably affect a greater number of people than would a project at an airport. This is particularly true recently as it has been reported that many people are choosing to drive to larger airports in larger cities that might have more attractive services rather than using their smaller, local airports.[2] The benefits of airports and specifically projects are also not always recognizable, especially the less tangible qualitative benefits that are derived from an airport. WSDOT’s *Aviation Economic Impact Study (2012)* identified 17 aviation-related activities that are supported at the airports and through the *Airport Investment Study*, the impacts of the lack of investment in projects on the 17 activities was determined. The level of impacts to airport users were determined to

[1] Funding Airport Investments (2015), *Washington Airport Investment Study Reference Guide*, p. 67
[2] Dillingham, G.L. (2014), *Aviation Industry Changes Affect Airport Development Costs and Financing*, US Government Accountability Office. p.7

affect operations, capacity, and sustainability, with moderate to significant impacts to the communities that support and benefit from airports, including all citizens that are affected by the loss of economic and tax revenue “opportunity costs.”[3]

Revenues Generated by the Airport

Some airports have the ability to generate additional funding for capital projects internally through airport-specific fees and non-aeronautical revenues. One example of an airport-specific fee is passenger facility charges (PFCs) at commercial service airports. The FAA guidance on PFCs dictates that airports are allowed to collect fees up to $4.50 per enplaned passenger at commercial airports that are operated by a public agency[4]. With these fees, airports can fund approved projects that enhance safety, security, or capacity or that improve the airport’s services or competitiveness in the aviation market. PFCs are an important source of revenue for larger, busier airports and can help provide the additional funding that is needed for critical projects not funded by the State Aid grants.

One challenge with PFCs is that they are only advantageous to airports with significant commercial service and a high number of enplanements. Airports will a small number of enplanements will get limited benefit from this additional fee because the number of passengers paying the $4.50 fee will be less significant. Further, as discussed in the previous section on increased taxes and fees, when additional fees are imposed, the whole fee amount is borne by the consumer in the form of increased ticket prices. At smaller airports that may not be as competitive in the airline industry, increased ticket prices could result in reduced consumer demand and be further detrimental to the airport.

Other sources of revenue that can be generated by an airport include:

- Retail and dining services that can be provided to passengers inside of airport terminals or airport properties
- Hangar leases and other aircraft parking and storage fees
- Leasing of airport property for non-aviation uses

As part of the *Airport Investment Study*, the leasing of airport property for non-aviation development was a primary topic, with the need for some infrastructure to support this type of development. A specific recommendation to establish a State-Sponsored Revolving Aviation Infrastructure Loan Fund (SRF) would support the infrastructure needs to enhance and further enable development of these properties for potential revenue generation at airports.

Additional revenue in the form of dining or retail revenue has been very important for the success of larger airports throughout the country; however, as with PFCs, these additional sources of revenue are often only feasible for larger airports, especially those with commercial airline service. Airports with limited operations and airport users often do not have the customer base to support significant private retail or dining, beyond that which is provided purely for customer convenience and necessity, and would have difficulty attracting major vendors to their airport. Thus, options for generating internal revenues are limited for smaller commercial service and GA airports, which are airports that are often in the greatest need of additional funding.

Revenue generated by leasing hangars and aircraft storage space is a beneficial source of income for airports with significant GA operations. Both commercial service airports and GA airports can benefit from providing hangars or other storage for aircraft that are based at the airport. For some small commercial service and larger GA airports, this can be a significant source of revenue every year. However, the amount of revenue from hangar and aircraft parking or storage leases is based on the number of based aircraft at the airport; smaller airports that do not have as many based aircraft often lack demand for storage space and must charge a market-based or even lower rate. Further, without adequate funding for

[3] Consequences of Perpetuating Current Funding (2015), *Washington Airport Investment Study Reference Guide*, p. 31

[4] http://www.faa.gov/airports/pfc/

development of the airport, a smaller GA airport will not have the facilities or amenities to attract the number of based aircraft needed to make significant money from storage-related leases.
Finally, airports can sometimes generate additional revenue by leasing out portions of airport property to be used for non-aviation uses such as agricultural or industrial/commercial uses. This allows airports to generate money on unused land and allows them to try and control the types of land uses surrounding the airport to make sure they are compatible with airport operations and local land use provisions. One challenge with this strategy is that leasing land on the airport could potentially constrain airport expansion in the future and is limited by the FAA through a requirement to obtain FAA approval through the ALP review process. Airports also have varying sizes of land envelopes and especially the amount of land that may be available for non-aviation related development, also affecting the amount of revenue that could be generated. Land leases on an airport for non-aviation related development are required to be fair market value. If there is land surrounding the airport available for development, the owner of that land has far fewer restrictions on the potential uses and fees than an airport, also inhibiting the ability of the airport to generate revenue with land that is not needed for aviation needs.

Another challenge with leasing land is the possibility of the development of incompatible uses surrounding an airport, which could constrain airport operations. There are guidelines regarding the types of uses that are compatible near an airport to ensure the safety of passengers as well as the surrounding populations. For example, there are height standards within an airport runway environment to minimize conflicts between aircraft and tall obstructions. For similar safety reasons, there is guidance on the density and type of land use development around an airport to ensure noise is not an issue.

Economic Impact of Airports in Washington and Nationally

It is critical to recognize that while the operation and maintenance of airports has a monetary cost, there are also substantial economic benefits that are created by airports and aviation-related activity. In 2012, WSDOT conducted an Aviation Economic Impact Study to understand the role that aviation plays in Washington's economy and demonstrate how the airport system and individual airports contribute to the well-being of the state and local communities. Through this study, it was found that the 135 public use airports in the Washington system resulted in 248,500 jobs, $15.3 billion in wages and $50.9 billion in total economic activity. Every year, more than $701 million is generated in tax revenue from aviation activities with $548 million of that used to support the State General Fund.

In addition to the significant economic impact that the aviation system has in Washington, airports also provide multiple social and quality of life benefits to the state and surrounding communities that are not quantifiable but that create significant, positive impacts.

Aviation Creates and Supports Employment and Businesses

Analyses conducted by organizations such as the National Business Aviation Association (NBAA) show that many businesses and sectors of the economy rely on aviation. NBAA found that businesses that have access to aviation are frequently more successful, both economically and institutionally, than those who do not have aviation as a resource. The use of an aircraft creates competitive marketplace advantages in the speed and efficiency of delivering employees, goods, and services that are essential for success. This is especially true for small and medium-sized businesses that are expanding into regional and national markets, but it is also applicable to larger companies that might have multiple locations and provide significant tax and retail revenue to the local jurisdiction and the state.

Aviation Supports Economic and Community Development

Airports and aviation in general also further support the economic and community development of jurisdictions. An airport's presence can make an area more attractive to businesses that are looking to locate there and can improve business investment in an area. Additionally, residents including permanent, part-time or seasonal can be drawn to a community because of the presence of an airport, both in the form of commercial service and general aviation. The availability of an airport also supports increased tourism, especially during special events that generate large numbers of visitors to an area. Many business and recreational visitors may choose to fly into a variety of available general aviation airports based on their proximity to their final destination or the ability to avoid the congestion at a commercial airport. Overall, an airport functions as a gateway into a city that helps attract visitors and businesses that might otherwise overlook or dismiss the area.

Aviation Supports Safety, Medical Services, and Emergency Preparedness and Response

Aviation facilities such as airports and heliports are important assets for emergency and medical personnel to help provide improved and expedited services to communities. Medical transport by airplanes and helicopters (air ambulance) at general aviation airports provides transportation for patients when a commercial service airport may not be nearby[5], and airports can help provide medical services to communities that are not close to a population center. Similarly, airports provide a critical alternative facility to support emergency and disaster response. An airport can provide essential evacuation services or can be the staging area for disaster relief personnel and supplies in the case of a large-scale, disruptive event.

Aviation contributes to critical emergency and safety services for communities. An airport can provide law enforcement and national security with locations for police helicopter fleets and other agencies. These functions improve the safety and stability of the surrounding jurisdictions. Airports also facilitate search and rescue missions to help locate and rescue missing persons by hosting or supporting patrols, providing fuel or other supplies, or providing transportation to medical facilities. In the western US, aviation is an important resource for fighting forest fires, as aircraft can cover larger geographical areas. They can also assist in staging areas for water rescues that might be required for airports along the coast.

Finally, general aviation airports provide alternative facilities for flight diversions in case of unexpected emergencies or bad weather. Each airport in a given area provides pilots with an immediate alternative for an emergency landing, which is critical to reduce the number of potential aviation accidents.

Overall, airports have been identified as a critical component of the transportation system as well as the economic fiber of a region, contributing to the vitality of a community to support business, tourism, emergency access, and transportation.

Summary of Impacts on Washington Airport System and Recommended Actions

As airport funding resources become more limited and the need and costs for infrastructure continues to rise, securing funding for implementing various projects is a challenge for most airports. There are potential state funding solutions derived from taxes and fees. There are also non-funding opportunities proposed to support the airports and the infrastructure challenges and funding needs. In addition, local funding solutions are more airport-specific and are unique to each airport and its location. In all cases, there are some overarching challenges for implementing funding solutions.

The challenge that is most widespread is that of finding funding streams that can benefit smaller airports that don't provide commercial service. There are several examples discussed above where both state and local funding solutions only benefit larger airports that either have very high numbers of operations or that have commercial airline service. For example, collecting additional taxes and fees on passengers provides the most benefit to airports that have significant commercial activity. Similarly, implementing new revenue streams such as charging for parking or providing dining or retail services at an airport will only

[5] FAA (2012). General Aviation Airports: A national Asset. Retrieved from: http://www.faa.gov/airports/planning_capacity/ga_study/media/2012AssetReport.pdf

be viable at large airports that can support these activities. This challenge creates a cyclical issue because without sufficient funding, smaller airports are unable to develop and improve infrastructure and services needed to support an increase in operations; yet, without the increased operations, the airport will continue to be at a disadvantage when it comes to sources of funding.

The other widespread challenge is associated with creating additional revenue by imposing new taxes or raising current taxes. There will have to be careful consideration when looking to raise taxes or impose new taxes.

Even with the challenges that have been identified, it is important to remember and consider the substantial economic benefits that are derived as a result of an airport's activity. Airports and aviation as a whole create and support employment and businesses throughout Washington, as well as economic and community development. Some of the benefits of aviation are easily quantifiable and have been evaluated, but there are also numerous social and quality of life benefits that are more qualitative and represent significant, positive impacts to the residents, businesses, and visitors to Washington.

As part of the WASP, WSDOT Aviation convened working groups to discuss aviation issues. A working group was established to discuss general aviation infrastructure funding challenges. This group recommended the following actions be considered:

POLICY CONSIDERATION: WSDOT Aviation support small group discussion through associations such as WAMA and WSCAA to develop and evaluate the potential implementation of combining multiple airports under a single administration, association, or partnership. Discussion would outline opportunities and issues including voluntary participation, benefits, need for formal memorandum of agreement or understanding, funding, etc.

POLICY CONSIDERATION: WSDOT Aviation should evaluate and consider a program related to reduced infrastructure standards for non-NPIAS airports. Options for this program could include:

- Vetting optimized infrastructure and safety standards
- Developing interim guidance to airports and requests/grants of temporary exemption from standards with an accompanying roadmap or plan for the requesting airport that outlines improvement goals with milestones and benchmarks
- Evaluating opportunities to voluntarily opt out of the aviation system, which could release an airport sponsor from any responsibility to meet state standards and include an accompanying release of eligibility for grants and loans from the state Airport Aid Program
- Examining the state airport classification to consider existing FAA classifications and specifically address airports that do not meet the FAA Basic level criteria, whether NPIAS or Non-NPIAS, to determine what adjustments may be appropriate to allow continued airport participation in the state aviation system with an adjusted set of requirements appropriate for smaller airports with lower aircraft density and operations
- Developing a minimum set of standards for participation in the state aviation system
- Developing a set of criteria for inclusion or opting-out of the aviation system, and for changing an airport's classification as airport characteristics and operation activities change

Memorandum

Re: Final Emerging Issues Paper
Preparing Airports for NextGen Implementation

This paper provides an overview, from an airport system perspective, of the potential need to conduct statewide studies similar to the recent and current PSRC studies that could benefit the aviation system. In addition, the following NextGen issues are discussed briefly: airspace changes, airport safety/design changes, weather/minimum improvements and terrain/immovable obstacles challenges.

Components to Utilize NextGen

The NextGen program has been in the process for decades and the next major milestone is 2020 when the deadline is reached for aircraft equipage requirements, making it mandatory in order to operate within Class B airspace, like that around Seattle-Tacoma International Airport. Although FAA may allow airlines to delay full equipage by this date, FAA is being firm that all general aviation (GA) aircraft must be ADS-B compliant by 2020 to operate within Class B airspace.

For the purpose of this summary, the four key elements to utilize NextGen consist of the following:

- WAAS or Wide Area Augmentation System
- Associated GPS Satellites
- FAA satellite-based approach procedures
- WAAS enabled aircraft instrumentation.

The Wide Area Augmentation System (WAAS) was developed by the FAA for civil aviation and is an extremely accurate, satellite-based navigation system. WAAS provides horizontal and vertical navigation capability for all phases of flight, including approaches, departures, and enroute operations. Area Navigation or RNAV is a method of navigation that permits aircraft operations on any desired flight path within the coverage of ground or space-based navigation aids, or a combination of both. Many Instrument Flight Rules (IFR) pilots are familiar with RNAV (GPS) approach procedures. These procedures can include a line of minima for Localizer Performance with Vertical guidance (LPV) or a line of minima for Localizer Performance (LP). Both LPVs and LPs are flown using WAAS, which covers the entire USA as shown in **Figure 1**.

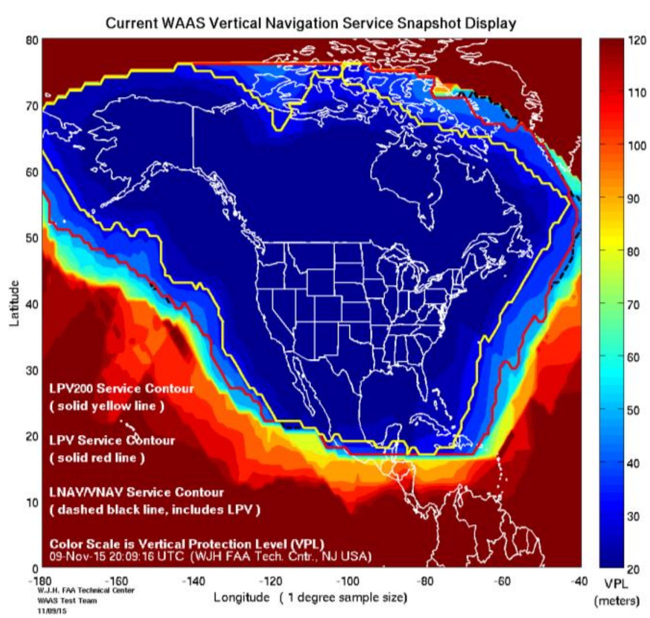


Figure 1 - Current WAAS Coverage Map

LPVs take advantage of the lateral and vertical guidance accuracy of WAAS and are very similar to a Category I Instrument Landing System (ILS) approach. Like an ILS, an LPV provides vertical guidance and is flown to a Decision Altitude (DA). Today, there are almost three times as many LPVs as there are ILS approaches. In addition, these near ILS approaches do not require expensive land based navigational aids such as a Localizer or Glide Slope. LPV approaches provide minima down to ¾ mile visibility and 200 foot ceiling. If an approach lighting system is provided, then the visibility minima can be lowered to ½ mile. This WAAS capability can provide airports with clear approaches and associated FAA design standards with similar benefits of an ILS without the associated cost.

Recent PSRC NextGen Studies and Recommendations

WSDOT Aviation participated in two studies designed to enable integration of NextGen technologies in the Seattle metropolitan area.

In May 2013 the Metropolitan Planning Organization (MPO) for the greater Seattle metropolitan area, the Puget Sound Regional Council (PSRC), completed a study on *Preparing Busy General Aviation Airports for Next Generation Technologies.* The study reviewed airports' level and type of aircraft activity to determine the need for improved navigation capabilities and enhanced access during bad weather. The analysis found there are 13 airports worthy of more in-depth analysis to determine if NextGen technologies offer worthwhile benefits.

In October 2015, the PSRC completed a *NextGen Airspace Optimization Study.* This study was designed to look at ways to reduce congestion, enhance safety, and improve the efficiency of the region's airspace. Some of the recommendations from this study were:

- Promoting GA aircraft to equip with ADS-B in the Puget Sound region.
- Encourage airports to collect up-to-date obstruction information.
- Develop NextGen approach procedures.

Required Navigation Performance (RNP) describes an aircraft's capability to navigate using performance standards. RNP is RNAV with the addition of an onboard performance monitoring and alerting capability. RNP enables the aircraft navigation system to monitor the navigation performance it achieves and inform the crew if the requirement is not met during an operation. This onboard monitoring and alerting capability enhances the pilot's situational awareness and can enable reduced obstacle clearance. RNP provides a more efficient design of airspace and procedures which collectively result in improved safety, capacity, predictability, operational efficiency, and environmental impacts. Specifically, improved access and flexibility help to enhance reliability and reduce delays by defining more precise terminal area procedures.

Figure 2 - Example RNP Approach

RNP approaches are designed for specific airlines/operators and their aircraft. Alaska Airlines pioneered the first RNP approach in 1996. In 2012, the Seattle-based carrier used RNP procedures at 30 airports in Alaska and in the continental U.S., operating a fleet of 117 Boeing 737s equipped with RNP-capable flight management computers, displays and navigation receivers. Its sister airline Horizon Air operates RNP-capable Bombardier Q400 turboprops.

Typical capital improvements identified to prepare the region's airports for the full benefits of NextGen include runway and taxiway widening; parallel taxiways; taxiway relocation; runway and taxiway lighting; and obstruction lighting, marking, and removal. Other actions include airport master plan and airport layout plan updates, obstruction surveys and obstruction removal, and land acquisition for runway safety areas and runway protection zones, approach protection, and acquisition of avigation easements. Additional suggested actions include technical evaluation and design of new NextGen approaches to establish Performance Based Navigation (PBN), Required Navigation Performance (RNP), and vertically guided approaches, typically Localizer Performance with Vertical guidance (LPV). Most of the region's busy airports will also need to address existing obstructions by lighting, marking, and/or removal and hold line and guidance sign improvements.

Impact on the Washington Airport System

Airspace Changes

FAA has been implementing RNAV arrival and departure routes at the busiest airports. On occasion, residences located under newly established RNAV tracks at large hub airports have expressed concern regarding noise.. According to a review of news articles of the past 5 years, it appears that Seattle has not had the same experience as other airports. This may be due to the confined airspace surrounding SEATAC thus RNAV routes are generally overlays of former flight corridors.

According to the *PSRC NextGen Airspace Optimization Study*, commercial and GA aircraft owners have been equipping for NextGen technology by preparing to use ADS-B for surveillance and WAAS for navigation. The FAA tech center tracks the number of domestically registered aircraft flying in the NAS that are ADS-B equipped. As of January 1, 2015, there were approximately 8,800 U.S. registered GA aircraft that are equipped with ADS-B out and 255 US registered commercial aircraft that are ADS-B equipped to the latest standard; this represents 4% and less than 1% of the fleet, respectively.

Figure 3 - ADS-B Architecture

Newly manufactured aircraft, both general aviation and commercial, will not necessarily be equipped with ADS-B in that it is an option by the customer. Equipage for GA is still meeting resistance because of the high cost and compliance issues. The central issue remains cost, with an average ADS-B unit cost of $5,000; this can represent up to 15% of the value of a small GA aircraft.

The number of GA aircraft equipped with WAAS is substantially higher than those equipped for ADS-B. A majority of general aviation aircraft that fly in IFR conditions are equipped. The higher performance the aircraft, the more likely it is WAAS equipped. WAAS is a technology that is primarily used by GA, and will not normally be equipped by Boeing aircraft used in the commercial fleet. Aircraft need to be equipped at a minimum with ADS-B "Out" technology to utilize WAAS and broadcast their identity, position, track, speed and other vital data to Air Traffic Control. ADS-B "In" equipped aircraft would receive this information once every second. In addition, ADS-B ground stations broadcast traffic information and weather information in the U.S.

Currently in the US, there are approximately 79,000 GA aircraft equipped with WAAS, which represents approximately 38% of the fleet (assumed 209,000 total GA aircraft). There are approximately 8,350 GA aircraft registered in Washington. In 2015 about 80% of GA aircraft that file and fly IFR in the NAS will have WAAS avionics; the PSRC consultant team assumed that most all Washington state registered aircraft will have pilots carrying at least a non-certified hand held GPS for situational awareness.

Airport Safety/Design Changes

In order for airports to be considered for WAAS precision approach procedures with vertical guidance, FAA has established minimum standards, as part of Advisory Circular 150/5300-13A. The following list summarizes the major areas required for precision approaches down to ¾ mile visibility:

- An approved Airport Layout Plan for all NPIAS airports
- Minimum runway length of 4,200 feet paved.
- Precision markings, etc.
- Runway edge lights.
- Parallel taxiway at required separation standards.

- Clear approaches, etc.

Approach Type Weather/Minimum Improvements

Improvements to approach minima by category are summarized below:

- Localizer Performance without Vertical Guidance (LP) and Lateral Navigation (LNAV) are non-precision approaches with WAAS lateral guidance, so LP minima are typically 300'/1 mile and LNAV are 500'/1 mile
- LPV decision altitudes can be as low as 200 feet and ¾ mile and down to ½ mile if an approach lighting system is provided.
- RNP can be as low as 300' and ½ mile if an approach lighting system is provided.

Terrain/Immovable Obstacle Challenges

The additional benefit of GPS/WAAS approach procedures is that airport approaches previously penetrated by mountains and preventing non-precision routes now have the opportunity of using curved approach and departure procedures. Upon request, FAA has developed curved procedures for qualifying airports with difficult terrain issues.

Summary and Recommendations

WAAS enabled NextGen instrument approach procedures have made it possible for appropriately equipped aircraft to fly approaches to a greater number of airports during poor weather conditions and low visibility. LP approach procedures use WAAS for horizontal guidance only, which can replace non-precision approach procedures at airports. LPV approach procedures using WAAS provide both horizontal and vertical guidance for aircraft and perform similar to a Category I ILS approach without the need for expensive land based navigational aids such as a Localizer or Glide Slope.

To be considered for WAAS precision approach procedures, FAA has established minimum requirements in Advisory Circular 150/5300-13A including runway length, approach lighting and runway marking needs, and approach clearance requirements.

The PSRC has recently completed two studies focused on NextGen optimization and implementation for airports in the Seattle metropolitan area. A similar study by WSDOT covering all state system airports can be conducted to identify airports ready for NextGen approach implementation, and infrastructure needs for airports not currently meeting the FAA minimum requirements to initiate WAAS enabled instrument procedures. A statewide study would identify airport needs, airport sponsor interest in providing WAAS enabled procedures, and potentially prioritize airfield improvements at system airports.

As part of the WASP, WSDOT Aviation convened working groups to discuss aviation issues. A working group was established to discuss NextGen. This group recommended the following actions be considered:

POLICY CONSIDERATION: Conduct periodic meetings that include WSDOT, the FAA and airports. To synthesize activities and share best practices

POLICY CONSIDERATION: Increase WSDOT and FAA outreach to academia and other stakeholders.

POLICY CONSIDERATION: Consider man-made and natural obstructions when developing NextGen implementation strategies.

POLICY CONSIDERATION: WSDOT should pursue a statewide NextGen study that will address high-density airspace, high levels of operations and based aircraft, airports with known obstructions, airports with frequent, limiting weather, and airports with noise sensitive areas.

POLICY CONSIDERATION: WSDOT should coordinate with FAA TSO to streamline the certification process for ADS-B and GPS navigation hardware.

POLICY CONSIDERATION: The FAA should incorporate geo-fencing into NextGen.

POLICY CONSIDERATION: The FAA should be mindful of weight, size and cost restrictions for GA aircraft NextGen components.

POLICY CONSIDERATION: This NextGen report should outline NextGen implementation next steps for airports and pilots

POLICY CONSIDERATION: WSDOT should conduct outreach to pilots to enhance their understanding of the 2020 mandate, and ADS-B equipage requirements

POLICY CONSIDERATION: WSDOT should promote airport engagement in NextGen implementation, by providing updates to airport sponsors on the progress of the NextGen study.

Memorandum

Re: **Final Emerging Issues Paper**
UAS in Washington State

Introduction

UAS Integration Review

The rise of Unmanned Aircraft Systems (UAS) integration into the National Airspace System (NAS) has become one of the most impactful events on the history of aviation. Just as the Grand Canyon crash in June 1956 led to the creation of the Federal Aviation Administration (FAA) for regulation and safety of air traffic operations nationwide, the emergence of UAS for routine commercial and civilian operations is forcing many stakeholders to reevaluate the entire aviation transportation system. Both traditional-aviation and non-aviation industry contributors are now developing technologies, services, and product packages that offer new capabilities related to UAS operations in the NAS. Legislatures, regulatory authorities, and standards organizations globally are evaluating strategies or implementing new structures and laws for managing the integration of UAS to protect the safety and integrity of civilian airspace, while also protecting the privacy rights of citizens. Education and certification requirements to meet evolving standards and regulations are as dynamic as the emerging UAS-based applications markets. There are many initiatives globally and nationally that are influencing the proliferation of UAS including standards development, research programs, advocacy efforts, and information programs.

Industry

The UAS industry as a whole encompasses a wide range of demographics. Traditional aerospace contractors such as Boeing, Lockheed Martin, and Northrup Grumman are actively engaged in the UAS industry. They are developing technologies, acquiring smaller companies with UAS products, or integrating other solutions into their capability portfolios. Other large companies like Intel and Google that specialize in computing and information management, not aviation products, are also emerging as major players in the UAS community. Small businesses have created the most disruption in the UAS sector in recent years with the explosion of the consumer-grade UAS companies like DJI and 3D Robotics.

Figure 1: UAS Industry Representatives

The UAS industry (Figure 2) should not be strictly defined by the companies that are manufacturing the aircraft. Hardware components such as sensors, avionics, transponders, ground control stations, and batteries are evolving at least as fast as small airframe designs. Increased battery performance to extend endurance or power more sensors translates directly to increased system capability. Software development for advanced autonomy, vehicle operating systems, information management, image processing, and data analysis is another big area of growth. Companies like Airware, Sierra Nevada

Corporation, and DJI are investing large amounts of money into developing or acquiring software to gain a competitive advantage in the UAS market.

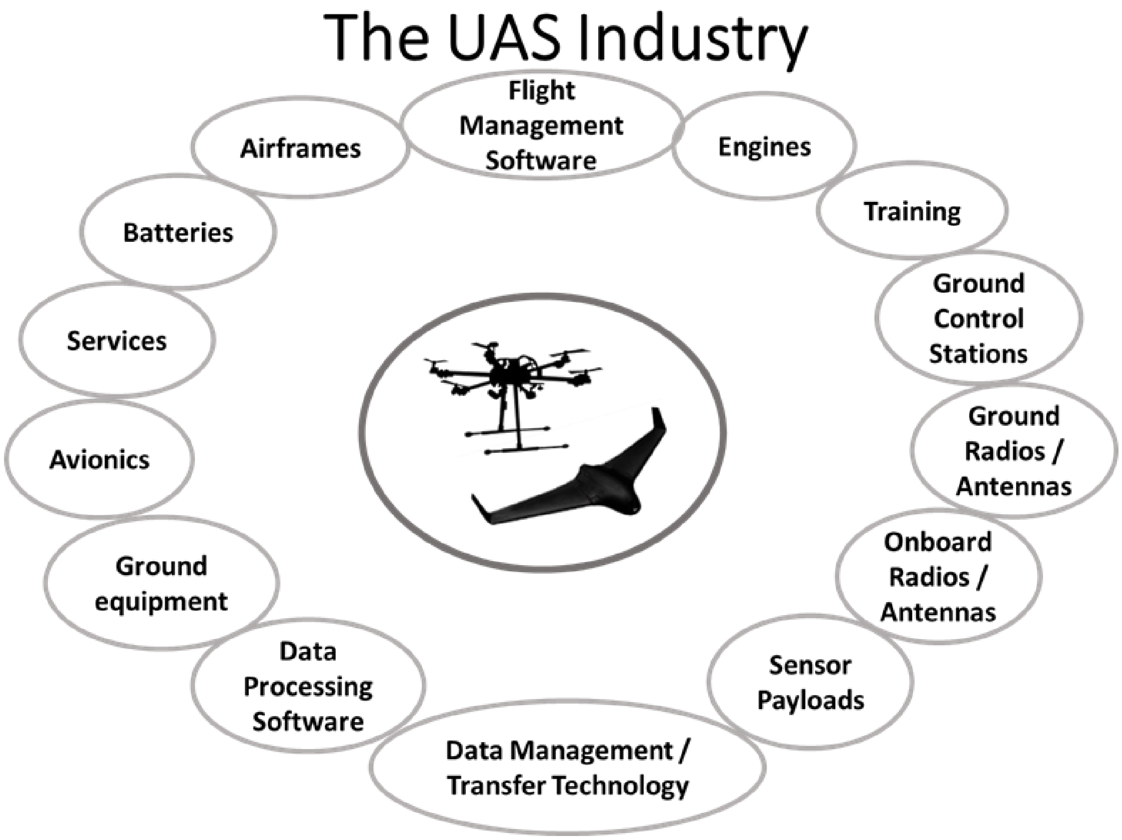


Figure 2: Types of UAS Industry Providers

Not all of the companies in the UAS industry are developing technologies or manufacturing products. Hundreds of companies that did not exist at the beginning of 2015 began offering UAS services in the United States. While many of these were legally offering UAS aerial photography and surveying services under the FAA's Section 333 Exemption program, many other service providers were acting outside the current regulatory structure for a variety of reasons (informed defiance, unaware, etc.). Measure 32, Juniper Unmanned, Boeing's Insitu, and SkyPan International are some of the more recognized names offering UAS services. Many organizations have chosen to build UAS operations units inside existing corporate structures such as engineering firms, construction companies, and film making studios. In June of 2016 when the FAA temporarily suspended the 333 Exemption process to release the Part 107 Small UAS Rule, the FAA had approved more than 5,500 exemptions for commercial operations. At that same time the FAA UAS registration program surpassed 500,000 registrations (General Aviation registration is widely estimated around 250,000 aircraft). These aircraft and exemptions were approved for a wide range of applications and missions (Figure 3).

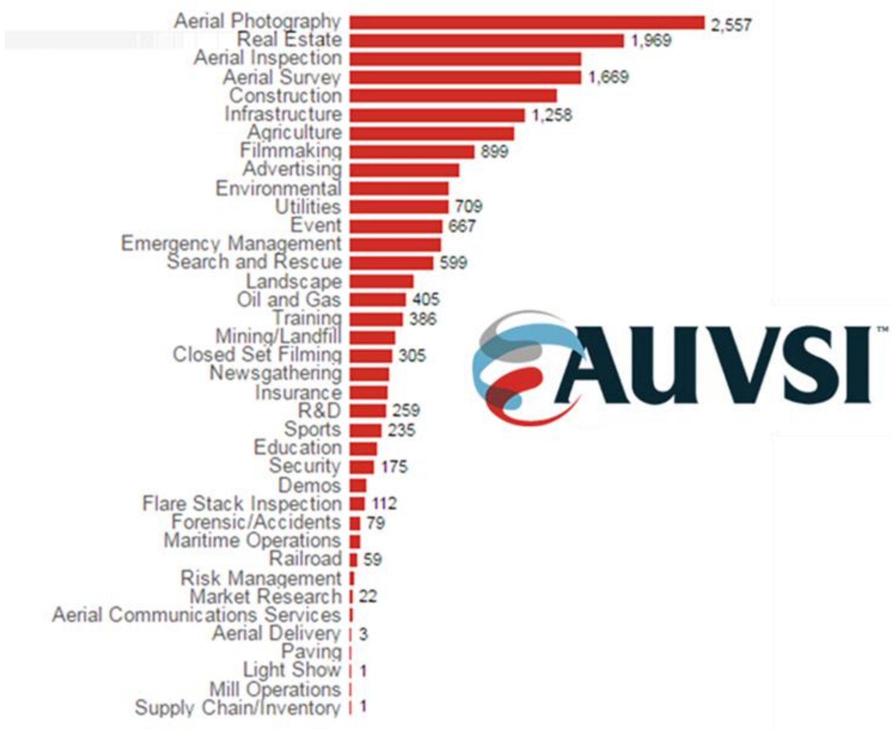


Figure 3: AUVSI Analysis of First 3,100 333 Exemptions
(AUVSI, AUVSI Commercial Exemptions Interactive Analysis, 2016)

Legislation

Just as the profile for a UAS industry organization takes many shapes, the approaches to UAS legislation across the country also span a wide range of expectations. The FAA responsibility to protect the safety of the national air transportation system provides the agency with the prime authority nationwide. In December of 2015 the FAA reminded the public and other government authorities of this responsibility vested in the Agency from Congress by releasing a Fact Sheet for State and Local Regulation of UAS (FAA, 2015). That Fact Sheet states the FAA's authority in multiple examples:

> "A consistent regulatory system for aircraft and use of airspace has the broader effect of ensuring the highest level of safety for all aviation operations. To ensure the maintenance of a safe and sound air transportation system and of navigable airspace free from inconsistent restrictions, FAA has regulatory authority over matters pertaining to aviation safety."

> "Substantial air safety issues are raised when state or local governments attempt to regulate the operation or flight of aircraft. If one or two municipalities enacted ordinances regulating UAS in the navigable airspace and a significant number of municipalities followed suit, fractionalized control of the navigable airspace could result. In turn, this 'patchwork quilt' of differing restrictions could severely limit the flexibility of FAA in controlling the airspace and flight patterns, and ensuring safety and an efficient air traffic flow."

The FAA originally used three methods for approving UAS operations in domestic airspace: (1) the Certificate of Authorization (COA) program for public agencies; (2) the Section 333 Exemption process for commercial UAS operations; and (3) the Special Airworthiness Certificate for UAS operations. Each of these methods is well-defined and discussed in various online resources including the FAA's website (http://www.faa.gov/uas/) and articles from industry experts. In February of 2015 the FAA released the long-awaited Notice of Proposed Rule Making (NPRM) for small UAS operations. After the 60-day public comment period closed, the FAA had approximately 4,500 comments to process and integrate into the final rule. On June 22, 2016 the FAA released 14 CFR Part 107, Operation and Certification of Small Unmanned Aircraft Systems. This rule is known as "Part 107, the Small UAS Rule." On August 29, 2016 Part 107 became effective and the FAA began issuing Remote Pilot in Command certificates. A summary of major provisions is outlined in Appendix B. Part 107 is expected to provide the structure for most small UAS operations, although the FAA is maintaining the public COA process for public agencies and a waiver/exemption process for operations outside of the Part 107 requirements. Table 1 provides a brief comparison summary of the FAA approval methods for UAS operations.

Table 1: FAA UAS Operations Authorization Methods

	Public COA	333 Exemption	Special Airworthiness Certificate	Part 107
Operator Certification	Agency determined (private ground school or Pilot's License)	Minimum FAA Sport Pilot's License	Minimum FAA Sport Pilot's License	FAA Remote Pilot Certificate
Altitude Limit	COA- specific	200' blanket approval Up to 400' with COA	Location specific, determined by FAA	400' AGL or within 400' of a structure
Aircraft Size Limit	COA-specific	55 lbs	Aircraft specific	55 lbs
Operational Time	COA-specific (some night ops are allowed)	Daylight hours only	Operation specific, determined by FAA	Daylight hours only
Visual Requirement	Line-of-sight only	Line-of-sight only	Operation specific, determined by FAA	Line-of-sight only
Visual Observer	Required	Optional	Operation specific, determined by FAA	Optional
Airworthiness Requirement	Self-certified	Exempt	Full FAA certification	Pre-flight inspection

As of December 2015, many states (see Figure 4) are also evaluating proposed legislation or implementing approved legislation to immediately help manage the growing demand of UAS across the country. More than a dozen states have established a UAS Task Force or some kind of committee specifically to assess the need for UAS legislation in their respective state. More than half of the country has passed legislation that addresses UAS operations, data capture, equipage, or illegal activity.

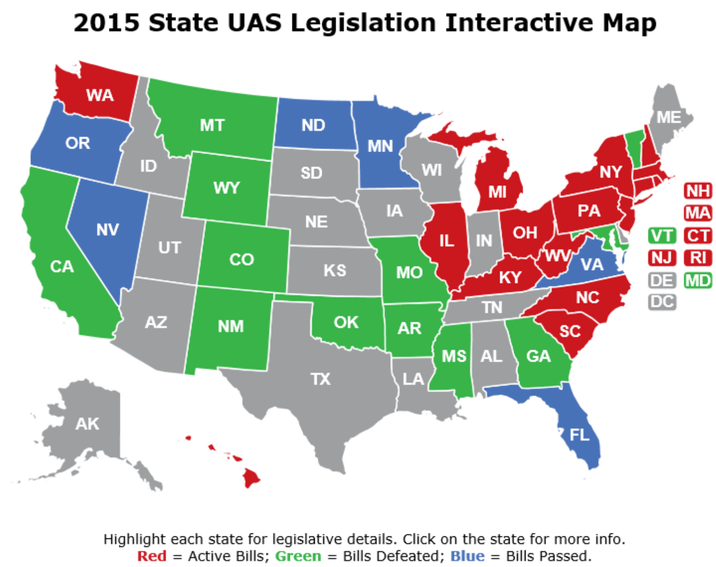


Figure 4: UAS Legislation Map

More details on this will be discussed later in the report. Just as when the FAA was established as a national regulator, the definitions of "airspace," "preemption authority over airspace," "control authority," and regulatory enforcement responsibilities are being reviewed at all levels.

Education/Training/Certification

As the FAA continues progressing toward broad integration for small UAS commercial operations, government agencies, universities, and private companies are using a variety of platforms to fill the UAS information needs. The FAA has multiple information websites covering UAS topics including details on Part 107, the Section 333 Exemption program, Model Aircraft Do's and Don'ts (FAA, FAA UAS Website, n.d.), and a UAS Roadmap (FAA, FAA UAS Website, n.d.) for long term planning. State departments of transportation and aeronautics authorities are posting UAS information pages with fact sheets and local knowledge (for example, the North Carolina and Minnesota UAS websites). Universities are offering UAS curricula for degrees and certificates in UAS operations. Aerospace engineering programs are still building small UAS as senior design or capstone projects, while higher level computer science classes are using UAS as platforms for demonstrating advanced artificial intelligence, dynamic networking, and human-machine collaboration knowledge comprehension. Remote sensing and Geospatial Information Systems (GIS) programs are integrating UAS data capture methods and samples into classes on modern surveying and image analysis skills techniques. Finally private companies are specializing in UAS operating training programs at the same time that traditional flight schools are also developing UAS-specific flight training programs building on existing Part 61 and Part 141 approvals. The challenge all of these organizations face is the FAA evolving definition of the requirements for the UAS operator license, including the transition from 333 exemptions that required a minimum Sport Pilot license to the creation of the new Remote Pilot certificate. As of August 2016 there is no such thing as an "FAA-approved UAS Flight School" or an "FAA-recognized degree program" to certify UAS professionals. Providing up to do date, accurate information that includes any pertinent and related local relevance is critical for state and local governments to keep their citizens informed. But as the regulatory and standards landscapes continue to evolve, the certification, permitting, registration, and education requirements for a professional UAS career will also continue evolve.

Applications

The demand for UAS in the national airspace is driven by the value that UAS capabilities are now providing users for a wide variety of applications. Although the benefits of UAS for aerial imagery were primarily isolated to the national defense community, the commercial sector and civilian services providers have begun adopting the technology and reaping the benefits. Although not an exhaustive list of applications, Figure 5 presents a core set of missions that many state governmental agencies and commercial services companies are performing under current FAA authorizations:

Sample UAS Applications	
Mapping / Surveying	Investigation
Aerial Photography	Drug Enforcement
Agriculture	Anti-terrorism
Mining	Law Enforcement
Forestry	First Responder Support
Wildlife Resources	Disaster Analysis
Transportation	Emergency Response
Weather Research	Insurance Assessments
Airport Planning	Real Estate Photography
Entertainment / Filming	Construction Management

Figure 5: Example UAS Applications

Major Initiatives

The continued acceleration and momentum of UAS growth provides several key initiatives worth tracking. The following examples of UAS leadership provide a description of the initiative and the value to the UAS integration community.

- The FAA UAS Center of Excellence: This is a 5-year funded research program for a university-led team of research institutions, industry partners, and government agencies to tackle the challenges facing UAS integration today and in the future. Mississippi State University leads a 22-school alliance called ASSURE (www.assureuas.org) that was selected by the FAA for the UAS COE in May of 2015. ***Value*: Research specifically designed to accelerate the broad, safe integration of UAS into the National Airspace System.** Academia, industry, and government agencies are collaborating to research current and future needs for UAS operations in domestic airspace.
- The FAA's UAS Test Sites (FAA, FAA UAS Website, n.d.): In December of 2013, six UAS test sites were selected to achieve cross-country geographic and climatic diversity and help the FAA meet its UAS research needs. The six sites are managed by the University of Alaska, State of Nevada, New York's Griffiss International Airport, North Dakota Department of Commerce, Texas A&M University-Corpus Christi, and Virginia Tech through the Mid-Atlantic Aviation Partnership. In June of 2016 the New Mexico State University's UAS Flight Test Center, which was the model for the other six test sites, was officially recognized as an FAA UAS Test Site when the FAA Extension, Safety, and Security

Act of 2016 was signed into law (Staff, 2016). ***Value*: Working with the UAS Test Sites is the FAA-preferred method for researching and evaluating new technologies related to UAS integration.** The Pan-Pacific UAS Test Range Complex is the official FAA test site managed by the University of Alaska, but includes facilities in Oregon, Hawaii, Kansas, and several other states. Washington State could consider collaborating with a UAS Test Site to evaluate UAS regulations and policies.

- Know Before You Fly and the B4U Fly App (FAA, FAA UAS Website, n.d.): The "Know Before You Fly" campaign started in December of 2014, when the AUVSI, the Academy of Model Aeronautics (AMA), the Small UAV Coalition, and the FAA partnered to provide prospective UAS operators with the information and guidance needed to fly safely and responsibly. The campaign plans to team with manufacturers and distributors to provide consumers and businesses with the types of information needed before flying a UAS. The information is provided through a website, educational videos, point-of-sale materials, and digital and social media campaigns. The "Know Before You Fly" website (http://knowbeforeyoufly.org/) contains pages with information applicable to recreational users, public entities, and business users. It contains contact information, links to additional resources, and printable brochures aimed at enhancing UAS operations. Airport operators can steer stakeholders and members of their communities toward the campaign materials as a starting point for local UAS discussions. (Neubauer, 2015, p. 27).

  B4UFLY is a smartphone app that helps unmanned aircraft operators determine whether there are any restrictions or requirements in effect at the location where they want to fly. ***Value*: These two initiatives are providing the general public free tools and information to safely operate UAS from a consumer and novice perspective.**

- RTCA SC-228 Minimum Operational Performance Standards for Unmanned Aircraft Systems Committee: "Established May 20, 2013, this committee is working to develop the Minimum Operational Performance Standards (MOPS) for "Detect and Avoid" (DAA) equipment and a Command and Control (C2) Data Link MOPS establishing L-Band and C-Band solutions. The initial phase of standards development will focus on civil UAS equipped to operate into Class A airspace under IFR flight rules. The Operational Environment for the MOPS is the transitioning of a UAS to and from Class A or special use airspace, traversing Class D and E, and perhaps Class G airspace. A second phase of MOPS development is envisaged to specify DAA equipment to support extended UAS operations in Class D, E, and perhaps G, airspace." (RTCA, n.d.) ***Value*: Standards committees are always looking for more participants with technical and policy knowledge.** These are the most impactful activities shaping the long term standards, procedures, and definition related to UAS integration.

- The Small UAV Coalition: "The Small UAV Coalition advocates for law and policy changes to permit the operation of small unmanned aerial vehicles beyond the line-of-sight, with varying degrees of autonomy, for commercial, consumer, recreational and philanthropic purposes." (Small UAV Coalition, n.d.) ***Value*: With members like Amazon and Google, the Small UAV Coalition is the dedicated voice for the emerging commercial UAS services industry.** Companies based in Washington are joining the coalition, so state policies and opportunities will be used for examples.

- The Association for Unmanned Vehicle Systems International (AUVSI): "The Association for Unmanned Vehicle Systems International is the world's largest non-profit organization devoted exclusively to advancing the unmanned systems and robotics community. Serving more than 7,500 members from government organizations, industry and academia, AUVSI is committed to fostering, developing, and promoting unmanned systems and robotic technologies. AUVSI members support defense, civil and commercial sectors." (AUVSI, n.d.) ***Value*: AUVSI has the reputation in Washington, D.C. and globally for shaping the entire unmanned systems industry and policy.** The Cascades Chapter of AUVSI was established to support the community in the northwest region of the United States.

- FAA UAS Registration Task Force (FAA, 2015): In October of 2015 a Registration Task Force was established to provide the FAA Aviation Rule Making Committee direct recommendations regarding UAS registration strategies and needs. The FAA charged the Task Force with the following three objectives:

  - Develop and recommend minimum requirements for UAS that would need to be registered.
  - Develop and recommend registration processes.
  - Develop and recommend methods for proving registration and marking

  On November 21, 2015 the RTF submitted their report to the FAA for immediate consideration. On December 21, 2015 the FAA released Registration and Marking Requirements for Small Unmanned Aircraft Interim Final Rule (FAA, 2015). This rule provides an alternative, streamlined and simple, web-based aircraft registration process for the registration of small unmanned aircraft, including small unmanned aircraft operated as model aircraft, to facilitate compliance with the statutory requirement that all aircraft register prior to operation. It also provides a simpler method for marking small unmanned aircraft that is more appropriate for these aircraft. ***Value*: This registration requirement is law and was a major step forward toward Part 107.**

- UAS Traffic Management (UTM) Program, NASA Ames Research Center: A UTM system would enable safe and efficient low-altitude airspace operations by providing services such as airspace design, corridors, dynamic geofencing, severe weather and wind avoidance, congestion management, terrain avoidance, route planning and re-routing, separation management, sequencing and spacing, and contingency management. UTM is essential to enable the accelerated development and use of civilian UAS applications.

  One of the attributes of the UTM system is it will not require human operators to monitor every vehicle continuously. The system will provide to human managers the data to make strategic decisions related to initiation, continuation, and termination of flight operations. This approach would ensure that only authenticated UAS operate in the airspace. In its most mature form, the UTM system will be developed using autonomicity (also known as autonomous, or self-directing) characteristics which will include self-configuration, self-optimization and self-protection. The self-configuration aspect will determine whether the operations should continue given the current and/or predicted wind/weather conditions. (NASA, n.d.) Value: The collaboration of FAA, NASA, and industry under the UTM concept is defining national, state, and local level technology, policy, and application expectations (Figure 6). UTM progress needs to be monitored.

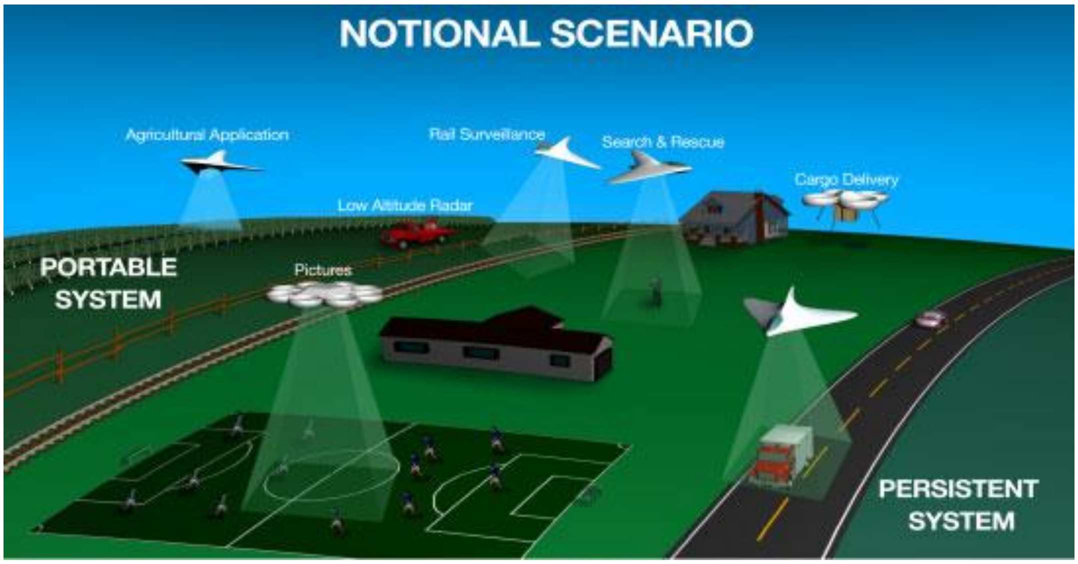


Figure 6: NASA UAS Traffic Management Concept

Framing the Impact of UAS on the Air Transportation System

When the FAA's "NextGen" program to modernize the national air transportation system was launched in the early 2000s, UAS integration into the NAS was considered a minor demand falling near the bottom of priority lists. ADS-B maturation, implementation, funding, and adoption was critical to provide the backbone for the modern, GPS-based digital airspace. System Wide Information Management, digital data-link communications between aircraft-to-aircraft, aircraft-to-controllers, and other airspace participants, and improved weather impact analysis were considered the top priorities for increasing capacity while maintaining or improving the air transportation safety performance. Based on analysts' predictions and industry trends today, UAS could outnumber traditional manned aircraft ten to one in the not-so-distant future. This exponential growth will require support for a wide range of unmanned aircraft operating in nearly all types of airspace including urban, rural, high density, low density, and various altitudes. UAS have the potential to epitomize the capabilities and benefits of NextGen, while also demanding the expedited, successful transition to the modern aviation system.

Industry Trends and Outlook

Small UAS

Small UAS are the largest growth sector and the primary focus of the FAA for UAS integration in the near future. “Small UAS” is currently defined as 55 pounds or less in maximum takeoff weight of an aircraft (i.e. airframe + payload + fuel). There is a consideration for a “micro UAS” class of aircraft, but current exemptions and waivers apply to all commercial and civilian UAS of small UAS. Small UAS include traditional Department of Defense systems such as the Aerovironment Raven and Puma (Figure 7) systems, but also the rapidly emerging public consumer type systems such as the DJI Phantom series and the SenseFly eBee. Most of these systems are hand-launched, launched from a small bungee powered catapult, or are vertical takeoff multi-copter designs. Flight time is anywhere from 15 minutes to 4 hours (for the extended range Puma) for aircraft less than 55 pounds, but the top of the small UAS weight range systems that are gas powered have completed 12+ hours missions. Except for a handful of research projects, small UAS are flown exclusively Line-of-Sight in the NAS today.

Figure 7: Puma UAS Launch

There were early predictions that the 2015 holiday season would see as many as 1 million small UAS sold at the general consumer level. Most of these aircraft would have been be sold as “hobby” devices intended for recreational purposes. However, the commercial potential for these devices is not a far leap into real estate photography, roof inspections, and surveying. That is why the UAS Registration Task Force was assembled to quickly develop a registration strategy as a step toward the release of the small UAS Rule (Part 107) and why the FAA quickly released the Interim Rule defining registration requirements for the hobbyist community.

The package delivery UAS concept (Figure 8) that organizations such as Amazon and Google are researching and evaluating is based on a network of small UAS that can carry an approximate 5-pound payload. Fleets of aircraft delivering toothpaste, books, medical supplies, and other immediate-need orders is not a fictional marketing concept, but an evolving business plan within multiple companies across the globe. Developing technologies for equipping these small UAS for tracking, path deconfliction, all-weather operations, and high-rate utilization are active development programs in research labs.

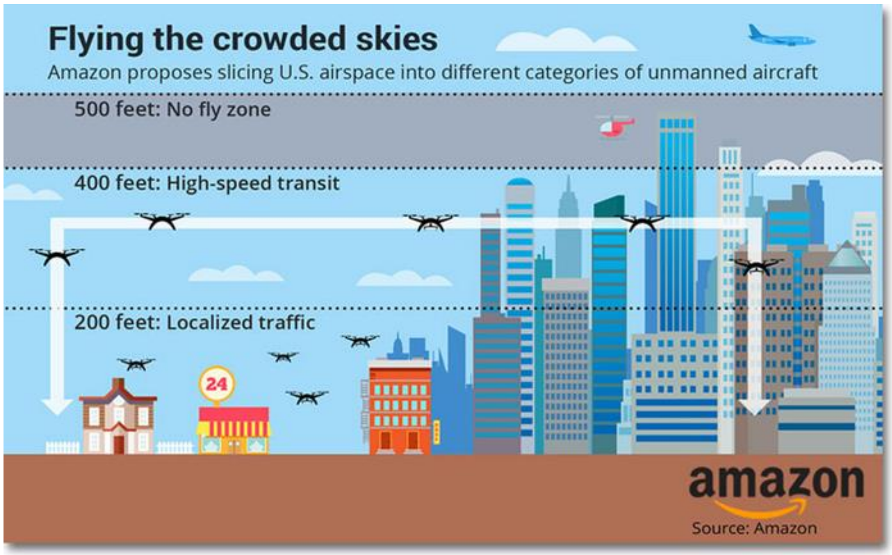


Figure 8: Amazon Airspace Management Concept

Based on the more than 2,200 approved small UAS commercial exemptions in December 2015 and with the release of Part 107 anticipated in the summer of 2016, routine UAS operations in the NAS could be witnessed daily before 2020.

Large UAS

A growing number of UAS operations, increased use of UAS in complex airspace, and the potential emergence of single-operator-multiple-vehicle control architectures will drive the development of new ATC integration technologies and protocols.

UAS larger than 55 pounds are emerging at a much slower pace than small UAS. Outside of the DOD Predators, Global Hawks, and Shadows, aircraft such as the Yamaha RMAX helicopter (Figure 9) for aerial spraying and the Arcturus T-20, a surveillance aircraft, are rarely seen in the United States NAS. Although large UAS provide more capacity for carrying transponders and other communications capabilities, and they are more likely to show up on radar due to size and higher flight altitudes, their cost and support logistics are significantly more than small UAS. The FAA and standards committees are just beginning to address the demand for Beyond-Line-of-Sight (BLOS) UAS operations.

Figure 9: RMAX Aerial Application UAS Preflight

Command and Control

ATC Integration

Air traffic control (ATC) integration for UAS is a multi-faceted challenge. Very small aircraft, flying below 500 feet altitude (very often less than 100 feet), that are only in the air for less than half an hour are not considered a major concern for most air traffic towers. However, for a crop duster operating at less than 500 feet that is actively scanning for new meteorological towers (met-towers) and power lines while making sure to only working specific fields, a small UAS with a camera that is capturing spectral imagery of a neighboring field is considered a serious air traffic threat. Meanwhile UAS operating along the northern and southern borders of the United States in support of Homeland Security Customs and Border Protection programs operate in Class A airspace following instrument flight rules (IFR) with complete communication capabilities for traffic alerting and transponders. To support ATC integration all, FAA approved UAS operations under the Certificate of Authorization program require the posting of a Notice to Airmen (NOTAM) two days before flying. The NOTAM does not restrict the airspace from other users; it is an awareness tool for pilots to be alert for UAS operations in a specified area.

Many companies and researchers are evaluating the UAS-to-ATC communication path as an opportunity for improvement and technology development. A growing number of UAS operations, increased use of UAS in complex airspace, and the potential emergence of single-operator-multiple-vehicle control architectures will drive the development of new ATC integration technologies and protocols. Deconfliction of airspace requires ATC awareness of aircraft operations, aircraft knowledge of position (via pilot or electronic device), and communication between the two for maintaining separation. Unmanned aircraft do not have the same level of autonomy as manned aircraft do today, but as command and control technologies improve and system-wide information management enables airspace participants to make more independent decisions that are shared throughout the system, UAS will integrate with ATC just as any other aircraft does.

Sense-and-avoid technologies, geo-fencing, highways-in-the-sky are technologies that are under development to support not only broader UAS integration, but increased capacity and safety for all modern aviation transportation system users. ADS-B, cellular based aircraft tracking, and the “internet of things in the sky” are concepts that may enable the concept of “free-flight” to fly direct from point-to-point, but they also enable the ability to structure airborne corridors allowing aircraft to self-sequence and self-separate with traditional ATC providing an overall system management function. As unmanned aircraft systems continue to mature, they will take advantage of these technologies to operate under the same rules of the sky and communication protocols that manned aircraft are required to follow.

Data links

Data links are the Achilles heel for UAS integration. Strong, powerful, secure data links enable UAS to perform more complicated tasks by sharing more information with the ground control station (GCS) and ATC regarding aircraft situational awareness. Higher performance data links also means that mission data captured on the aircraft can be shared safely and quickly during flight. Intermittent or unreliable data links require UAS communications architectures to focus on command and control to maintain safety of flight operations and protection of the airspace, which often means storing mission data onboard the aircraft and downloading after landing. Satellite based communications are expensive for small UAS. Cellular-network based UAS data links are being tested for both navigation data distribution and mission (imagery) data transport. Cellular networks have never been part of the FAA's certification programs, so there is concern about evaluating these resources to meet FAA standards and requirements.

Applications of UAS

Washington State UAS user profiles

There are two types of UAS users in Washington to address: public (i.e. government) agencies, and commercial operators. The authority by which each type of user is allowed to operate and the regulatory requirements on each type are different. Expectations on public agencies for communication transparency, economic efficiency, and data management influence decision making regarding establishment of a UAS program. Commercial users must meet FAA, state, and local regulations for operating UAS and using UAS-acquired data, while demonstrating a cost benefit for using the technology. Applications, user profiles, and a minimum scope of operations for near-term UAS operations in the state are provided below.

- Public Agency Uses:
  - Public safety/Law Enforcement—perform accident investigations, search missions, disaster response and support.
  - Surveying/mapping—flood plain mapping, imaging earthworks projects, DOT construction site management and safety
  - Infrastructure inspections—structural analysis of a buildings and bridges
  - Agriculture—crops monitoring, forestry management, aquatic grass and wildlife (fisheries) monitoring, herd and wildlife management, environment conservation
  - Utilities—power line inspections, treatment facility management
  - Research—public universities, K-12 schools
- Public Agency Profiles:
  - Public agencies will probably use one of two basic models to fulfill UAS operational needs (1) establishment of internal frequent use teams for high tempo operations; or (2) development of an internal capability with approved staff and access to aircraft, but necessarily a dedicated resource. These are explained further in Figure 10.

Frequent Use Teams

A UAS unit that would be active weekly

2 or 3 dedicated flights crews. Each crew has one pilot, two observers, and a data analyst.

Team owns equipment- aircraft, sensors, radios, mobile communications unit, transportation vehicle

On-demand Operations

Need for UAS capabilities just a couple times a year max.

Either maintains 1 flight crew that has other job responsibilities or maintains service agreements with commercial UAS service providers.

Internal team maintains a small UAS capability, leases equipment when needed, or contracts the services as needed.

Figure 10: Types of Public UAS Organization Structures

- Scope of Public Operations
  - Aircraft are operated under the FAA Public Agency Certificate of Authorization (COA) Process
  - Aircraft are operated as "public aircraft".
  - Crews are self-certified to meet a minimum credential, not necessarily an FAA issued private pilot's license.
  - Aircraft are self-certified as "airworthy".
  - Altitude limitations are based on the specific COA approval from the FAA.

- Commercial Operator Uses:
  - Surveyors
  - Engineering Firms
  - Film companies
  - Real Estate companies
  - Aerial photographers

This list will continue to grow as the technologies mature and the regulations are defined.

- Commercial UAS Operator Profiles:
  - Commercial UAS can most likely be categorized into one of the three types since in Figure 11.
  - Scope of Commercial Operations (as of August 2016)
    - Commercial operations are approved under 14 CFR Part 107
    - Operator must have a Remote Pilot Certificate
    - Aircraft is exempt from an airworthiness certificate, but must be inspected before every flight.
    - Line of Sight operations only.
    - Daylight operations only.
    - Blanket operations are approved 400’ AGL or within 400’ of a structure.

Small UAS Services Business (part-time)	Internal Business Team	Dedicated UAS Services Company
• 1 or 2 experienced, approved UAS operator(s) • Own a small number of aircraft with minimal or specialized capabilities • Contract services for hourly or daily imagery • May be a side job for the operator(s)	• Company has established a UAS unit inside an existing organization • A dedicated flight team(s) is established with pilot, observer, and data manager roles • Own a range of aircraft to meet corporate mission needs	• Company is constructed to offer contract UAS services to a range of clients • Operators are full time staff or contracted • Aircraft are owned • Services rates are formally published

Figure 11: Types of Commercial UAS Organization Structures

UAS Mission Descriptions for Washington State

Other than a limited number of research, homeland security, and commercial operations that are specifically approved by the FAA for Beyond Line of Sight, night operations, or altitudes higher than 500’ AGL, the large majority of domestic UAS operations will be small UAS (less than 55 lbs) operating under the bounds of the Small UAS Part 107 Rule for the near future. In Washington these flights will meet the objectives of public and commercial operators performing the applications described previously. Surveying, agriculture, environmental monitoring, infrastructure inspections, aerial photography, aeronautical research, and emergency response missions should include the elements described in Table 2:

Table 2: UAS Mission Planning Elements

UAS Mission Planning Process		
1	Identify Mission Type	Define the mission application (crop survey, surveying, mapping, building inspection, etc.) and selecting the UAS type to be used to execute the mission.
2	Define Desired Outcomes	Determine the deliverables (for example images or video) for the flight mission.
3	Define Operational Environment	Define the flight area perimeter, the Command Center with the Pilot in Command and observer(s), flight altitude, and any alert areas/structures within the flight box.
4	Review Capabilities and Resources	Review of operator credentials, aircraft inspection, FAA approval to operate, and any additional approvals necessary to operate (land owner permission, nearby airport acknowledgement).
5	Compose Flight Plan (Figure 12)	Describes how the UAS flies during the mission to accomplish the objectives. Includes (1) any limiting factors such as flight restricted area or obstacles; (2) contingency planning with safe routes in the event of a system failure, degraded performance, or lost communication link. Most UAS products offer ground control stations that can be used to develop flight plans, configure the UAS, plus monitor the UAS in flight using a telemetry link. Each flight plan is composed of a sequence of stages, such as take-off, departure procedure, mission area of interest procedures, and return-to-base, which must be followed and adhered to in the correct order.
6	Develop Security Plan	Announcement flight safety briefing, risk assessment, site manager authority.
7	Execute Data Management Plan	Formalized data capture, transfer, distribution management plan.
8	Publish Flight Schedule	Flight crew and equipment, daily and monthly schedules.

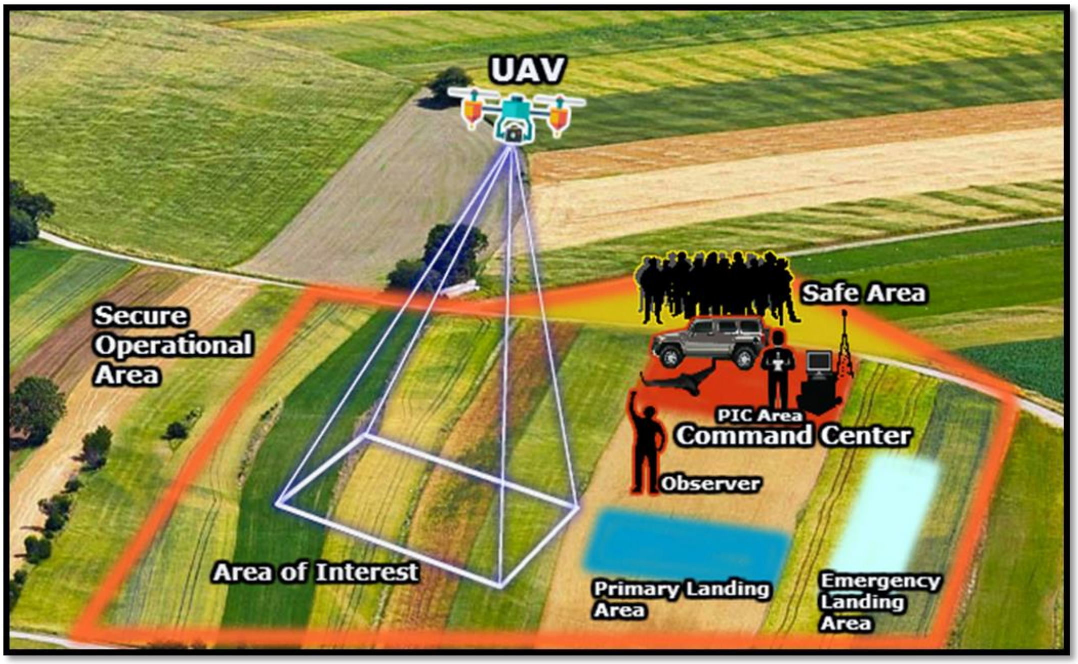


Figure 12: Notional UAS Mission Plan Description

An Aviation Rule Making committee is established and preparing recommendations for a broad UAS rule allowing for a wider range of operations and even more applications. The FAA will use lessons learned from the UAS Test Sites, results from the UAS Center of Excellence research, and the traditional regulatory development structures to prepare for the next phase of UAS integration with larger aircraft, operating Beyond Line of Sight, in a wider number of conditions.

Legislation/Policy

Review of Other States' Activities

The National Conference of State Legislatures maintains a comprehensive list of state UAS-related legislation. (NCSL, n.d.) As of the writing of this report (Jan 2016), 20 states have passed legislation related to UAS operations. Most of this legislation is related to protecting citizens' privacy through data management, establishing a UAS Task Force or Commission to develop a state strategy, or to prohibiting operations at state facilities such as around the state Capitol, correctional institutions, or recreational parks. Some specific examples are from the following states:

- Alabama—The Governor established an Alabama Drone Task Force that recommended the Alabama Department of Transportation be designated as the lead state agency on drones and that the task force stays intact to continue monitoring the issue. Their recommendation report was published in January 2015.
- Georgia—In December 2015 the Georgia House of Representatives UAS Study Committee published a report with 15 recommendations for addressing UAS economic development potential, safety, and other operational issues. Recommendations include forming a commission to develop policy and encourage UAS expansion in the state, prohibiting the installation of weapons on drones, keeping

drones from flying in or around certain public properties, making it unlawful for drones to interfere with public safety personnel, prohibiting the use of drones in hunting or fishing, and prohibiting drone operations within some yet-unspecified distance from a public road. The committee also recommended local governments be allowed to restrict drone use on their publicly owned land, and also calling for measures to ensure drones don't invade people's privacy, including requiring law enforcement agencies to get a search warrant before using a drone to collect evidence "in areas where someone has a reasonable expectation of privacy."

- Illinois—In November 2015 the Illinois General Assembly approved legislation establishing the Unmanned Aerial System Oversight Task Force. The task force is chartered to deliver a recommendations report to the governor and the state legislature by July 1, 2016.
- Michigan—Not a regulatory action, but the Michigan Economic Development Corporation provided a $250,000 grant to the Michigan Unmanned Aerial Systems Consortium to promote the growth of the UAS in the state in November of 2015.
- Minnesota—State law became effective in 2015 in Minnesota requiring all UAS to be registered with the Minnesota Department of Transportation Office of Aeronautics. This registration does not apply to recreational aircraft. The fee for registration is $100 for commercial operators.
- Rhode Island—In October 2015 The Special Legislative Commission to Study and Review Regulation of Drones and Unmanned Aerial Vehicles was established to recommend laws, rules, or regulations for operating UAS in the state to the state's House of Representatives.

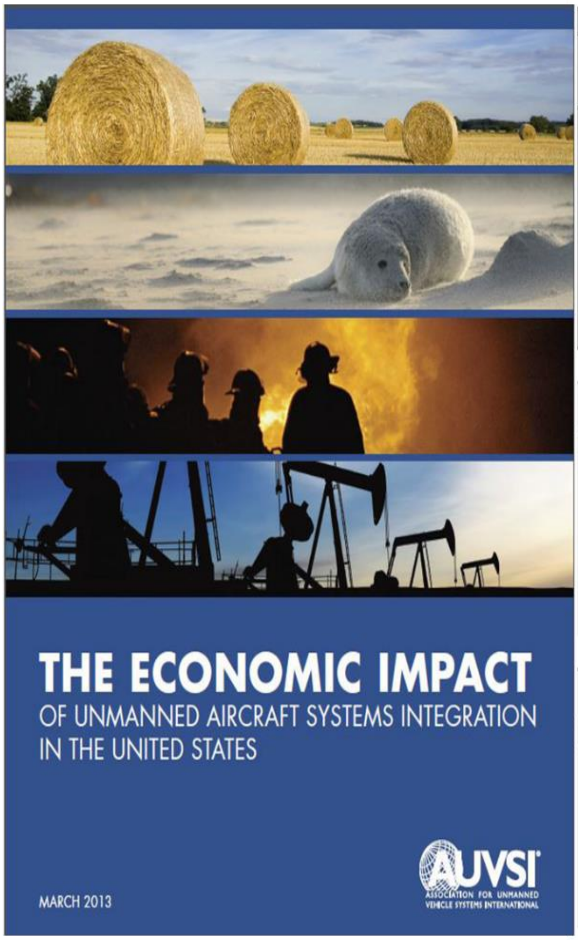
Cities are also developing UAS specific legislation to manage safety and impacts of the expanding operations. Miami, Chicago, and Deer Trail, Colorado have explored local level legislation to regulate operations of unmanned aircraft within city limits. Some cities have passed legislation, some are considering following the national and state level leadership for guidance, and some are choosing education campaigns or temporary methods to manage potential unwanted UAS activities. Tourist destinations are limiting operations by requiring city council/management approval before any operations are allowed by a specific operator. Other cities are banning operations in parks and other public areas. Some municipalities are temporarily restricting operations during large events, such as Pinehurst, North Carolina reminding the general public that no UAS, drone, remote-control aircraft operations were allowed within the village limits during the PGA major golf tournaments in 2015.

Although the FAA acknowledges in the State and Local Regulation Fact Sheet (FAA, 2015, p. 3) that state and local authorities may pass laws "traditionally related to state and local police power, including land use, zoning, privacy, trespass, and law enforcement operations," there are other areas that states should not encroach on federal authority. The FAA recommends state and local regulators to consult with the FAA when considering "operational UAS restrictions on flight altitudes, flight paths; operational bans, and regulation of the navigable airspace." They also suggest that "mandating equipment or training for UAS related to aviation safety such as geo-fencing would likely be preempted."

Projected Policy Needs for Washington State

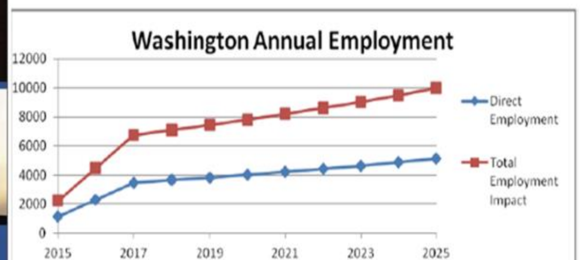
At this point, following the FAA's lead with the release of Part 107 will give the state time to watch how other states are performing under approved legislation, how industry is reacting to FAA and other states, and evaluate what is needed based on current activities by Section 333 Exemption approved operators in the state. As of the production of this report, there are approximately 50 Section 333 Exemption holders in the state of Washington (SUASnews, n.d.). The following policy/legislative recommendations are suggested to position Washington with a comprehensive, managed UAS integration strategy.

- A process for monitoring FAA approved operations in the state (333 holders and Part 107 certified pilots). This may be a registration program, a permitting program, or a simple notification mechanism, but it will provide data informing authorities of UAS activity in the state.
- Provide tools for supporting airspace integration such as local airport communications and agreements, positions of routine launch and recovery locations, preferred testing/training locations for new operators. These tools will support the safe integration of UAS by informing the local air and ground community.
- Establish a UAS Integration Commission. This commission should consist of members from Washington DOT, Department of Commerce, Department of Ecology, Department of Agriculture, State Patrol, Technology Solutions, and local universities. This commission should build on the research done by the UAS Working Group established in 2015. The commission should monitor national activities (regulations and policies, research, and commercial developments), internal state activities (industry growth, policy needs), related data privacy developments, security needs (state infrastructure and installations), and airspace safety performance.
- Develop a UAS Education Strategy. Public schools across the state, including community colleges, universities, and even K-12 institutions need guidance for developing UAS education and training programs. Green River College is currently developing a UAS operator training program (Thompson, 2015). University of Washington (Banse, 2015) (Aitchison, 2014) and Gonzaga University (Lindsay, 2015) are example schools developing UAS degrees and on-campus flight policies to manage how UAS are used in research and recreational activities.
- Develop an Economic Development Strategy. The Association for Unmanned Vehicle Systems International (AUVSI) published a report in 2013 predicting the rapid growth of the UAS industry once commercial UAS operations were legal in the United States. This growth correlated to economic growth in jobs and spending related to the proliferation of UAS companies, services, and applications nationwide. The predictions for Washington State are included in Figure 13. The state already has a Legislative Committee on Economic Development and International Relations that is studying the potential growth of the commercial space industry in the state to support local companies like Blue Origin, Spaceflight, Planetary Resources, and others. UAS companies, manufacturers, suppliers, and services providers, are looking for locations that are embracing the technology and encouraging the growth in their regions.



Washington Economic Impact

Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	1157	2249	$102.88	$218.61	$0.00	
2016	2314	4497	$205.76	$437.23	$0.00	100%
2017	3470	6746	$308.63	$655.84	$0.00	50%
2018	3644	7083	$324.06	$688.64	$0.00	5%
2019	3826	7438	$340.27	$723.07	$0.00	5%
2020	4017	7809	$357.28	$759.22	$0.00	5%
2021	4218	8200	$375.14	$797.18	$0.00	5%
2022	4429	8610	$393.90	$837.04	$0.00	5%
2023	4651	9040	$413.60	$878.89	$0.00	5%
2024	4883	9492	$434.28	$922.84	$0.00	5%
2025	5127	9967	$455.99	$968.98	$0.00	5%



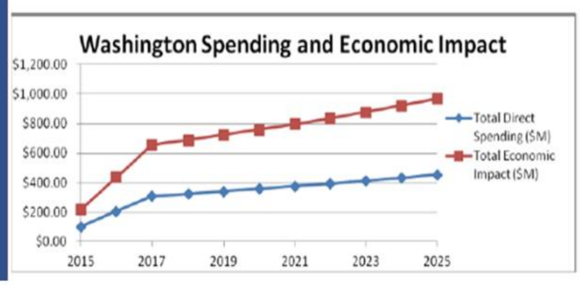


Figure 13: AUVSI UAS Economic Impact in Washington Analysis

Public Perception and Engagement Strategies

Public perception and engagement is absolutely critical to successfully establishing a UAS program in a government organization. Public agency UAS programs must be built on principles of transparency, regular communications, and commitments to protecting personally identifiable information (PII).

The Seattle Police Department UAS Program failure to launch in 2012 means that Washington has a steep climb to gaining public trust and confidence. (Times, Police apologize for not keeping council in loop on new drones, n.d.) (Times, Seattle grounds police drone program, n.d.) Public understanding of UAS capabilities, policies, applications, and intentions continue to evolve. Governments and advocacy groups are publishing guidelines and standard procedures that have been publicly reviewed and adopted by other organizations. Thorough planning and preparation are essential for any organization beginning UAS operations.

Six suggested Communications Best Practices to support UAS integration are included below.

- **Public outreach**—Airports looking to introduce UAS into their operations will be well served by actively reaching out to their local communities. The purpose of the outreach should be to educate the public on the aircraft to be flown, the types of activities the UAS will perform, and the risk mitigations implemented to ensure public safety. (Neubauer, 2015, p. 21)
- **Building and maintaining community support for UAS** operations is a continuous process that goes beyond simply giving the public notice of upcoming operations. The community needs to be informed about the organizations that will be conducting the operations, how the flight activities could impact them, and then given the opportunity to ask questions and express any concerns. A list of topics the airport and UAS operator might present to the public is as follows:
  - Define a UAS
    - Explain the history of UAS operations
    - Describe the different types of UAS
  - Who is doing the flying
    - Overview and history of the organization
    - Safety record and risk management processes
    - Examples of past missions and their results
  - The aircraft and the missions
    - Types of UAS
    - Sensors on board UAS
    - Purpose of the flights
    - Flight routes and restrictions
  - Benefits to the community
    - Economic benefits
    - Safety benefits
    - Environmental benefits
  - Status of regulations
    - Current regulations
    - Proposed regulations
  - The Future of UAS
    - Companies involved in the UAS industry, especially local
    - Future applications of UAS

The topics are best presented by a chosen UAS operator or by persons experienced in the type of UAS operations to be conducted in order to provide the public with the most accurate information and to completely answer any questions the audience might pose. (Neubauer, 2015, pp. 22-23)

- **Develop a Communications Plan** for those that handle related external communications inside the agency. This plan should be finalized and ready for distribution well before the agency is prepared to take on its first operational mission. The agency should keep the public informed about the changes that would significantly affect privacy, civil rights, or civil liberties. Information will be provided via the public request process.
- **Provide an Annual UAS Program Summary Report** to the public that summarizes UAS operations during the fiscal year, to include a brief description of types or categories of missions flown, the safety standards maintained and the value provided by using UAS.
- **Identify a Public Liaison Officer (PLO)** who should be available via email or phone to answer any concerns or questions the people have regarding UAVs.
- **Create an Oversite Committee** for safety and protection of people and property, both on ground and in the air. The Oversite Committee, which includes at a minimum the Agency PLO, state DOT representative, UAS Industry representative, Law Enforcement and local government representation, should ensure that the agency is maintaining high safety standards. The committee should meet quarterly and should be briefed by the PLO on the progress. The agency should let the committee know if any changes or additions will be made to the proposed program and get the necessary approvals. The committee should review the annual summary report to assess the efficiency and success of the program.

Future Implications

Unmanned Air Cargo

There are many organizations considering unmanned aircraft for cargo delivery. The military has tested and proven the value of using a full-sized helicopter, the K-MAX (Figure 14), for autonomous cargo delivery. There is potential transition of this technology in fire-fighting and other large scale operations. But current corporate analysts are evaluating the business case for routine small UAS package delivery systems, while some companies are already developing and testing potential solutions. Companies like Amazon and Google are working closely with NASA and the FAA to develop not only the aircraft to provide package delivery, but also the rest of the aviation infrastructure necessary to support routine small UAS operations in urban, congested, low altitude airspace.

Three primary principles will shape UAS Cargo adoption in the NAS:

- **Autonomous operations are fundamental for routine BLOS operations.** Multiple aircraft being managed from a single, remote control station is fundamental to the concept of a distributed network of UAS picking up and delivering packages, providing public safety agencies with real-time video during emergency response calls, or supplying on demand aerial traffic and news monitoring feeds.

- **Definition of a warehouse will determine cost benefit**. For autonomous package delivery to become cost effective, the definition of warehouse or cargo source may be variable. Whether it is a traditional post office, a large discount market store, a distribution only warehouse, or it is a tractor trailer stocked with temporarily high-demand consumer products- determining the location for basing these operations, coordinating them as UAS launch and recovery sites (aka "droneports") with federal and local authorities, and developing airspace integration plans (approach and departure routes) for each one will be challenging.

Figure 14: KMAX Cargo UAS in Action

- **Ownership of cargo UAS may follow the cellphone adoption curve** as individual-ability to retrieve and transport cargo becomes feasible. Whether that is launching a personal aircraft to pick up medicine at a pharmacy or sending it home from the field to retrieve forgotten sports gear, when the infrastructure is in place and the technology is mature enough, the benefits of ownership will create the market.

Unmanned Commercial Air Service

The general consensus within the UAS community is that commercial passenger transportation will not transition to a pilotless cockpit any time soon. The pilot may become the co-pilot to the autopilot, fulfilling the role of system manager, but a human will remain in the cockpit for a multiple reasons.

Commercial cargo services, however, have received significant research and business case analysis for assessing the potential value of unmanned operations. Especially long-haul flights across the Atlantic and Pacific Oceans, autonomous commercial cargo operations are considered economically practical.

Both of these concepts are natural extensions of current capabilities in commercial airlines and large DOD unmanned aircraft programs. Autonomous takeoff, navigation, and landing has been performed thousands of times with large aircraft. Integration into commercial airport terminal operations and contingency management are the primary areas for research into technology and procedure development.

Unmanned Local Passenger Transport (Aerial commuting)

As autopilots and vehicle management systems continue to advance and the NextGen system matures, the line between manned and unmanned aircraft will begin to blur. Personal Aircraft Systems that are highly efficient, semi-autonomous air taxi services will operate as large UAS carrying commuters as cargo with pilots that are more "system managers" than aviators. An FAA Aviation Rulemaking Committee committed to developing recommendations for large UAS integration is established and preparing a report for the FAA. The expected release date for that report is not yet determined. In January 2016 the Chinese Company eHang announced the development of an autonomous personal transport vehicle the eHang184 (Figure 15). In August of 2016 the Airbus innovation group in Silicon Valley announced Project Vahana as an autonomous airborne personal transportation system research project evaluating aircraft and airspace structure concepts (SUASnews, n.d.). Much like the introduction of the consumer-targeted small multi-copter in 2013, the physical production of functional aircraft has a way of impacting reality.

Anticipated Impacts on Washington Air Transportation System

Impacts on Airports

As reflected in the ACRP UAS Primer Report (Neubauer, 2015), there are two overarching considerations that stakeholders would be well served by addressing when developing an airport's UAS vision. First, airports should consider the types of UAS that can be expected and the number of operations anticipated. Most small UAS operations do not require an airport and are expected to stay at least 5 miles away from airports. So if an airport is intentionally attracting UAS business and activity, a detailed description may need to be in the airport strategic plan. Second, airports should determine the facilities necessary and currently available for UAS activities, including a communications infrastructure. A vision for UAS operations could be integrated into the master plan, or an airport strategic plan or financial plan if those are more applicable vehicles, and take into consideration tasks needed for UAS development and provide a roadmap for this change in airport operations.

Figure 15: eHang184 Concept Vehicle

The most likely airport interaction situation is that UAS will co-exist with manned aircraft on the airport, on runways and taxiways, and in the airspace to the extent the FAA determines an acceptable level of safety is provided. Operations near the airport (within 5 miles) will require ATC approval.

Operations

Airports may benefit by making sure the rates for services and facilities paid by UAS operators are comparable to those paid by the manned aircraft community in order to avoid conflicts and ensure operational cooperation.

It is commonly accepted that large UAS operations require more support than manned aircraft from the ground, and perhaps in the air, because of the necessary communications and control protocols. This trend is worth tracking to assess planning and impact strategies.

Understanding and communicating any restrictions placed on manned aircraft operations to the tenants based at the airport, and to known transient users, will be important for airport operators. This will allow airport tenants and known transient aircraft pilots to adjust schedules and flight plans accordingly.

Infrastructure

As the airport makes preparations for recruiting UAS, taking inventory of available facilities that potentially meet UAS operator needs is an important early step. The goal of the inventory is to help ensure an airport does not turn UAS operations into a negative revenue situation.

The considerations for infrastructure requirements should start with some basic questions from the airport to the UAS operator: (Neubauer, 2015, pp. 20-21)

- Does the UAS need a runway for takeoff, landing, or both? If so, what runway length and width is required?
- Can the UAS taxi to/from the runway and follow ATC commands and other voice commands?
- Does the UAS company need hangar space when not flying?
- Does the UAS company need ramp space prior to or after flight?
- What sort of control station is required (truck, trailer, office space, etc.)?
- Does the UAS need launch and recovery space (in lieu of a runway)? If so, how close to the airport does this space need to be?
- What sort of communications infrastructure is needed? Does the UAS operator need special towers of antennas in order to ensure communications are established and maintained with the UAS?
- Will the communication frequencies needed create conflicts? Will they interfere with existing frequencies used by airport staff, the FAA, tenants, airlines, fixed base operators, or others?
- Will the UAS need special emergency standby equipment? Is it available at the airport or does it need to be brought in from an outside source? As an example, a large general aviation airport might need to bring in a local fire department truck to standby for UAS operations as a matter of protocol.

"Long-range planning for land use and UAS is a slightly different matter. Airport operators are encouraged to take a master planning approach in creating a vision for future UAS operations. Land-use planning is an important aspect of this approach. Long-range planning about where permanent ground based control stations might be located, as well as where to place storage and maintenance facilities that may require airfield access might be prudent approaches for those airports looking to attract UAS operators.

For those airports that receive FAA grant funds, it will be important for the airport management to ensure there are no land-use issues that violate the grant assurances. Airport operators are encouraged to have a discussion with their FAA Airport District Office (ADO) prior to executing agreements with UAS operators for airport facilities or property. The property itself might be encumbered in such a way that UAS use might not be permitted. This is highly unlikely, however, given that the FAA and the NTSB have determined that UAS are aircraft. Moreover, local zoning laws and local restrictions might prohibit such activity. It will be up to the airport management to investigate and ensure UAS operations do not violate any restrictions. Land-use issues are listed on the UAS checklist in Appendix C for reference." (Neubauer, 2015, pp. 32-33)

Impacts on Washington Airspace

Any increase in UAS operations directly increases the utilization of Washington airspace. Class G airspace in suburban and rural areas with low population densities will have most of the early UAS-proliferation integration. Flight operations over large groups of non-participating people are banned for public COA operations, commercial 333 exemption operations, and Part 107 operations. The FAA is expected to a release an NPRM for small UAS flights over people, aka "the Micro UAS Rule," in December of 2016. Line-of-sight restrictions will keep small UAS flying under VFR conditions, even though they will be operating as IFR flight plans. Commercial and business aviation should anticipate minimal UAS interaction from **approved**-UAS operations while the small UAS Rule (Part 107) is the primary managing regulation keeping aircraft small, operating at low altitudes, and relatively small areas. Once a method for BLOS, highly autonomous operations is established, then altitudes higher than 500' AGL and more urban operations can be expected because technology for sense-and-avoid, obstacle detection, traffic alerting, and dynamic flight planning will have matured and been certified by the FAA. When that happens we can expect to see established UAS terminal facilities, flight routes and fixes published on aviation charts.

While the transition to a UAS integrated airspace, NextGen technology roll-out (ERAM, SWIM, ADS-B, etc.), and related regulations are evolving, airspace users need to maintain superior vigilance and communications within the community. Rogue UAS operations are to be reported to local law enforcement and/or directly to the FAA. Responsible UAS operators should be posting NOTAMs to make the airspace community aware of planned activity. Information sessions to either share goals for planned UAS operations or reach out to burgeoning UAS services groups will help protect the integrity of the airspace. As the FAA approaches 3,000 approved Section 333 Exemptions to provide civilian UAS services, the future of the air transportation system where UAS outnumber manned aircraft at least two to one is not unrealistic. The FAA's NextGen program was launched to increase the capacity of the NAS. UAS already require that increased capacity, even if it utilization of low altitude airspace that has historically had low use.

Impacts off Airports

The broad approval of small UAS operations means aviation becomes more local. Whether it is a once-per-project operation to scan a new construction site before breaking ground, or the establishment of UAS-package delivery service corridor that runs around the perimeter of a small suburban community, UAS are breaking the traditional tie between aircraft and airports for performing airborne operations. Airspace is a global resource that exists everywhere. UAS can provide value to a homeowner flying three feet over his roof to do an inspection or 50 feet over his property to survey his yard in planning a garden or grass treatment program in the spring. Another service provider may offer an in-town courier service to retrieve and deliver high priority packages, while using a subscription-based protocol for launching and landing at previously surveyed drone pads that are on building tops, driveways, or other defined areas. UAS are offering new ways to use the natural resource of accessible airspace in a much more dynamic, multi-purpose, adaptive capacity that has ever been available since the dawn of powered flight in 1903.

Access to the airspace is a regulated privilege that is becoming accessible by the general population, but it is still restricted to those that follow the rules. Just as cars that are unregistered (no license plate) and drivers that are uninsured and unlicensed are not legally allowed to operate within the national ground transportation roadway and highway system, the same principles apply to the aviation system. Infrastructure is under development that will enable UAS (and all aircraft for that matter) connectivity and tracking at all times. Aircraft launch and recovery launches will grow as UAS and new manned aircraft, such as the Terrafugia Transition, used fixed and temporary locations, which may be airports, streets, rooftops, or even a front yard, for terminal procedures. As demand for UAS to carry bigger payloads (cargo or imaging systems), the aircraft size will increase, which will correlate to an increased use of existing airports or increased development of new launch and recovery pads. In addition to the expanded physical infrastructure, the digital infrastructure to support GPS-defined 4-dimensional aerial pathways, aircraft-to-aircraft, aircraft-to-ATC, aircraft-to-ground communications will mature creating a digitized sky. The ability to track all aircraft in the air or on the ground while providing new services via access to the airspace using UAS will make aviation a routine, local experience that does not require a visit to a local airport.

Public Policy

Washington State Government UAS Management

Licensing, permitting, and registration programs

Many states are evaluating or activating UAS permitting or registration programs to provide a holistic management structure within the state regulatory authority. Some of these actions are intended to demonstrate foresight and leadership at the local level while the FAA wrestles with a national strategy and regulatory structure. Although the state registration programs cannot supersede or replace FAA requirements, they provide possible revenue and information sources at the local level. Two examples of states with registration and permitting programs are Minnesota and North Carolina.

- **Minnesota's approach:** Under Minnesota state law, Unmanned Aerial Systems (UAS) or drones, are required to be registered with MnDOT Office of Aeronautics. State Registration is not required for unmanned aircraft operated solely for recreational use. Commercial operators are required to obtain a licensed from MnDOT before they advertise, represent, or hold themselves out as giving or offering to provide UAS services. (MNDOT, n.d.)
- **North Carolina's approach:** The North Carolina General Assembly passed legislation in 2014 requiring UAS operators to pass a Knowledge Test in order to obtain a UAS permit to operate within the state. This Knowledge Test is designed to ensure safety of operations and safety of those in the operating area, in addition to providing evidence of understanding related laws such data privacy and the requirement for permission to take-off and recover UAS on public and private property. (NC GS § 63-95) The UAS Permit is required for commercial and public operators and is issued by the North Carolina Department of Transportation Division of Aviation. (NC GS § 63-96)In December 2015 the FAA began the mandatory UAS registration program for all aircraft weighing less than 55 pounds and more than 0.55 pounds (250 grams) on takeoff. Failure to register may result in a direct fine

from the FAA. Although initial registration process was just for hobbyists, the registration requirement applied to all aircraft as commercial and publicly operated UAS were required to follow the traditional N-number registration process until the streamlined process for small UAS was released in May of 2016. Any state level registration regulations are in-addition to these federally posted requirements. (NCDOT, n.d.)

Enforcement

In December of 2015 the FAA issued a press release titled "Law Enforcement Guidance for Suspected Unauthorized UAS Operations." (FAA, 2015) The FAA uses this guidance document to recognize that "state and local Law Enforcement Agencies (LEA) are often in the best position to deter, detect, immediately investigate, and pursue enforcement actions to stop unauthorized or unsafe UAS operations." The FAA is actively working with LEAs to provide up-to-date information on regulations, activities, and developments related to UAS integration into the NAS. In addition to framing the FAA's authority to regulate UAS operation, including model aircraft, the guidance document also outlines six functions for local LEAs to assist the agency regarding UAS flights.

- Witness Identification and Interviews
- Identification of Operators
- Viewing and Recording the Location of a Reported Event
- Identifying Sensitive Locations, Events, or Activities
- Notification to the FAA Regional Operation Center
- Evidence Collection

Given the growing interest in UAS and still widely held civic safety and privacy concerns, one opinion is that the public will become the enforcers of the regulations. As more and more UAS fly, and the flying increases in frequency in populated areas, it is possible that people may become concerned with the activity and call police or the local airport to report the UAS operations they see.

Airport managers and operators can be a positive force in ensuring safe UAS operations by staying abreast of the rulemaking process and UAS related stories. The FAA regularly posts news releases relating to the status of UAS regulation on the FAA website, and news on advancing UAS technologies can be found on the Internet. Airport operators should be ready to respond to questions and concerns from the public about unmanned aircraft.

Washington State Public Safety, including state and local officers, may consider developing policies for collaborating with FAA for UAS regulatory enforcement, while also working with the state Department of Justice to determine state-level UAS law enforcement protocols. The FAA's experience with enforcement has included "stop and talk" interviews for awareness, formal warning letters, and fines, preferring not to use methods that require court orders or potential use of force by law enforcement personnel.

Managing public agency operations

Public agencies in Washington may benefit from the access to information about UAS capabilities just as commercial organizations do. Low cost, on demand, frequent capture of aerial imagery is valuable for making many decisions. Public agencies may want to consider development of policies to manage their wide range of operations. A possible list of baseline policies includes the following:

- Data Management, Including Handling Personally Identifiable Information, Policy
- Contract UAS Services vs Building Internal Capabilities Policy
- Platform Selection Policy
- Crew Selection Policy
- Manned or Unmanned Operations Selection Policy
- Access to Land Policy
- Training Policy
- Reporting/auditing
- Procurement Policy

Washington State Policy Considerations

The following considerations are influencing the proliferation of UAS and should be considered by regulatory agencies involved in UAS policy development.

- UAS service companies are not supportive of having to be licensed/permitted everywhere. Lawyers, construction firms, mortgage brokers understand the value of local and federal regulations for protecting their trade and meeting the expectations of the local community.
- Infrastructure to establish a licensing/permitting program could be a significant undertaking. Tying it to the evolving FAA program is complicated as cross referencing to a COA, Remote Pilot Certificate list, or National Drivers' License database could be involved.
- What is the intent of a permitting program? There is debate on the value of state level legislation versus implementation of an extensive education campaign. Responsible companies and government agencies are not the threat to safety and data misuse. The rogue, uninformed, over-confident operators are the threat to the system and there is not clear data that additional regulation reduces those activities.
- Corporate programs versus operator-based programs will rise. Warehouses offering routine package distribution via UAS will increase noise, airspace congestion, and potentially use other modern infrastructure (cellular networks for instance). These kinds of operations, in addition to small, discreet operations that are becoming more frequent today, present opportunities for creative revenue streams for governments committed to protecting citizens and capitalizing on local resources.

- Cargo/package delivery is considered cost beneficial to companies that have large volumes of delivery. These business cases and others that are demonstrating financial and public value, such as increased situational awareness in a 911-response call scenario, are driving the accelerated adoption of UAS in the NAS and the related-technology advancements necessary to increase performance, reliability, and capabilities.
- Driverless cars with autopilots, small aircraft with advanced autopilots and avionics, increased access to global communication structures and bandwidth- these trends are opening new transportation capabilities around the planet. UAS will benefit and contribute to this new age of connected, intelligent transportation.

Protecting the Public through Aviation Safety

Aviation safety is the primary responsibility of the FAA. That responsibility includes the management and deconfliction of the airspace, as well as the protection of the safety of the ground and public below the airspace. As the December 2015 guidance document for state law enforcement agencies states, “The FAA has promulgated regulations that apply to the operation of all aircraft, whether manned or unmanned, and irrespective of the altitude at which the aircraft is operating.” The emergence of UAS as disruption to traditional aviation is forcing FAA and other legal authorities to review the definitions of aviation concepts such as “aircraft”, “navigable airspace,” airspace sovereignty, aerial curtilage, airworthiness, and “sense and avoid.” The FAA is working with federal, state, and local law enforcement agencies to understand the federal legal position to support nationwide enforcement of UAS and other aviation regulations to protect the safety and integrity of the aviation transportation system.

The FAA has increased the communications and outreach activities of the agency to share the progress in the development of a broad small UAS rule (Part 107) as the agency transitions away from the exemptions and waivers programs of COAs and the Section 333 exemptions. The state should enable these communications between state LEAs and the FAA, but should also provide mechanisms for local aviation stakeholders to interact with the emerging UAS community, local LEAs, and state authorities to develop Washington-specific programs for ensuring airspace safety. Education and communication are just influential in the dynamic UAS landscape as regulations and enforcement are. Building a user community and general public that are informed about the complexity of the air transportation system, the current regulations, and the proper methods for utilizing airspace is as big a challenge as developing new technologies for capitalizing on the resource.

UAS are expected to perform in the NAS at an equivalent level of safety or better than manned aircraft. This means that UAS must sense-and-avoid potential conflicts on the ground during taxi and in the air during flight operations. Published flight plans, or at least defined pathways in the sky, are under consideration and development as a method for managing large numbers of UAS in routine operations. These flight corridors may be predetermined (FAA or local agency defined) or submitted in a traditional “file-and-fly” structure in the future. As the protocols mature, the flight plans will maximize efficiency of flight operations, while considering flight contingencies, ground factors such as obstacles, populations, and radio interference, and regulatory constraints. UAS will not be allowed for routine operations in the

NAS if either the risk to other airspace users or the public on the ground is too high or regularly jeopardized.

To address these concerns, Washington should consider getting involved in standards committees and support research initiatives addressing the challenges. The concerns regarding UAS risks and noise flying over populated areas, the role of local enforcement engaging the public on federal aviation law, the need for UAS operators to report all planned flight activity are all valid; data is needed to determine the proper direction for removing these concerns. There are many active research efforts related to these concerns the FAA through the ASSURE UAS Center of Excellence, the Transportation Research Board (TRB) through Airport Cooperative Research Program (ACRP) projects, DOD through SBIRs and other initiatives. To take a leadership role and shape these decisions, policy and technology assessment and development research is necessary.

Airport staff need training related to UAS integration. "In addition to the physical differences of the aircraft and facilities, airport personnel should also be made aware of any communication requirements for UAS. Airport personnel should understand any potential impacts to locally used radio frequencies, microwave links, or other communication systems. Understanding these impacts will support the safety of the UAS operation, the performance of the air transportation system, and the protection of the ground and public beneath the operations." (Neubauer, 2015, p. 40)

Although some accidents are truly accidents and unavoidable, establishing rules and standards to minimize accidents is a high priority for public and commercial UAS stakeholders. The Pier 57 Great Wheel tourist venue in Seattle was recently visited by a small UAS that lost control and crashed into the empty outdoor patio on November 11, 2015 (Times, Drone hits Seattle's huge Ferris wheel; SPD investigating, n.d.). This is a densely populated area with many flight planning challenges where no hobbyist or commercial UAS operator should have been flying an aircraft. Finding the balance of laws, technologies, and education to reduce the risk of dangerous, undesired, illegal activities is challenge facing the entire UAS community for the present and future.

Summary

Infrastructure Impacts

The initial impact of small UAS for commercial and public operations on the Washington Aviation System is expected to be minimal. Most small UAS operations are restricted to less than 400' AGL for an operating altitude via the FAA regulations. All of these operations are limited to line-of-sight operations only and for aircraft less than 55 lbs. (most less than 15 lbs); that distance is usually less than one mile range. These operations will either use existing resources, including cellular networks, Unicom stations, and the NOTAM system for announcing operations, or they will bring the additional resources necessary for operations and also approved by the FAA.

Beyond small UAS, line-of-sight operations, the Washington transportation infrastructure can expect continued increased demands on communications and connectivity networks, especially with more UAS requiring communications for control and [mission] data transfer. The development of autonomous package delivery UAS systems will be required to integrate into the existing aviation structure, but may require additional resources for registering aircraft, takeoff and recovery locations, and fixed flight paths. The GPS-based navigation and tracking protocol that is the backbone to the FAA's NextGen program is designed to support the digitally-native UAS communication needs. More connectivity and communications between aircraft (manned or unmanned) supports better decision-making throughout the aviation transportation system, so NextGen advancements are beneficial and critical to modernizing aviation.

General Aviation Airports Impact

Near term growth of small UAS should have minimal impact on the network of airports in Washington. Most commercial small UAS operations use aircraft weighing less than 15 lbs. at takeoff and can only fly within five miles of an airport with prior approval from the local air traffic control facility (or airport manager). As UAS integration increases, coordination with airports will provide the preferred path to the manned aviation community to support communications regarding the increased number of UAS activities in a local area.

GA airports can also explore potential opportunities for growth as larger UAS integrate or UAS companies look to move into aviation industrial parks attached to airports for connecting to the local aviation community. Airport operators who have been or are now actively receiving grant funds, AIP grant funds in particular, should treat a new UAS operator as they would any new operator or tenant. (Neubauer, 2015, p. 30)

Other recommendations for General Aviation Airports to consider in preparation for UAS integration are seen in Table 3 from the ACRP UAS Primer.

Table 3: Airport Recommendations for UAS Integration (Neubauer, 2015)

Airport Action	Benefits to the Airport
Engage with a UAS National Test Site	Test sites have available segregated airspace; COAs in place; potential research requirements for airports.
Engage with Area Universities	Multiple universities offer UAS related courses; multiple universities conduct UAS research; universities are partnered with national UAS test sites and Center of Excellence proposal teams.
Contact State Government	Departments of Aviation; Commerce, Agriculture and Forestry; Mines, Minerals, and Energy; state police may be potential advocates for UAS business at airports.
Attend UAS Conferences and Seminars	Conferences and seminars on aspects of the UAS industry are conducted regularly to network and become informed on upcoming technologies.
Investigate Complementary UAS Businesses	Research UAS businesses that could be supported by the airport or by the local economy.
Determine UAS Facility/Infrastructure Requirements	Inventory airport facilities and infrastructure that could be used by UAS operators for marketing purposes.
Contact the FAA	FAA Office of Airports (ARP) and FAA UAS Integration Office (AFS-80) can inform and offer direction to interested airports.

Legislative Analysis

Based on current FAA policies and a survey of other state legislative activities regarding UAS integration, the following five recommendations are provided for Washington.

- Construct a process for monitoring FAA approved operations in the state (333 holders and Part 107 certified operators).
- Provide tools for supporting airspace integration such as local airport communications and agreements, positions of routine launch and recovery locations, preferred testing/training locations for new operators.
- Establish a UAS Integration Commission.
- Develop a UAS Education Strategy.
- Develop an Economic Development Strategy.

Preparation Strategies

The following recommendations are general guidance supporting the communication strategy of "Educate over legislate" to support the growth of UAS in Washington, while preparing for a sensible regulatory structure.

- Follow FAA leadership and guidance on UAS adoption.
- Encourage routine communication between the emerging UAS operations community and existing aviation system community.
- Legislate specifics to protect WA citizens and critical infrastructure.
- Require state registration of UAS service providers that intend to operate in the state.
- Educate on proper use, approved (federal and state) legislation, local training resources, and available information sources (WSDOT UAS Fact Sheet)

The mischievous, criminal, intentionally uninformed cannot be stopped by more legislation. More public awareness of proper use and enforcement/reporting mechanisms is an effective deterrent.

Future Expectations

UAS are entering more airspace nationwide on a daily basis. The transition to remotely operated aircraft is the natural evolution of aviation technology. From Wright Brothers' performed wing-warping, to manual controls, to hydraulic assist, to fly-by-wire, to fly-by-satellite, unmanned aircraft provide another method for man to experience flight. UAS are not the discovery of something new, but rather the next step in human ingenuity improving a technology to do more. States should strive to embrace the dynamic nature of the industry with minimal laws and restrictions while still protecting citizen rights and safety and encouraging innovation or many of the economic benefits may go somewhere else.

All of aviation is changing over the next 10-15 years as the airspace environment becomes a digitized 3-D world. UAS will be a piece of the Intelligent Transportation System that connects and reports participants, non-participants, infrastructure, and system status.

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Appendix A: Recommendations from WSDOT UAS Working Group

These recommendations came from the UAS Working Group meeting in October 2015.

1. Larger UAS should operate with the same requirements as manned aircraft.
2. As related to off-airport UAS activity (such as amazon prime air or Domino's pizza) government should know where commercial launch and recovery (VTOL) pads are located.
3. Government should establish policy for zones where UAS activity should be prohibited or regulated. Factors such as safety, noise, privacy, and inappropriate use (e.g. commercial activities) should be considered, and areas such as schools, public events, hospitals and assisted living facilities, certain residential zones, etc., should be considered and addressed.
4. Until technology enables co-use of airspace, UAS should be prohibited from operating in Hub airport airspace.
5. Unmanned activity at non-towered airports should require an operator to communicate with manned aircraft on the CTAF/UNICOM.
6. WSDOT should facilitate a process for establishing GeoFencing, and support the development/implementation of a universal standard.
7. WSDOT should assist in the development of documentation to address new infrastructure requirements to support UAS (e.g. power, hazardous materials disposal [batteries], etc.)
8. WSDOT should support and facilitate the development/clarification/promulgation of procedures for close-proximity manned (crop duster) and unmanned aviation agriculture operations.

Appendix B: FAA Overview of Small UAS Rule, Part 107

Table 1: Summary of the Major Provisions of part 107

Operational Limitations	• Unmanned aircraft must weigh less than 55 lbs. (25 kg). • Visual line-of-sight (VLOS) only; the unmanned aircraft must remain within VLOS of the remote pilot in command and the person manipulating the flight controls of the small UAS. Alternatively, the unmanned aircraft must remain within VLOS of the visual observer. • At all times the small unmanned aircraft must remain close enough to the remote pilot in command and the person manipulating the flight controls of the small UAS for those people to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses. • Small unmanned aircraft may not operate over any persons not directly participating in the operation, not under a covered structure, and not inside a covered stationary vehicle. • Daylight-only operations, or civil twilight (30 minutes before official sunrise to 30 minutes after official sunset, local time) with appropriate anti-collision lighting. • Must yield right of way to other aircraft. • May use visual observer (VO) but not required. • First-person view camera cannot satisfy "see-and-avoid" requirement but can be used as long as requirement is satisfied in other ways. • Maximum groundspeed of 100 mph (87 knots). • Maximum altitude of 400 feet above ground level (AGL) or, if higher than 400 feet AGL, remain within 400 feet of a structure. • Minimum weather visibility of 3 miles from control station. • Operations in Class B, C, D and E airspace are allowed with the required ATC permission. • Operations in Class G airspace are allowed without ATC permission. • No person may act as a remote pilot in command or VO for more than one unmanned aircraft operation at one time. • No operations from a moving aircraft. • No operations from a moving vehicle unless the operation is over a sparsely populated area. • No careless or reckless operations. • No carriage of hazardous materials. • Requires preflight inspection by the remote pilot in command. • A person may not operate a small unmanned aircraft if he or she knows or has reason to know of any physical or mental condition that would interfere with the safe operation of a small UAS.

	• Foreign-registered small unmanned aircraft are allowed to operate under part 107 if they satisfy the requirements of part 375. • External load operations are allowed if the object being carried by the unmanned aircraft is securely attached and does not adversely affect the flight characteristics or controllability of the aircraft. • Transportation of property for compensation or hire allowed provided that- o The aircraft, including its attached systems, payload and cargo weigh less than 55 pounds total; o The flight is conducted within visual line of sight and not from a moving vehicle or aircraft; and o The flight occurs wholly within the bounds of a State and does not involve transport between (1) Hawaii and another place in Hawaii through airspace outside Hawaii; (2) the District of Columbia and another place in the District of Columbia; or (3) a territory or possession of the United States and another place in the same territory or possession. • Most of the restrictions discussed above are waivable if the applicant demonstrates that his or her operation can safely be conducted under the terms of a certificate of waiver.
Remote Pilot in Command Certification and Responsibilities	• Establishes a remote pilot in command position. • A person operating a small UAS must either hold a remote pilot airman certificate with a small UAS rating or be under the direct supervision of a person who does hold a remote pilot certificate (remote pilot in command). • To qualify for a remote pilot certificate, a person must: o Demonstrate aeronautical knowledge by either: · Passing an initial aeronautical knowledge test at an FAA-approved knowledge testing center; or · Hold a part 61 pilot certificate other than student pilot, complete a flight review within the previous 24 months, and complete a small UAS online training course provided by the FAA. o Be vetted by the Transportation Security Administration. o Be at least 16 years old. • Part 61 pilot certificate holders may obtain a temporary remote pilot certificate immediately upon submission of their application for a permanent certificate. Other applicants will obtain a temporary remote pilot certificate upon successful

	completion of TSA security vetting. The FAA anticipates that it will be able to issue a temporary remote pilot certificate within 10 business days after receiving a completed remote pilot certificate application. • Until international standards are developed, foreign-certificated UAS pilots will be required to obtain an FAA-issued remote pilot certificate with a small UAS rating. A remote pilot in command must: • Make available to the FAA, upon request, the small UAS for inspection or testing, and any associated documents/records required to be kept under the rule. • Report to the FAA within 10 days of any operation that results in at least serious injury, loss of consciousness, or property damage of at least $500. • Conduct a preflight inspection, to include specific aircraft and control station systems checks, to ensure the small UAS is in a condition for safe operation. • Ensure that the small unmanned aircraft complies with the existing registration requirements specified in § 91.203(a)(2). A remote pilot in command may deviate from the requirements of this rule in response to an in-flight emergency.
Aircraft Requirements	• FAA airworthiness certification is not required. However, the remote pilot in command must conduct a preflight check of the small UAS to ensure that it is in a condition for safe operation.
Model Aircraft	• Part 107 does not apply to model aircraft that satisfy all of the criteria specified in section 336 of Public Law 112-95. • The rule codifies the FAA's enforcement authority in part 101 by prohibiting model aircraft operators from endangering the safety of the NAS.

Appendix C

July 2017

Washington State
Department of Transportation

WASP
Washington Aviation System Plan

APPENDIX C – PROPOSED WASP AIRPORT CLASSIFICATION RESULTS

Table C-1. Results Organized by Proposed Classification/Associated City

ASSOCIATED CITY	AIRPORT NAME	PROPOSED NEW WASP CLASSIFICATION	3-LETTER IDENTIFIER
Bellingham	Bellingham International	Major	BLI
East Wenatchee	Pangborn Memorial	Major	EAT
Everett	Snohomish County/Paine Field	Major	PAE
Moses Lake	Grant County International	Major	MWH
Pasco	Tri-Cities	Major	PSC
Seattle	Sea-Tac International	Major	SEA
Seattle	Boeing Field/King County International	Major	BFI
Spokane	Spokane International	Major	GEG
Walla Walla	Walla Walla Regional	Major	ALW
Yakima	Yakima Air Terminal-McAllister Field	Major	YKM
Arlington	Arlington Municipal	Regional	AWO
Bremerton	Bremerton National	Regional	PWT
Burlington	Skagit Regional	Regional	BVS
Chehalis	Chehalis-Centralia	Regional	CLS
Deer Park	Deer Park Municipal	Regional	DEW
Ellensburg	Bowers Field	Regional	ELN
Ephrata	Ephrata Municipal	Regional	EPH
Friday Harbor	Friday Harbor	Regional	FHR
Hoquiam	Bowerman Field	Regional	HQM
Olympia	Olympia Regional	Regional	OLM
Port Angeles	William R. Fairchild International	Regional	CLM
Pullman	Pullman-Moscow Regional	Regional	PUW
Puyallup	Pierce County/Thun Field	Regional	PLU
Renton	Renton Municipal	Regional	RNT
Richland	Richland	Regional	RLD

ASSOCIATED CITY	AIRPORT NAME	PROPOSED NEW WASP CLASSIFICATION	3-LETTER IDENTIFIER
Shelton	Sanderson Field	Regional	SHN
Snohomish	Harvey Field	Regional	S43
Spokane	Felts Field	Regional	SFF
Tacoma	Tacoma Narrows	Regional	TIW
Vancouver	Pearson Field	Regional	VUO
Anacortes	Anacortes	Community	74S
Auburn	Auburn Municipal	Community	S50
Brewster	Anderson Field	Community	S97
Camas	Grove Field	Community	1W1
Cashmere	Cashmere Dryden	Community	8S2
Chelan	Lake Chelan	Community	S10
Colfax	Port of Whitman Business Air Center	Community	S94
College Place	Martin Field	Community	S95
Colville	Colville Municipal	Community	63S
Concrete	Mears Field	Community	3W5
Dalles, OR	Columbia Gorge Regional/The Dalles Municipal	Community	DLS
Davenport	Davenport Municipal	Community	68S
Eastsound	Orcas Island	Community	ORS
Elma	Elma Municipal	Community	4W8
Kelso	Southwest Washington Regional	Community	KLS
Kent	Crest Airpark	Community	S36
Lopez	Lopez Island	Community	S31
Lynden	Lynden Municipal	Community	38W
Mead	Mead Flying Service	Community	70S
Monroe	First Air Field	Community	W16
Moses Lake	Moses Lake Municipal	Community	W20
Oak Harbor	A J Eisenberg	Community	OKH
Okanogan	Okanogan Legion	Community	S35
Oroville	Dorothy Scott Municipal	Community	0S7
Port Townsend	Jefferson County International	Community	0S9
Richland	Prosser	Community	S40

ASSOCIATED CITY	AIRPORT NAME	PROPOSED NEW WASP CLASSIFICATION	3-LETTER IDENTIFIER
Sequim	Sequim Valley	Community	W28
Silverdale	Apex Airpark	Community	8W5
Spanaway	Shady Acres	Community	3B8
Toledo	Ed Carlson Memorial - South Lewis County	Community	TDO
Tonasket	Tonasket Municipal	Community	W01
Twisp	Twisp Municipal	Community	2S0
Wilbur	Wilbur Municipal	Community	2S8
Woodland	Woodland State	Community	W27
Chewelah	Sand Canyon	Local	1S9
Cle Elum	DeVere Field	Local	2W1
Cle Elum	Cle Elum Municipal	Local	S93
Darrington	Darrington Municipal	Local	1S2
Eatonville	Swanson Field	Local	2W3
Electric City	Grand Coulee Dam	Local	3W7
Forks	Forks Municipal	Local	S18
Forks	Quillayute	Local	UIL
Goldendale	Goldendale Municipal	Local	S20
Greenwater	Ranger Creek State	Local	21W
Ilwaco	Port of Ilwaco	Local	7W1
Ione	Ione Municipal	Local	S23
Lanley	Whidbey Airpark	Local	W10
Lind	Lind Municipal	Local	0S0
Mansfield	Mansfield	Local	8W3
Mattawa	Desert Aire	Local	M94
Morton	Strom Field	Local	39P
Ocean Shores	Ocean Shores Municipal	Local	W04
Odessa	Odessa Municipal	Local	43D
Omak	Omak Municipal	Local	OMK
Othello	Othello Municipal	Local	S70
Packwood	Packwood	Local	55S
Port Angeles	Sekiu	Local	11S

ASSOCIATED CITY	AIRPORT NAME	PROPOSED NEW WASP CLASSIFICATION	3-LETTER IDENTIFIER
Quincy	Quincy Municipal	Local	80T
Republic	Ferry County/Merritt Field	Local	R49
Ritzville	Pru Field	Local	33S
Rosalia	Rosalia Municipal	Local	72S
South Bend	Willapa Harbor	Local	2S9
Spanaway	Spanaway	Local	S44
Stanwood	Camano Island Airfield	Local	13W
Sunnyside	Sunnyside Municipal	Local	1S5
Tekoa	Willard Field	Local	73S
Warden	Warden	Local	2S4
Waterville	Waterville	Local	2S5
Westport	Westport	Local	14S
Wilson Creek	Wilson Creek	Local	5w1
Winthrop	Methow Valley State	Local	S52
Anacortes	Skyline SPB	General Use	21H
Anatone	Rogersburg State	General Use	D69
Bandera	Bandera State	General Use	4W0
Battle Ground	Cedars North Airpark	General Use	W58
Battle Ground	Goheen Field	General Use	W52
Bellingham	Floathaven SPB	General Use	0W7
Clayton	Cross Winds	General Use	C72
Colfax	Lower Granite State	General Use	00W
Copalis Beach	Copalis Beach State	General Use	S16
Easton	Easton State	General Use	ESW
Friday Harbor	Friday Harbor SPB	General Use	W33
Kahlotus	Lower Monumental State	General Use	W09
Kenmore	Kenmore Air Harbor - Lake Washington	General Use	S60
Lakewood	American Lake SPB	General Use	W37
Laurier	Avey Field	General Use	69S
Leavenworth	Lake Wenatchee State	General Use	27W
Lester	Lester State Ultralight Flightpark	General Use	15S

ASSOCIATED CITY	AIRPORT NAME	PROPOSED NEW WASP CLASSIFICATION	3-LETTER IDENTIFIER
Mazama	Lost River	General Use	W12
Metaline Falls	Sullivan Lake State	General Use	09S
Olympia	Hoskins Field	General Use	44T
Point Roberts	Point Roberts Airpark	General Use	1RL
Poulsbo	Poulsbo SPB	General Use	83Q
Renton	Will Rogers Wiley Post SPB	General Use	W36
Rimrock	Tieton State	General Use	4S6
Roche Harbor	Roche Harbor SPB	General Use	W39
Rochester	R & K Skyranch	General Use	8W9
Rosario	Rosario SPB	General Use	W49
Seattle	Kenmore Air SPB - Lake Union	General Use	W55
Skykomish	Skykomish State	General Use	S88
Starbuck	Little Goose Lock & Dam State	General Use	16W
Stehekin	Stehekin State	General Use	6S9
Sultan	Sky Harbor	General Use	S86
Vancouver	Fly For Fun	General Use	W56
Vashon Island	Vashon Municipal	General Use	2S1
Walla Walla	Page	General Use	9W2

Table C-2. Results Organized by Associated City

ASSOCIATED CITY	AIRPORT NAME	PROPOSED NEW WASP CLASSIFICATION	3-LETTER IDENTIFIER
Anacortes	Anacortes	Community	74S
Anacortes	Skyline SPB	General Use	21H
Anatone	Rogersburg State	General Use	D69
Arlington	Arlington Municipal	Regional	AWO
Auburn	Auburn Municipal	Community	S50
Bandera	Bandera State	General Use	4W0
Battle Ground	Cedars North Airpark	General Use	W58
Battle Ground	Goheen Field	General Use	W52
Bellingham	Bellingham International	Major	BLI
Bellingham	Floathaven SPB	General Use	0W7
Bremerton	Bremerton National	Regional	PWT
Brewster	Anderson Field	Community	S97
Burlington	Skagit Regional	Regional	BVS
Camas	Grove Field	Community	1W1
Cashmere	Cashmere Dryden	Community	8S2
Chehalis	Chehalis-Centralia	Regional	CLS
Chelan	Lake Chelan	Community	S10
Chewelah	Sand Canyon	Local	1S9
Clayton	Cross Winds	General Use	C72
Cle Elum	DeVere Field	Local	2W1
Cle Elum	Cle Elum Municipal	Local	S93
Colfax	Port of Whitman Business Air Center	Community	S94
Colfax	Lower Granite State	General Use	00W
College Place	Martin Field	Community	S95
Colville	Colville Municipal	Community	63S
Concrete	Mears Field	Community	3W5
Copalis Beach	Copalis Beach State	General Use	S16
Dalles, OR	Columbia Gorge Regional/The Dalles Municipal	Community	DLS
Darrington	Darrington Municipal	Local	1S2
Davenport	Davenport Municipal	Community	68S

ASSOCIATED CITY	AIRPORT NAME	PROPOSED NEW WASP CLASSIFICATION	3-LETTER IDENTIFIER
Deer Park	Deer Park Municipal	Regional	DEW
East Wenatchee	Pangborn Memorial	Major	EAT
Easton	Easton State	General Use	ESW
Eastsound	Orcas Island	Community	ORS
Eatonville	Swanson Field	Local	2W3
Electric City	Grand Coulee Dam	Local	3W7
Ellensburg	Bowers Field	Regional	ELN
Elma	Elma Municipal	Community	4W8
Ephrata	Ephrata Municipal	Regional	EPH
Everett	Snohomish County/Paine Field	Major	PAE
Forks	Forks Municipal	Local	S18
Forks	Quillayute	Local	UIL
Friday Harbor	Friday Harbor	Regional	FHR
Friday Harbor	Friday Harbor SPB	General Use	W33
Goldendale	Goldendale Municipal	Local	S20
Greenwater	Ranger Creek State	Local	21W
Hoquiam	Bowerman Field	Regional	HQM
Ilwaco	Port of Ilwaco	Local	7W1
Ione	Ione Municipal	Local	S23
Kahlotus	Lower Monumental State	General Use	W09
Kelso	Southwest Washington Regional	Community	KLS
Kenmore	Kenmore Air Harbor - Lake Washington	General Use	S60
Kent	Crest Airpark	Community	S36
Lakewood	American Lake SPB	General Use	W37
Lanley	Whidbey Airpark	Local	W10
Laurier	Avey Field	General Use	69S
Leavenworth	Lake Wenatchee State	General Use	27W
Lester	Lester State Ultralight Flightpark	General Use	15S
Lind	Lind Municipal	Local	0S0
Lopez	Lopez Island	Community	S31
Lynden	Lynden Municipal	Community	38W

ASSOCIATED CITY	AIRPORT NAME	PROPOSED NEW WASP CLASSIFICATION	3-LETTER IDENTIFIER
Mansfield	Mansfield	Local	8W3
Mattawa	Desert Aire	Local	M94
Mazama	Lost River	General Use	W12
Mead	Mead Flying Service	Community	70S
Metaline Falls	Sullivan Lake State	General Use	09S
Monroe	First Air Field	Community	W16
Morton	Strom Field	Local	39P
Moses Lake	Grant County International	Major	MWH
Moses Lake	Moses Lake Municipal	Community	W20
Oak Harbor	A J Eisenberg	Community	OKH
Ocean Shores	Ocean Shores Municipal	Local	W04
Odessa	Odessa Municipal	Local	43D
Okanogan	Okanogan Legion	Community	S35
Olympia	Olympia Regional	Regional	OLM
Olympia	Hoskins Field	General Use	44T
Omak	Omak Municipal	Local	OMK
Oroville	Dorothy Scott Municipal	Community	0S7
Othello	Othello Municipal	Local	S70
Packwood	Packwood	Local	55S
Pasco	Tri-Cities	Major	PSC
Point Roberts	Point Roberts Airpark	General Use	1RL
Port Angeles	William R. Fairchild International	Regional	CLM
Port Angeles	Sekiu	Local	11S
Port Townsend	Jefferson County International	Community	0S9
Poulsbo	Poulsbo SPB	General Use	83Q
Pullman	Pullman-Moscow Regional	Regional	PUW
Puyallup	Pierce County/Thun Field	Regional	PLU
Quincy	Quincy Municipal	Local	80T
Renton	Renton Municipal	Regional	RNT
Renton	Will Rogers Wiley Post SPB	General Use	W36
Republic	Ferry County/Merritt Field	Local	R49

ASSOCIATED CITY	AIRPORT NAME	PROPOSED NEW WASP CLASSIFICATION	3-LETTER IDENTIFIER
Richland	Richland	Regional	RLD
Richland	Prosser	Community	S40
Rimrock	Tieton State	General Use	4S6
Ritzville	Pru Field	Local	33S
Roche Harbor	Roche Harbor SPB	General Use	W39
Rochester	R & K Skyranch	General Use	8W9
Rosalia	Rosalia Municipal	Local	72S
Rosario	Rosario SPB	General Use	W49
Seattle	Sea-Tac International	Major	SEA
Seattle	Boeing Field/King County International	Major	BFI
Seattle	Kenmore Air SPB - Lake Union	General Use	W55
Sequim	Sequim Valley	Community	W28
Shelton	Sanderson Field	Regional	SHN
Silverdale	Apex Airpark	Community	8W5
Skykomish	Skykomish State	General Use	S88
Snohomish	Harvey Field	Regional	S43
South Bend	Willapa Harbor	Local	2S9
Spanaway	Shady Acres	Community	3B8
Spanaway	Spanaway	Local	S44
Spokane	Spokane International	Major	GEG
Spokane	Felts Field	Regional	SFF
Stanwood	Camano Island Airfield	Local	13W
Starbuck	Little Goose Lock & Dam State	General Use	16W
Stehekin	Stehekin State	General Use	6S9
Sultan	Sky Harbor	General Use	S86
Sunnyside	Sunnyside Municipal	Local	1S5
Tacoma	Tacoma Narrows	Regional	TIW
Tekoa	Willard Field	Local	73S
Toledo	Ed Carlson Memorial - South Lewis County	Community	TDO
Tonasket	Tonasket Municipal	Community	W01
Twisp	Twisp Municipal	Community	2S0

ASSOCIATED CITY	AIRPORT NAME	PROPOSED NEW WASP CLASSIFICATION	3-LETTER IDENTIFIER
Vancouver	Pearson Field	Regional	VUO
Vancouver	Fly For Fun	General Use	W56
Vashon Island	Vashon Municipal	General Use	2S1
Walla Walla	Page	General Use	9W2
Walla Walla	Walla Walla Regional	Major	ALW
Warden	Warden	Local	2S4
Waterville	Waterville	Local	2S5
Westport	Westport	Local	14S
Wilbur	Wilbur Municipal	Community	2S8
Wilson Creek	Wilson Creek	Local	5W1
Winthrop	Methow Valley State	Local	S52
Woodland	Woodland State	Community	W27
Yakima	Yakima Air Terminal-McAllister Field	Major	YKM

Appendix D

July 2017

Washington State
Department of Transportation

WASP
Washington Aviation System Plan

Washington Aviation System Plan
Public Involvement Summary

The Washington Aviation System Plan (WASP) is an update of the previous system plan to reflect changes in the aviation industry, community and system. The primary purpose of airport system planning is to study the performance and interaction of an entire aviation system to understand the contributions of individual airports to the system as a whole. Airports are an essential component of Washington State's overall transportation system, providing critical links to people, goods and services.

Because of the breadth and significance of Washington's aviation system, the development of the WASP needed to be informed by broad range of individuals and organizations who have a stake in its future.

The WSDOT Planning Studies Guidelines "Public and Stakeholder Involvement" and the Federal Aviation Administration (FAA) Advisory Circular (AC) No.150/5070-7 "The Airport System Planning and FAA's Community Involvement Manual," FAA-EE-90-03, provide guidance on system planning public involvement and stakeholder consultation. The FAA Advisory Circular states specifically that:

> *Appropriate coordination of study drafts with the aviation public, community organizations, airport sponsors and users, and other interested parties is critical to the successful adoption and implementation of the final planning report. It is important that all affected or potentially affected parties perceive that the process is open, that the opportunity for participation exists, and that the study is designed to consider input from all of them.*

The community engagement program for the WASP embraces that philosophy to assure that the resultant system plan supports the public's best interest.

Community Engagement Plan Objectives

The Community Engagement Program for the WASP was designed to meet the following objectives:

- Increase public awareness about why aviation matters to people and communities in Washington State.
- Engage and grow key stakeholder audiences in understanding what the System Plan addresses and what it does not address.
- Partner with key stakeholders to obtain stakeholder and public input about the System Plan.
- Document stakeholder/public involvement.
- Promote accurate media coverage about the System Plan.

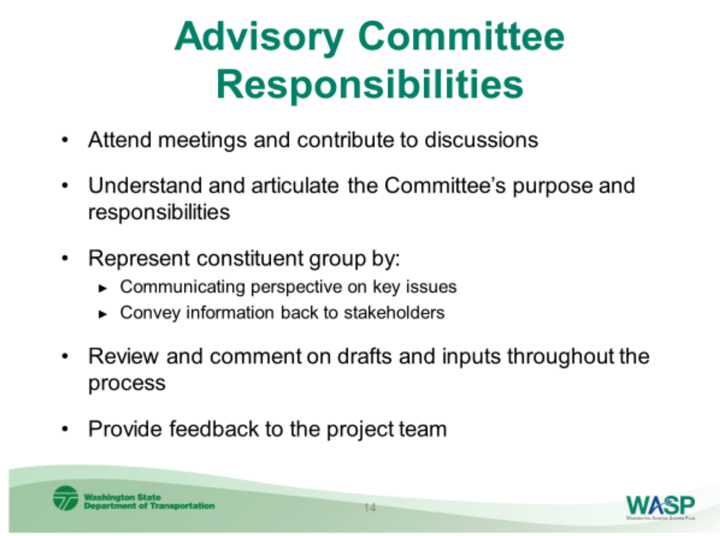
Stakeholder Analysis

The complexity, technical nature and subject matters of statewide Aviation System Plans require that they be primarily stakeholder driven. Consequently, the community engagement process was focused on those who have a direct interest the aviation system planning issues. Diverse stakeholders have interest in the Washington Aviation System Plan. The WASP Public Involvement program started with an analysis of potential stakeholder groups, their overall concerns associated and outreach tools to address concerns and ensure participation in the process.

Audience	Range of Concerns/Interests	Outreach Recommendations
○ Governor ○ Legislature ○ Transportation Commission ○ Airports / Sponsors ○ Urban communities ○ Rural communities ○ Cities, towns, counties ○ General Aviation pilots ○ Airlines ○ Airline passengers ○ Regional Transportation Planning Organizations/ Metropolitan Transportation Planning Organizations (RTPOs/MTPOs) ○ Business communities ○ Business aviation ○ Association of Washington Cities ○ Washington State Association of Counties ○ Washington Chapter of the American Planning Association (WA-APA) ○ Passenger rail ○ Air cargo ○ Environmental groups ○ Special interest groups ○ WASP Advisory Committee ○ WSDOT Internal audiences	○ Adequate background information about state aviation system and policies ○ Adequate background and technical information regarding WASP ○ Delivery of technically sound system plan to be used for the basis of making long-term airport investment decisions ○ Local constituent concerns ○ Intermodal integration and efficiency ○ Data collection/airport inventory and overall fact finding data reported accurately ○ Opportunity to contribute to a comprehensive plan for future airport development ○ Impacts of capacity recommendations ○ Impacts on airport planning and investment ○ Land use conflicts ○ Noise ○ Relationship to local land uses ○ Economic development ○ Emergency access ○ Community impacts ○ Airport maintenance ○ Funding of airport maintenance ○ Funding equity ○ Availability of airports ○ Impact on long-term facility and services planning ○ Tax burden ○ Cost impacts ○ Consistency with regional/metropolitan transportation ○ Impact on transportation facilities ○ Economic development ○ Impacts on costs of doing business ○ Impacts on distribution systems ○ Social issues ○ Transportation system integration ○ High-speed passenger rail connectivity with major urban areas ○ Alternate modes of transportation	○ Ongoing coordination with key audiences ○ Regularly scheduled advisory committee meetings ○ Prepare briefing items in advance ○ Provide technical expertise and resources ○ Clear messaging about legislative directives and expectations ○ Initial stakeholder outreach to gain perspective of expectations ○ Ongoing coordination with legislative and Governor's staff ○ Regular briefings to interested parties including tribes ○ Start early and disseminate study goals, objectives and tasks early ○ Clear messaging about study purpose and outcomes as well as what the study does not include ○ Multiple opportunities for involvement ○ Easily accessible information, presented in simple formats – leverage WASP Website and existing aviation forums associations/meetings ○ Outreach to identify deficiencies in aviation airports ○ Clarity about how the classification system works ○ Clear information about decision process

The WASP Advisory Committee

The WASP Advisory Committee was convened to engage aviation system plan stakeholders throughout the development of the WASP. In addition to providing ongoing technical input, each member of the Advisory Committee also served as a communications conduit with their respective stakeholders. The charge included the following items:



The Advisory Committee served as a key resource during each step of the development of the WASP, providing guidance and concurrence on the foundations of the plan (such as vision, goals and system framework), strategies and system performance metrics. The Advisory Committee also reviewed and provided input to the WASP Community Engagement Plan, including guidance on the key messages of the Plan.

Organizations represented on the Advisory Committee include:

- Aircraft Owners and Pilots Association
- Airlift Northwest
- Alaska Airlines
- Association of Washington Business
- Association of Washington Cities
- Department of Commerce
- Federal Aviation Administration
- Felts Field
- Inland Northwest Aerospace Consortium
- Pacific Northwest Business Aviation Association
- Pearson Field
- Port of Seattle
- Recreational Aviation Foundation
- Skagit Regional Airport
- State House of Representatives
- Tri-Cities Airport
- University of Washington
- Washington Airport Management Association
- Washington Pilots Association
- Washington Public Ports Association
- Washington Seaplane Pilots Association
- Washington State Association of Counties
- Washington State Community Airports Association
- Washington State Emergency Management Division
- Yakima Valley Tourism

The WASP Advisory Committee met on six occasions to address the following topics

Meeting Date	Topic
July 9, 2015	Kick off meeting and overview of plan scope; vision and mission statement; expectations of advisory committee in communicating with stakeholders, breakout groups on goals
December 10, 2015	Discussion about state aviation system goals, objectives and performance measurements; discussion about emerging issues
March 23, 2016	Discussion with Senator Karen Keiser on Sea Tac community issues; discussion about Airport Classification System; discussion about performance metrics for WASP goals; discussion about Community Engagement Plan;
October 11, 2016	Discussion about alternative airport strategies and alternatives analyses; review of policy recommendations
November 3, 2016	Workshop to refine policy recommendations
January 27, 2016	Chapter by chapter review of draft Washington Aviation System Plan

Public Outreach

The Public Outreach Program was organized around key milestones of the Plan, to assure that input could be incorporated as the plan was developed. Outreach efforts focused primarily on obtaining input from those individuals and organizations who have a direct relationship with aviation activities in Washington State.

Public Information Program

- Folios

Two project folios were created during the development of the WASP:
  - The first folio, published in July 2015 provided general information about the scope of the WASP, key milestones and advisory committee participation. It was distributed during briefings about the WASP.
  - A second folio, published in Feb. 2017 provided information about the WASP's draft policy recommendations, the proposed Airport Classification System and upcoming decision milestones for the Plan
- News releases
  - 3/17 **WSDOT seeks input on Washington Aviation System Plan**
  - 4/20: **WSDOT extends public comment period for Washington Aviation System Plan review**
- WASP Webpage on WSDOT website
  - The WSDOT Aviation Division developed a webpage linked to its homepage that provides an overview of WASP and includes links to the Community Engagement Plan and white papers related to each of the seven emerging issues that have been identified as key to the future of Washington State aviation.

Targeted Stakeholder Outreach

- **Government Stakeholder Presentations**
  - Washington State Transportation Commission
    - On July 19, 2016 WSDOT Aviation made a presentation that included an overview of the WASP planning process, aviation system goals, the proposed airport classification system and metrics for achieving state aviation system goals.
    - On June 19, 2017 WSDOT Aviation made a presentation that summarized key findings and policy recommendations of the WASP.
  - Legislative outreach
    - Airport Awareness Day: Jan. 19, 2016
    - March 10, 2016 Aviation Caucus presentation
    - Airport Awareness Day: Jan. 18, 2017
- **Issue Specific Workgroups**
  - WSDOT Multi-Modal Task Force
    - Feb. 23 Washington Aviation System Plan (WASP) Multimodal Working Group
  - Emerging Issues Workgroups
    - Airport Infrastructure Working Group – October 5, 2015
    - Aircraft Innovation Working Group – October 6, 2015
    - UAS Working Group – October 9, 2015
    - General Aviation Working Group – October 13, 2015
    - NextGen Working Group – October 16, 2015
    - Aviation Fuels Working Group – October 16, 2015
    - Alternate Strategies Working Group – September 23, 2016

- **Aviation Stakeholder Group Presentations**
  - Washington Airport Management Association: May20, 2015; May 18, 2016; May 2, 2017
  - Washington State Community Airports Association: October 29, 2015; October 27, 2016
  - Washington Pilots Association: March28, 2015; Mar18, 2016

   - Washington Public Ports Association: November 18, 2015 and May 18, 2017
   - South County Area Transportation Board: April 18, 2017

- **State Aviation Airport Workshops**
   - Tuesday, September 15, WSDOT Shoreline Office, 15700 Dayton Ave North, Shoreline, WA 98177
   - Wednesday, Sept. 16, WSDOT Aviation Office Olympia, 7702 Terminal Street, Tumwater, WA 98501
   - Thursday, September 17, WSDOT Vancouver Office, 11018 NE 51st Circle, Vancouver, WA 98682
   - Tuesday, September 29, WSDOT Wenatchee Office, 1551 N. Wenatchee Ave., Wenatchee, WA 98801
   - Wednesday, September 30, WSDOT Spokane Office, 2714 N. Mayfair Street, Spokane, WA 99207
   - Thursday, October 1, WSDOT Yakima Office, 900 East Selah Rd, Yakima, WA, 98901
   - Wednesday, Sept. 21: Arlington Municipal Airport, 18204 59th Drive NE, Suite B, Arlington, 98223
   - Thursday, Sept. 22: WSDOT Aviation Office, 7702 Terminal Street SW, Tumwater, 98501
   - Wednesday, Sept. 28: WSDOT Spokane Office, 2714 N. Mayfair Street, Spokane, 99207
   - Thursday, Sept. 29: WSDOT Wenatchee Office, 2830 Euclid Avenue Building #B, Wenatchee, 98801

Survey

During the period between July 15 and October 7, WSDOT Aviation conducted an online survey designed to get input on public priorities related to Washington State's aviation system. Of 70 participants, the overwhelming majority of responses were from pilots.

Respondents indicated that the top three challenges facing the aviation system were:

- Public understanding about the economic role of airports (78% said it is a significant challenge)
- Preserving the number of airports in Washington State (72% reported this as a significant challenge)
- Conflicts between aviation operations and nearby land uses (67% reported this as a significant challenge)

When considering future/emerging trends for aviation in Washington State, 72% of respondents expressed a high level of interest and 92% expressed either high or medium interest in the development of aviation-compatible businesses on and around airport land. Regarding NextGen technology, 43% expressed a high level and 54% expressed a medium level of interest.

Respondents were also asked about the weight that should be given to state funding criteria for airports. For this group, the criteria that should be given the highest weight are":

- Providing for sufficient capacity for the future of Washington's aviation system (61% said this should be given a high weight)
- Ability to support future passenger demand and GA demand (60% said this should be given a high weight)
- Whether the airport has a written plan to preserve and maintain its assets (55% said this should be given a high weight)

The questionnaire and data summary are included as an attachment to this public involvement summary.

Public Comment Period Outreach

WSDOT asked for public input on the Draft WASP during a 30-day public comment period beginning on 3/17. Responding to feedback, WSDOT extended the public comment period for a week longer on 4/20

About 40 people provided written public comment, mostly via email. Key themes during public comment were:

- Concerns about how to meet state aviation capacity needs beyond the current planning horizon
- Sea-Tac neighbors and communities expressed concerns over airport expansion, noise, pollution, etc.
- Concerns about coordinating roadway accessibility with future airport expansion
- Interest in emerging issues such as the decline in general aviation (GA), as well as sustainability and mobility.

For more detail about public comment received, contact WSDOT Aviation.

ATTACHMENTS

WASP
WASHINGTON AVIATION SYSTEM PLAN

Washington Aviation System Plan Questionnaire[1]

The Aviation Division of the Washington State Department of Transportation is currently updating the statewide Washington Aviation System Plan (WASP) to identify and develop strategies to meet Washington's long-term air transportation needs from a broad and integrated system perspective.

The WASP will be completed by the end of 2016. It is important to us that we have a chance to hear your perspectives as we continue to develop the plan. This questionnaire will only take a few minutes of your time. Please circle the options that best reflect your perspective.

Washington's Aviation System

Includes Many Activities

- Air cargo
- General aviation-personal transportation
- General aviation—business and corporate travel
- Emergency preparedness and disaster response
- Medical air transport
- Blood tissue and organ transportation
- Aerial sightseeing
- National security
- Pilot training
- Agriculture
- Firefighting
- Aircraft manufacturing
- Search and rescue
- Commercial service
- Aerial photography
- Scientific research

1. The first set of questions have to do with challenges that are facing the State aviation system. For each challenge below, please indicate whether it is a significant challenge, a mid-level challenge, or not a challenge from your personal perspective.

CHALLENGES	Significant challenge	Mid-level challenge	Not a challenge	Add any comments here
Conflicts between aviation operations and nearby land uses	1	2	3	
Maintaining runway pavement conditions	1	2	3	
Multi-modal access to airports	1	2	3	
Preserving the number of airports in Washington State	1	2	3	
Public understanding about the economic role of airports	1	2	3	
Managing noise generated from the use of airports	1	2	3	
Federal and state funding for airport improvements	1	2	3	
Are there other challenges you would like the Plan to address?				

2. The WASP is a 20 year plan. When considering future/emerging trends and opportunities for aviation in Washington State, how interested are you in the following:

Trends and Opportunities	Highly interested	Moderately interested	Not interested
Integration of Unmanned Aircraft Systems (such as drones)	1	2	3
Green or alternative aviation fuels	1	2	3
Development of aviation-compatible businesses on and around airport land	1	2	3
NextGen technology for use at airports	1	2	3
More connections between airports and public transportation	1	2	3

[1] Note that this format differs from the on-line version used by survey participants

Are there other trends or opportunities you would like the Plan to address?

There are just a few more questions on the other side of this sheet of paper!

3. When it comes to considering how state funds should be allocated to airports in Washington, what weight should be given to the following criteria?

Potential funding criterion	**High weight**	**Medium weight**	**Low Weight**	**Add any comments about each criteria here**
Whether the airport has a written plan to preserve and maintain its assets	1	2	3	
Whether the airport can demonstrate how it contributes to the local economy	1	2	3	
Whether the airport meets state and FAA design standards	1	2	3	
Ability to support future passenger demand and GA demand	1	2	3	
Providing for sufficient capacity for the future of Washington's aviation system	1	2	3	
Whether the airport has a plan in place for financial and environmental sustainability (appropriate to its size)	1	2	3	
Whether there is multimodal access to the airport	1	2	3	
Whether the airport has a documentable plan for engagement and outreach with the community	1	2	3	
Whether the airport meets airfield geometric safety criteria requirements	1	2	2	
Are there other criteria you would like the State to consider?				

Finally, tell us a little about yourself.

4. What is the name of the community in which your airport is located? ___________________________________

5. How would you describe your role in aviation in Washington State? (check all that apply)
   - ☐ Pilot
   - ☐ Airport management
   - ☐ Elected policy maker
   - ☐ Local government
   - ☐ Airport-related business
   - ☐ Other ____________________

6. Would you be interested in receiving email updates about the Washington Aviation System Plan?

1…YES Your e-mail address: ________________________

2..NO

Other comments?

THANK YOU FOR YOUR TIME AND INPUT!

THE WSDOT AVIATION DIVISION

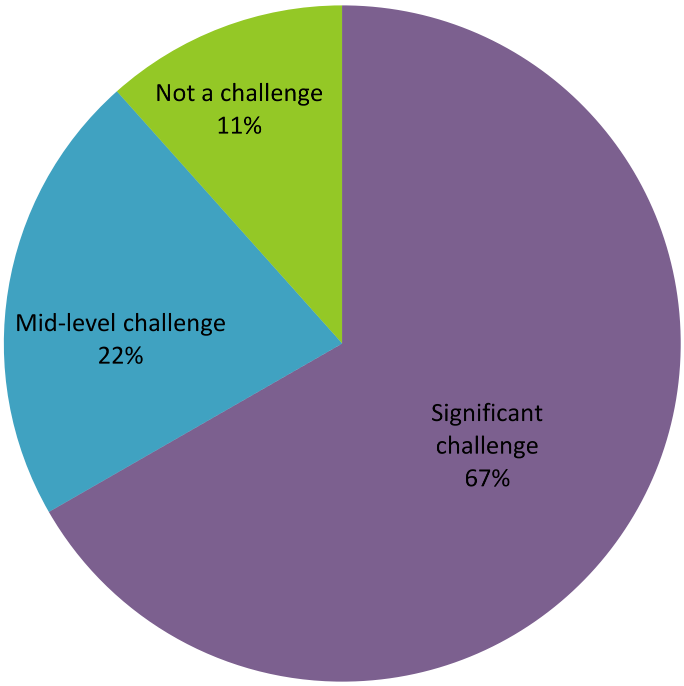
Washington Aviation System Plan

On-line Survey Results

Washington Aviation System Plan Questionnaire

The first set of questions have to do with challenges that are facing the State aviation system. For each challenge below, please indicate whether it is a significant challenge, a mid-level challenge, or not a challenge from your personal perspective. Add comments to explain further.

- Conflicts between aviation operations and nearby land uses

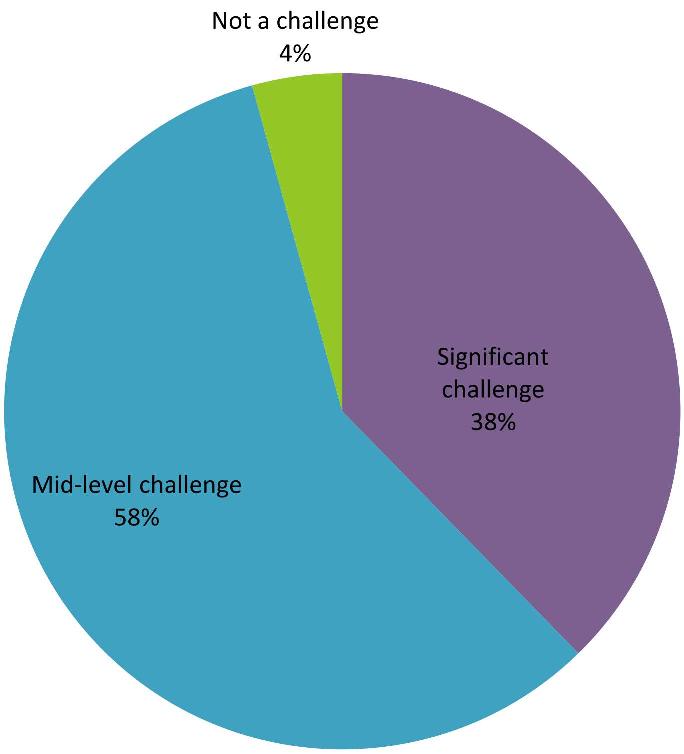


Value	Percent	Count
Significant challenge	66.7%	46
Mid-level challenge	21.7%	15
Not a challenge	11.6%	8
	Total	69
Count	Response	

1	All situations are different, which makes it more challenging
1	As cities grow and look for ways to increase their density and make their communities more livable, they conflict with the purpose of airports and regulatory guidelines supporting airports.
1	Buying a home in the traffic pattern then complaining about airplane noise is an old story. Land developers should either be kept from doing this to people or buyers should be made to understand that there is an airport in the vicinity and it will stay there.
1	Developers and politicians
1	Most significant challenge facing aviation.
1	Typically the airport was there first, placed in an outlying area. Improved & proper zoning & laws need to support this precedence.
1	We must protect our airports. It seems after airports are constructed or improved then people build homes nearby and conflict always follows. KTIW is a good example. Tacoma built a beautiful airport in 1962 at a location that was safe and insulated from residential structures only to become surrounded by same in the ensuing years.
1	We really need protected zones especially in approach and departure areas.

1	again airport importance - legislators are uninformed when it comes to changing zoning and development
1	as the state grows, many airports are being encroached on by incompatible land use

- **Maintaining runway pavement conditions**

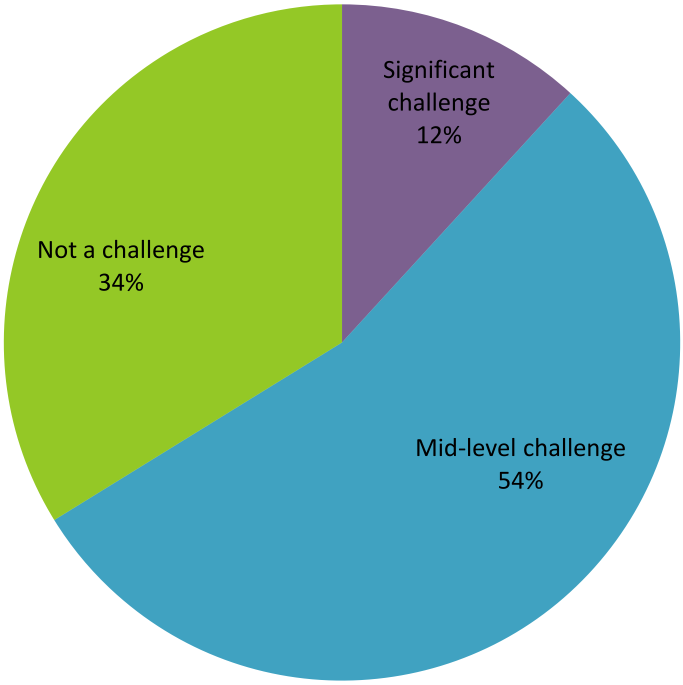


Value	Percent	Count
Significant challenge	37.7%	26
Mid-level challenge	58.0%	40
Not a challenge	4.3%	3

	Total	69

Count	Response
1	How about just changing this to "runway surface conditions" to include grass & gravel state maintained strips.
1	I don't know too much about this issue, but I can imagine if it is anything similar to maintaining pavement on roadways, funding to maintain runways clashes with funding sources and has a direct impact on economic interests at airports.
1	Lots of need, little money
1	Most important
1	My home field runways at KSFF are in great shape, but some small airports need attention
1	Not a challenge. FAA provides funding
1	Not all airports pavement should be kept to NAS standards
1	Only money id a factor
1	Same as funding issues
1	Various airports I've visited have had weeds growing through cracks in the runway.
1	money is always a problem

- **Multimodal access to airports**



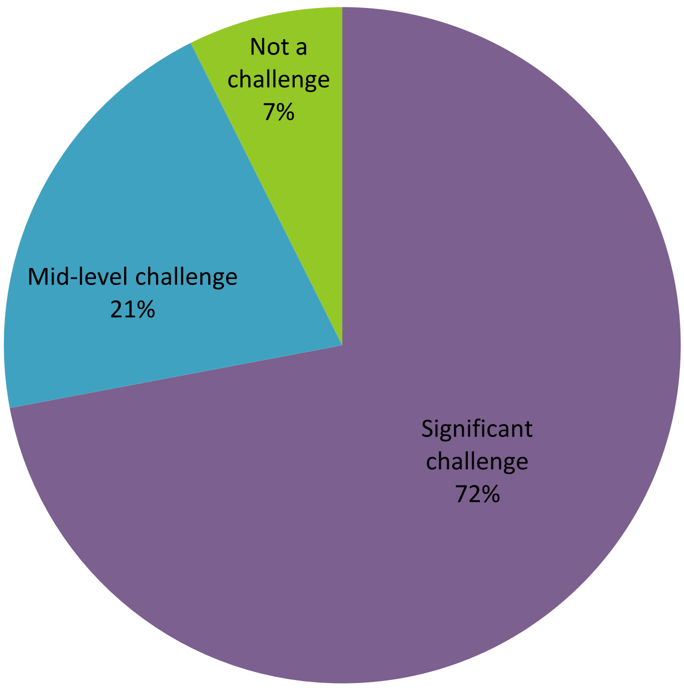
Value	Percent	Count
Significant challenge	11.8%	8
Mid-level challenge	54.4%	37
Not a challenge	33.8%	23
	Total	68

Count	Response
1	Airports are rarely final destinations. People need transportation options after they arrive. Idaho does a great job by having airport

	courtesy cars available at nominal costs in many of the smaller towns. Maybe license fees could be waived for such vehicles and old surplus state vehicles positioned at some of our airports. Even having bicycles is a big help. We were in McCall, ID last summer and they had courtesy bikes available that we rode into town for dinner. Any other ideas would be great!
1	Not sure how you mean this, access by gliders, hot air balloons, piston turbine& jet aircraft & helicopters or walking, driving, bike riding & wheel chairs.
1	Planning ahead
1	Public transportation is underutilized as it is.
1	Some airports have multimodal access, but it isn't all created equal. In areas with significant multimodal access (SEA-TAC) there are still opportunities to make the frequency of transit better. Or to ensure that different modes like rail and bike/ped can be supported by infrastructure improvement with examples like bus loading zones, bigger bike racks, and sidewalk accommodations for pedestrians and persons with special needs. I think a multimodal approach would focus not just on the traveling public, but also increasing multimodal connections for employees of the airport. Smaller airports across the state might still be able to have meaningful connections with transit

	and/or other modes to increase the economic generating capacity of those smaller airports.
1	not clear about this item.

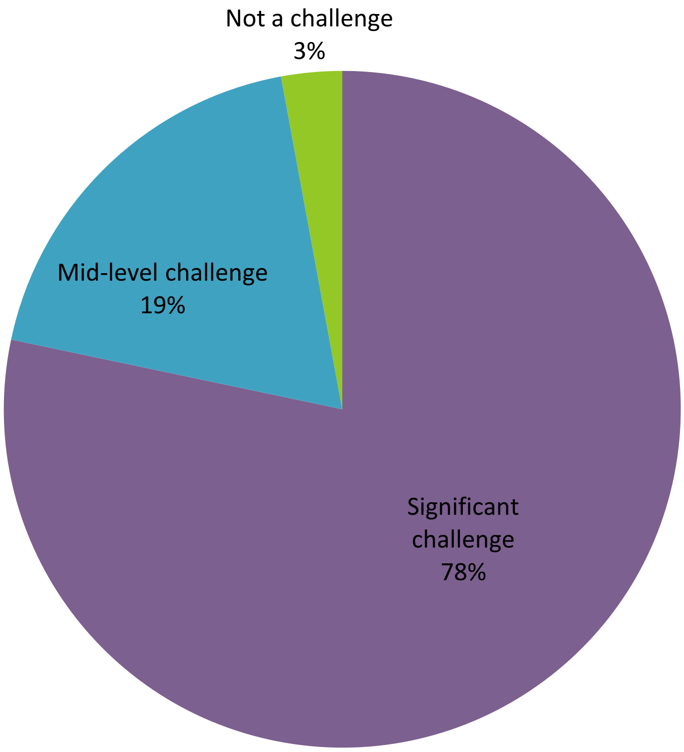
- **Preserving the number of airports in Washington State**



Value	Percent	Count
Significant challenge	72.1%	49
Mid-level challenge	20.6%	14
Not a challenge	7.4%	5
	Total	68

Count	Response
1	Developers and politicians have personal agendas. Economics of operating small airports are tough for many communities.
1	Established airports should not be allowed to be forced to close be new neighbors
1	I have been flying for over 45 years; I have seen a significant number of public & privately owned airports & airstrips closed. More needs to be done to support both. For example as and Point Naval air station in Seattle, vista field in Kennewick, Bellevue, Oswald & Gross aviation fields in Tacoma just to name a few.
1	I'm not familiar with this issue.
1	Land developers seem to be a hungry lot.
1	Too many small airports are being closed, diminishing general aviation
1	Yes. Do. This State needs more airports. No significant new airports to meet the growing need for several decades.
1	public awareness of the importance is lacking

- **Public understanding about the economic role of airports**

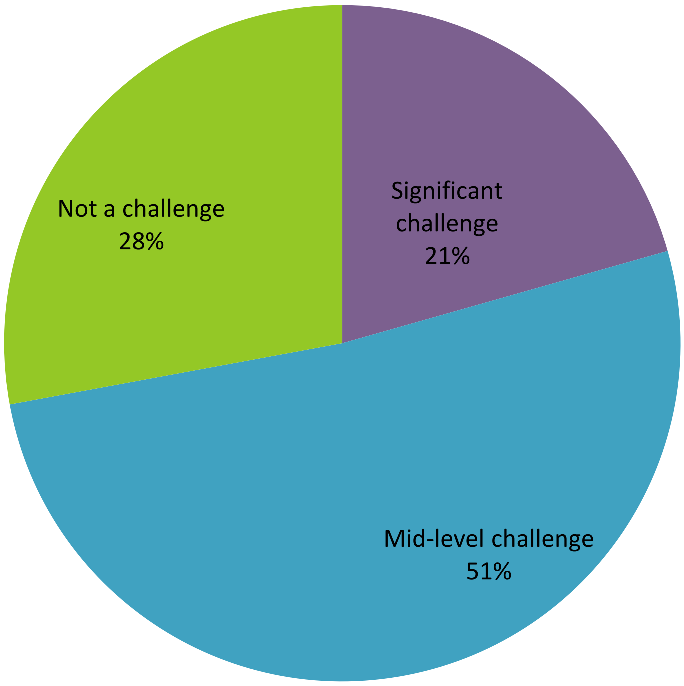


Value	Percent	Count
Significant challenge	78.3%	54
Mid-level challenge	18.8%	13
Not a challenge	2.9%	2
	Total	69

Count	Response
1	Especially for airports other from KSEA, KGEG, KBLI

1	I think there is the perception by many members of the public that airports are for transportation and provide only minimal economic benefit through other lines of business.
1	If the public had a better understanding of the benefits of airports, there would be less objection to airport ops.
1	Many of the airport operators don't even try to show their airports economic value.
1	Public doesn't have a clue
1	Some airports are doing far better than others on this, and of course you simply can't please everyone, but more efforts can be made to help the public understand what their local airport does for their region.
1	The general public does not understand that airports, like railroads, are critical transportation infrastructure
1	Too many people think the only flying is military or airline. More needs to be done to educate & support aerial photography, medical, business, package delivery, flight training etc. The numbers of jobs and benefits those businesses make to the communities.
1	every pilot should be sure his friends and neighbors know the importance of general aviation to a community.

- Managing noise generated from the use of airports

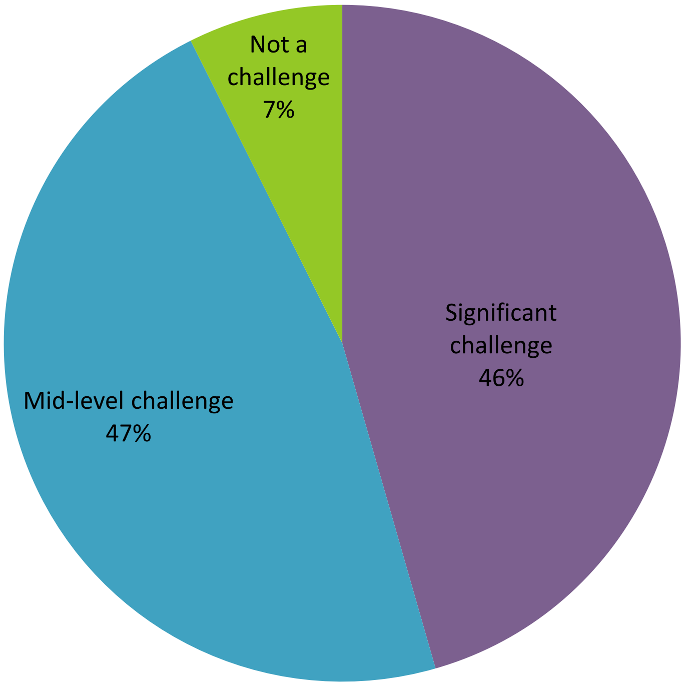


Value	Percent	Count
Significant challenge	20.6%	14
Mid-level challenge	51.5%	35
Not a challenge	27.9%	19
	Total	68

Count	Response
1	Again people should be aware where they are buying a home and act accordingly.

1	Again prefacing that a small minority will never be made happy, airport authorities and local residents should try to work together to create sensible noise abatement policies.
1	Aircraft do not have as much of a noise foot print as in past times
1	Airports are noisy- always have been. Aircraft are becoming quieter. We need to stop legislation against aircraft noise.
1	Growth of residential areas in proximity
1	Local agencies need to protect the right of airports to make noise.
1	Read previous comment.
1	Similar to the above comment about housing moving closer to airports. This will always be an issue as the outward movement of people to find cheaper housing pushes people to live in areas that have higher volumes of noise from airports. There is also a connection to the lower housing prices near airports and the environmental justice issues directly related to lower-income populations that have to deal with the noise if they want cheaper housing.
1	age old problem - who was there first

- **Federal and state funding for airport improvements**



Value	Percent	Count
Significant challenge	45.6%	31
Mid-level challenge	47.1%	32
Not a challenge	7.4%	5
	Total	68
Count	Response	

1	Again, KSFF has been undergoing considerable improvements, but rural airports need better funding
1	As we continue to move toward being a welfare society without as many checks as should be in place money becomes scarce for those things with future impact.
1	Aviation taxes should go for aviation uses, not just enforcement and regulation.
1	Community airport mgmt. doesn't seem to follow through
1	I don't know enough about this
1	I'm not fully aware of the details of this issue. I imagine that it could be significant considering that other modes also feel that fed and state funding is a challenge.
1	Proper priorities need to be established. For example recent FAA rule changes dictated changes to how close the approach end of the runway could be to a road. Richland spent many dollars tearing out the closed section and planting native vegetation, Prosser painted a "displaced threshold" making this section available for aircraft taking off, and saving the expense of tearing up asphalt and plantings.
1	Quick deadlines, and unpredictable

1	To many times an airport improvement is made because we have federal money, not because the airport has a need for the project.
1	What will you do with the data point from this question

Are there other challenges you would like the Plan to address?

Count	Response
1	As a float plane pilot, closure of waterways has become a large issue.
1	Emergency/grass/back country airport preservation, maintenance and additional airports.
1	Getting local governments, and port authorities, to understand the economic impacts of general aviation and air carrier operations.
1	Ignorant & irresponsible airport custodians allowing or causing airports to close.
1	Incompatible land uses.
1	KCLM is being run like it is still a commuter airport, it has not had commuter service for several years and likely never will. The airport needs to determine who is using it the airport and what their needs are.
1	Land use surrounding airports

1	Management of Airports . . . Sponsors lacking the knowledge of their role in protecting airports
1	More and better seaplane facilities are needed.
1	More limitations on who has drones, what they are used for and some way to keep them from interfering with small, manned aircraft.
1	No
1	No
1	Not all state owned/managed airstrips have published patterns (specifically when Right traffic is used) in the FAA airport & facility directory; certain electronic pilot information systems (Seattle Avionics FlyQ) assign the FAA suggested Left traffic to any runway which doesn't have a published pattern. For example see lower Monumental or Little Goose airfields on the Snake River
1	Public access and signage at GA airports
1	Real consequences for airport sponsors who do not take their grant obligations seriously.
1	Role of airports in potential disasters (human caused, natural), potential Search and Rescue operations at the individual and mass scale, medical evacuation, national defense/counter terrorism, resource management (surveys, management operations, harvesting/extraction, planning/development).

1	Strategically serving areas of the state with air cargo service (i.e., from a system perspective, where should air cargo services be enhanced to provide improved opportunities in some areas, and to mitigate impacts of air cargo in other areas)
1	Yes
1	public general awareness of the asset to the community

The WASP is a 20 year plan. When considering future/emerging trends and opportunities for aviation in Washington State, how interested are you in the following:

	Highly interested	Moderately interested	Not interested
Integration of Unmanned Aircraft Systems (such as drones)	13 18.8%	35 50.7%	21 30.4%
Green or alternative aviation fuels	22 31.9%	27 39.1%	20 29.0%
Development of aviation-compatible businesses on and around airport land	50 72.5%	17 24.6%	2 2.9%
NextGen technology for use at airports	30 43.5%	37 53.6%	2 2.9%
More connections between airports and public transportation	27 39.1%	30 43.5%	12 17.4%

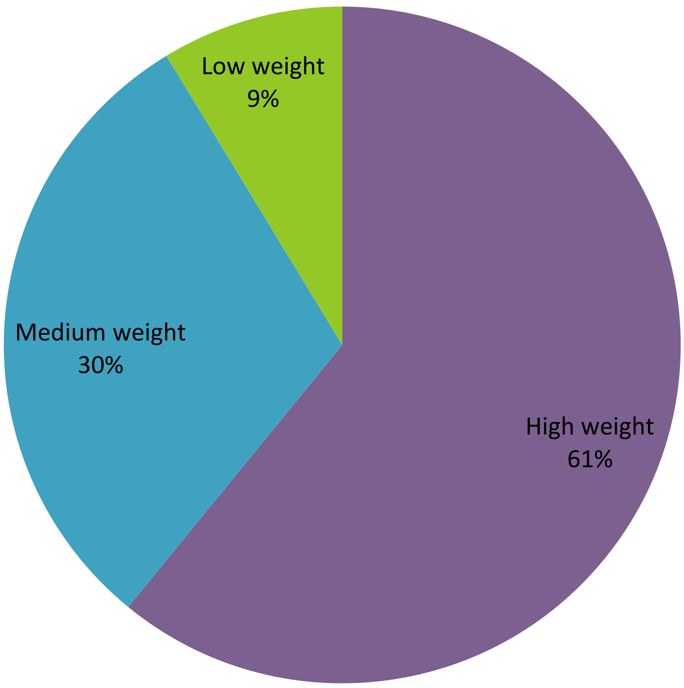
Are there other trends or opportunities you would like the Plan to address?

Count	Response
1	As technology improves I would like to see more airport Web cams and more conversion of existing still frame systems to streaming.
1	GA fit in plan.
1	Human demographic changes and trends served by remote (low development) airports, community (rural) airports, and regional GA airports. What are the likely and probable resource trends and how will airport and aviation infrastructure keep pace?
1	I'm also interested in the connection between UAS and the general trend of technology and automated vehicles that could change how freight is shipped and the effects on airports. Also the concept of shared mobility as it relates to potentially reducing the number of vehicles that come into an airport. This would have an impact on the parking requirements for airports and space dedicated to travelers arriving by SOV. The costs associated with maintaining parking garages and enforcement could potentially be realized as cost savings to airports.
1	More opportunities for the general public to come feel welcomed at an airport (eg, Bremerton's new children's play area or Tacoma Narrows' viewing area next to the tower.

1	No
1	No
1	Not at this time
1	Seaplane bases as part of the state aviation system.
1	Yes
1	Belly cargo: how much is moved by commodity by airport annually? Can we track these figures as performance indicators?

When it comes to considering how state funds should be allocated to airports in Washington, what weight should be given to the following criteria?

- Whether the airport has a written plan to preserve and maintain its assets

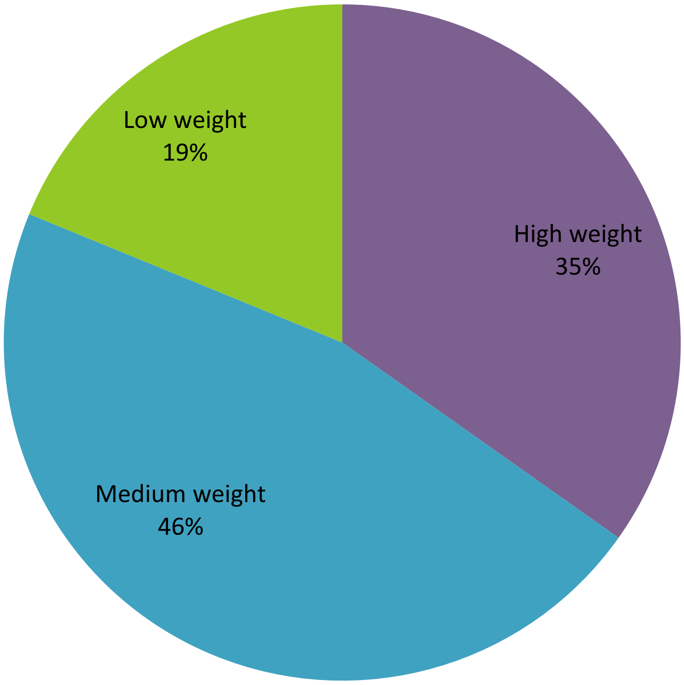


Value	Percent	Count
High weight	60.9%	42
Medium weight	30.4%	21
Low weight	8.7%	6
	Total	69

Count	Response
1	A simple written plan is more effective than a voluminous written plan no one reads

1	Current master plans should be a requirement Is an asset a business like Boeing at Renton or only pavement and property
1	It not only must be written, it must be understood by the operating body. For example many ex-military fields require that they be operated 'in perpetuity"; yet time and time again we hear that they didn't understand that this meant for ever. Pasco, I know has such a rule providing free public use area (aka tie downs) but they now charge for those assets. & we have all heard the battle over Santa Monica in CA were they deny in perpetuity means forever.
1	This directly relates to the ability of airports to remain financially solvent and remain as an economic generator for a community.

- **Whether the airport can demonstrate how it contributes to the local economy**



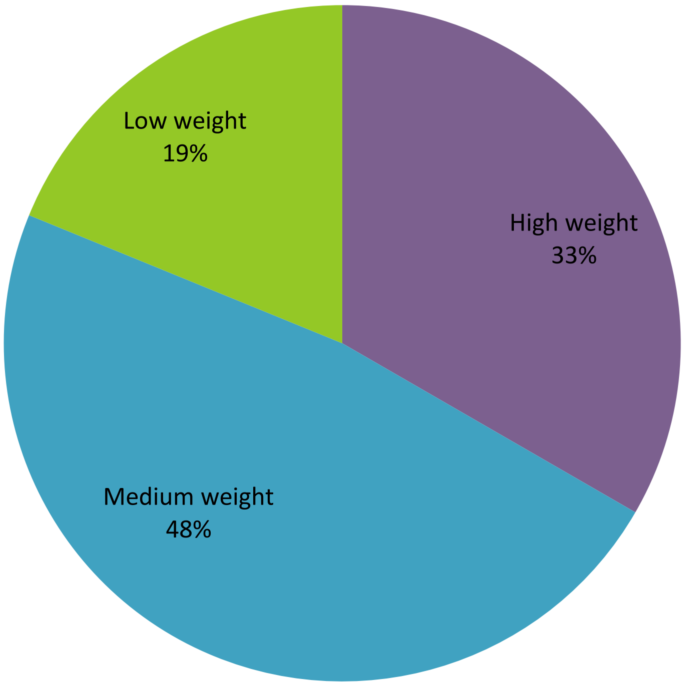
Value	Percent	Count
High weight	34.8%	24
Medium weight	46.4%	32
Low weight	18.8%	13
	Total	69

Count	Response
1	All GA airports contribute to the local economy, it is the State's mission to educate communities with the help of the aviation community

1	Honestly this is a state aviation department responsibility. Comm7nities depend on you for this.
1	I think these types of discussions are helpful when making requests for funding. the more people understand the lines of business for an airport, the more support can be thrown behind it.
1	It's economic contribution is only one measure of its value.
1	It's like the fire extinguisher on the wall. It's real worth only comes when you use it first hand.
1	Small airports don't "demonstrably demonstrate" an economic contribution... until they score big. This measure is valid only for high use airports and will obfuscate the contribution/performance of lower use airports that are critically important for DR, SAR, resource management, local medical needs, and for critical production parts. How would this be applied to Lower Goose if critical parts are flown in one time in two or three years, but that one time means a turbine is down for hours instead of days?
1	Some airports don't have a financial contribution. They do have a contribution to the safety of the area it is located by providing access during emergencies and natural disasters.

1	This is not under control of the airport, and is speculative at best.

- **Whether the airport meets state and FAA design standards**

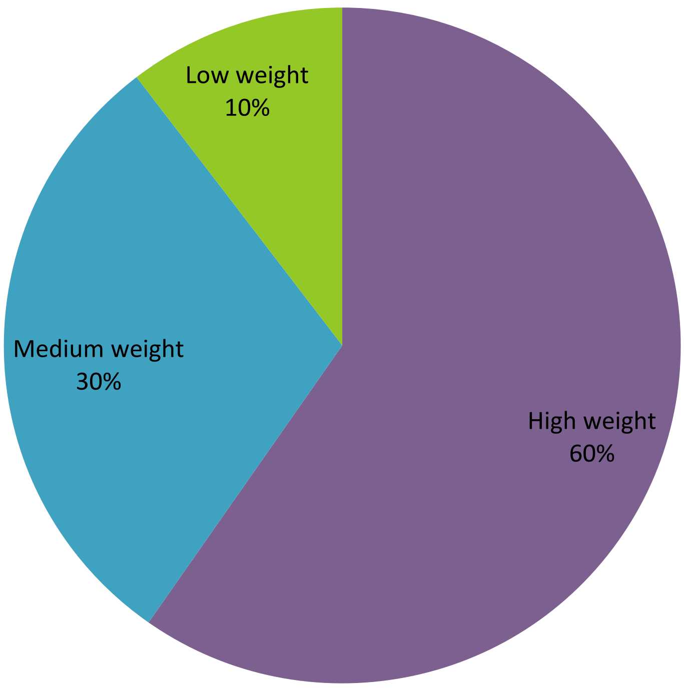


Value	Percent	Count
High weight	33.3%	23
Medium weight	47.8%	33
Low weight	18.8%	13
	Total	69

Count	Response

1	Another "that depends" the FAA design standards don't always apply the same to all airports.
1	The standards have changed over time. One could say they used to meet standards. You don't have a legitimate database to use this criteria
1	This depends on its usage, & funding sources. Privately owned or even publicly owned airfields that don't take federal dollars typically aren't required to meet the federal rules.

- **Ability to support future passenger demand and GA demand**

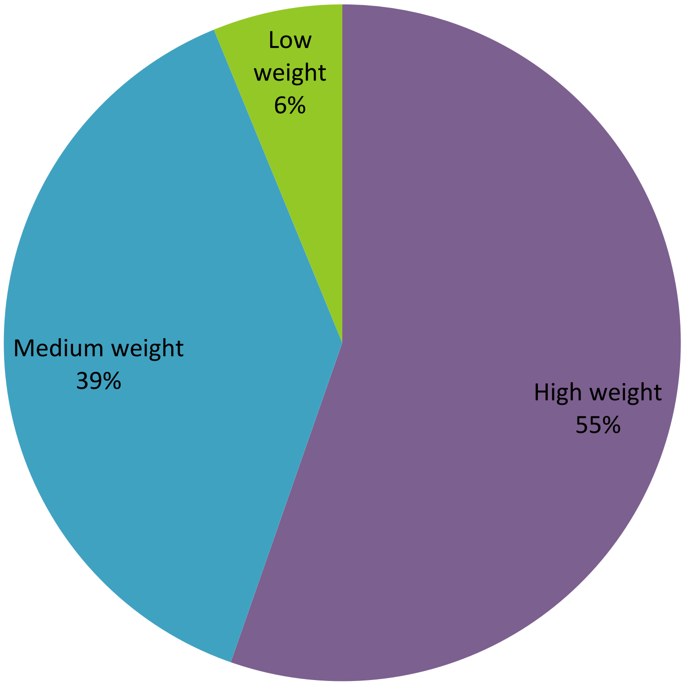


Value	Percent	Count

High weight	59.7%	40
Medium weight	29.9%	20
Low weight	10.4%	7
	Total	67

Count	Response
1	"passenger demand" and "GA demand" are very, very different. These issues should be addressed with much greater attention to detail.
1	Again...WDDOT has no capacity data or true operational data. How wpuld this be measured is a weakness of this. Concept. If it were to be implemented.
1	The federal government is killing GA with more and more rules. More needs to be done to support GA.
1	Unless someone can predict future demand, airport plan should include present and potential capacity

- **Providing for sufficient capacity for the future of Washington's aviation system**

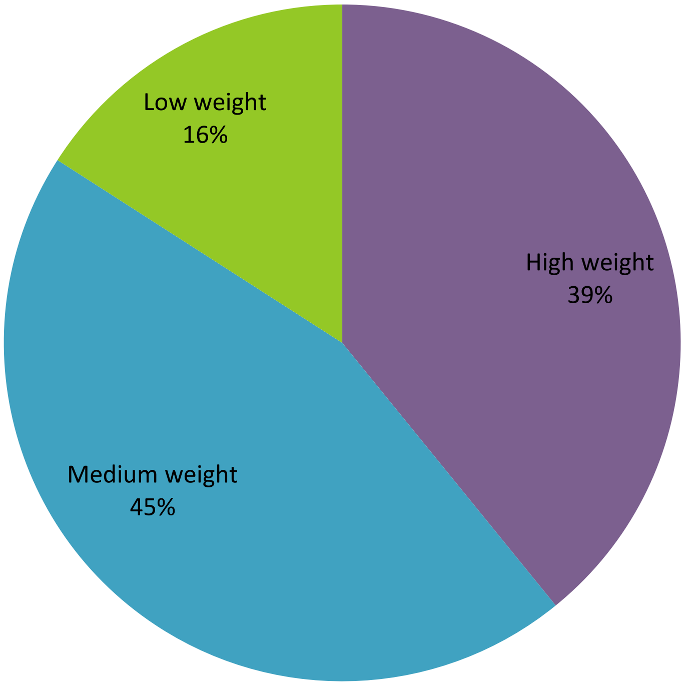


Value	Percent	Count
High weight	55.4%	36
Medium weight	38.5%	25
Low weight	6.2%	4
	Total	65

Count	Response
1	Can we suitably prepare for future aviation uses, or are we going to continue catching up?
1	Does the state have capacity data?

1	I'm not quite sure what 'capacity' means in this context. Does this mean that setting aside more land so that airports can grow in the future to meet greater demand (passenger and freight)?
1	Quit allowing airports to close. As populations increase this pushes users either closer together in less facilities at higher costs or out of flying all together.
1	This is a critical element. "Capacity" cannot be defined as the number of passengers, passenger miles, etc. As a meaningful measure it must address the utility of airports to meet a wide range of needs (economic health of communities, provision of health services, robust prepositioned capacity for disaster relief, SAR bases, etc.)
1	Unclear what is meant by this

- **Whether the airport has a plan in place for financial and environmental sustainability (appropriate to its size)**

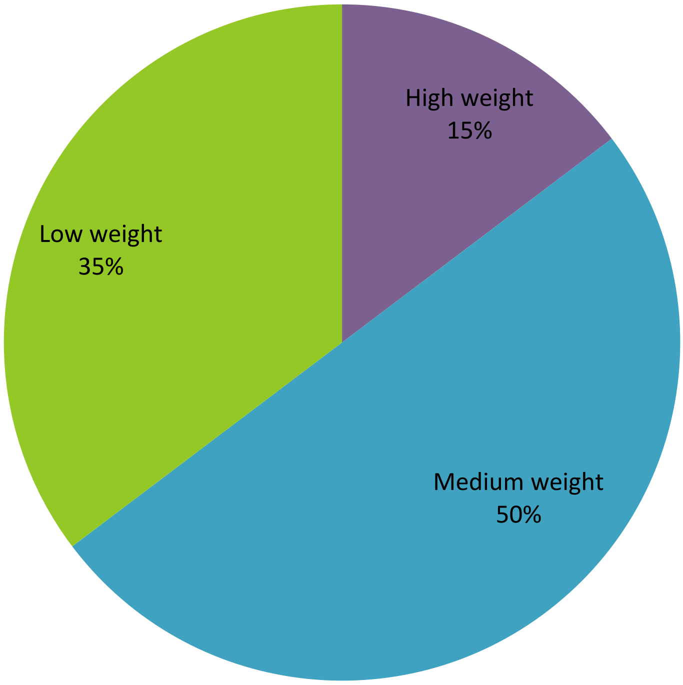


Value	Percent	Count
High weight	39.1%	27
Medium weight	44.9%	31
Low weight	15.9%	11
	Total	69

Count	Response
1	A simple written plan is more useful
1	Cities & counties need to be accountable for their planning beyond the next 20 years after

	receiving FAA dollars. I have seen sales of 20 year options to buy land at a cure the set price that the city only had options to buy stuff current market price. Costing thx payers over $8M difference when the options were exercised. I have seen cities promise businesses they would operate 'in purpatuity" in order to secure airport related developments only to close the airport 20 years later leaving those business hangar facilities no longer on an airport.
1	Too many moving parts. financial plans are key for grants othet than preservation of pavement...leave the environmental issues to EPA and other agecies as needed on a project basis.
1	What is airport sustainability? It is the State's obligation to provide adequate funding for airports. Look at Texas airport funding.

- **Whether there is multimodal access to the airport**

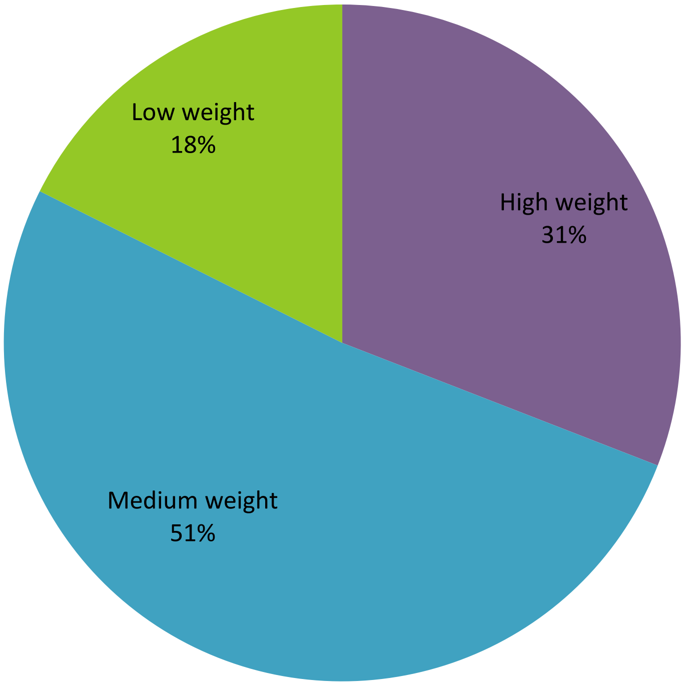


Value	Percent	Count
High weight	14.7%	10
Medium weight	50.0%	34
Low weight	35.3%	24
	Total	68

Count	Response
1	"Multimodal" is a meaningless term for nearly all of Washington's airports, including community airports (Omak, Wilbur, Ritzville, The Dalles, Goldendale, Deer Park, Colville, Puyallup, Chelan, Chehalis, etc. etc. etc.) and Regional

	airports such as Wenatchee, Felts Field, Walla Walla, Pullman-Moscow, Arlington, etc. etc.) The term and criteria are the sole property of larger airports with high numbers of enplanements (SEATAC, KGEG, KPSC...)
1	As stated before, I think this would make it easier to more people to access airports and also potentially reduce the costs associated with infrastructure that was built to support SOV access.
1	Except for major commercial airports, people drive or take cabs - not buses or trains to community airports
1	Generic question. Show me an airport on the planet that is not multi modal. All have roads.
1	I'm not familiar with this topic.
1	Some airports with only aviation access are highly valuable
1	This is a repeated question answered earlier
1	previously answered

- **Whether the airport has a documentable plan for engagement and outreach with the community**

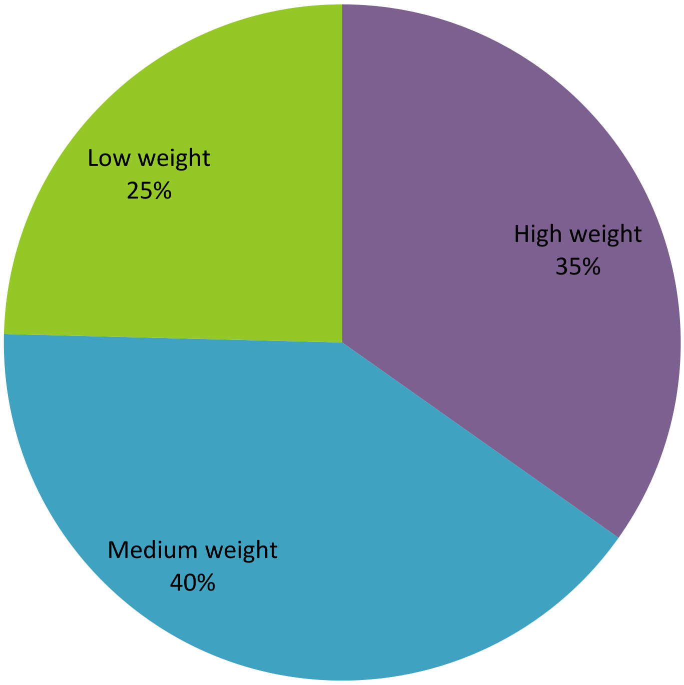


Value	Percent	Count
High weight	30.9%	21
Medium weight	51.5%	35
Low weight	17.6%	12
	Total	68

Count	Response
1	A simple written plan is more useful
1	How many public airports in this state have "airport appreciation" days like Prosser &

	Richland. These seem to be effective in getting people to learn more about their local airport & aircraft related businesses.
1	I think there needs to be a robust community engagement process to fully realize the demands placed on the service and to make sure that all voices have equal representation.
1	Interesting...what microcosm of a community is relevant.. I think this is a factor for the chamber of commerce and the aviation community. Not the community at large.
1	What are the funds truly going to be used for, and are the uses documentable?
1	While I believe this is important, I am not sure this is the best use for scarce state funds.

- **Whether the airport meets airfield geometric safety criteria requirements**



Value	Percent	Count
High weight	34.8%	24
Medium weight	40.6%	28
Low weight	24.6%	17
	Total	69

Count	Response
1	?

1	Again it comes to priorities. Airfields that have been operating for years with now 'unapproved' geometry but no incidents should be lower that fields, even with approved geometries that need safety improvements having had incidents. And again look at how you accomplish the upgrade, do you have to tear out a feature to meet the specs. & intent of the regulation or can you do something like making a displaced threshold that yields improvement like a longer departure runway if the spec only addresses arrivals.
1	Again.. The requirements change. This is a silly question.
1	I'm not familiar with this topic.
1	Many existing community airports (Colville, Oroville, Ritzville, etc), and some Regional airports (Felts Field, Boeing Field) have surrounding physical constraints such as mountains and rapidly expanding incompatible development. Airfield geometry may be secondary to the environment in which the airport is located.
1	Pilots can avoid airports if they are not fully compliant with certain design criteria. Have some non-compliant airports is far better than losing some airports because full compliance is costly or impractical for other reasons. The system needs to be reasonably flexible.
1	That depends on who develops the safety criteria.

Are there other criteria you would like the State to consider?

Count	Response
2	No
1	Criteria are woefully short sighted where they emphasize immediate needs over capacity to respond to disasters. Effective disaster response in a cost avoidance exercise. The WASP must articulate and provide a blue print for how aviation infrastructure will support, enhance, and provide opportunities to mitigate or avoid adverse impacts of disasters that occur from various sources, that vary in scale, and that affect a wide range of persons. What categories (natural i.e. geologic/hydrological/biotic-epidemic/biotic-other/atmospheric/climatic; or human caused i.e. terrorism/sabotage/industrial/war/disease classes of disasters would require mitigation?
1	History of airport and preserving it.
1	How to enhance the availability of low cost aviation resources to attract new/young people to the fun of flying. Not everyone wants to be an airline pilot, but the airports need a plan to support "fun" flying and the education of new people. Too many airports drive young people away with all their policies and rules.
1	Is the airport in a position to help meet the growing demand for GA activities.
1	Pass

1	The answers to this series of questions depends heavily on the size, function and location of the airport.
1	True interest Economic development support from elected officials Educational programs ...promoting youth opportunities... Performance measures Outreach opportunities within WSDOT infrastructure promoting and fostering aviation ...ie. Spokane WSDOT district should promote aviation locally.
1	What facilities are at the airport - Fuel, Services, Businesses, Food, Industrial, etc.
1	Whether the airport can demonstrate how it contributes to the state economy, with a specific analysis for air cargo
1	Volume of GA operations and/or volume of airline operations.

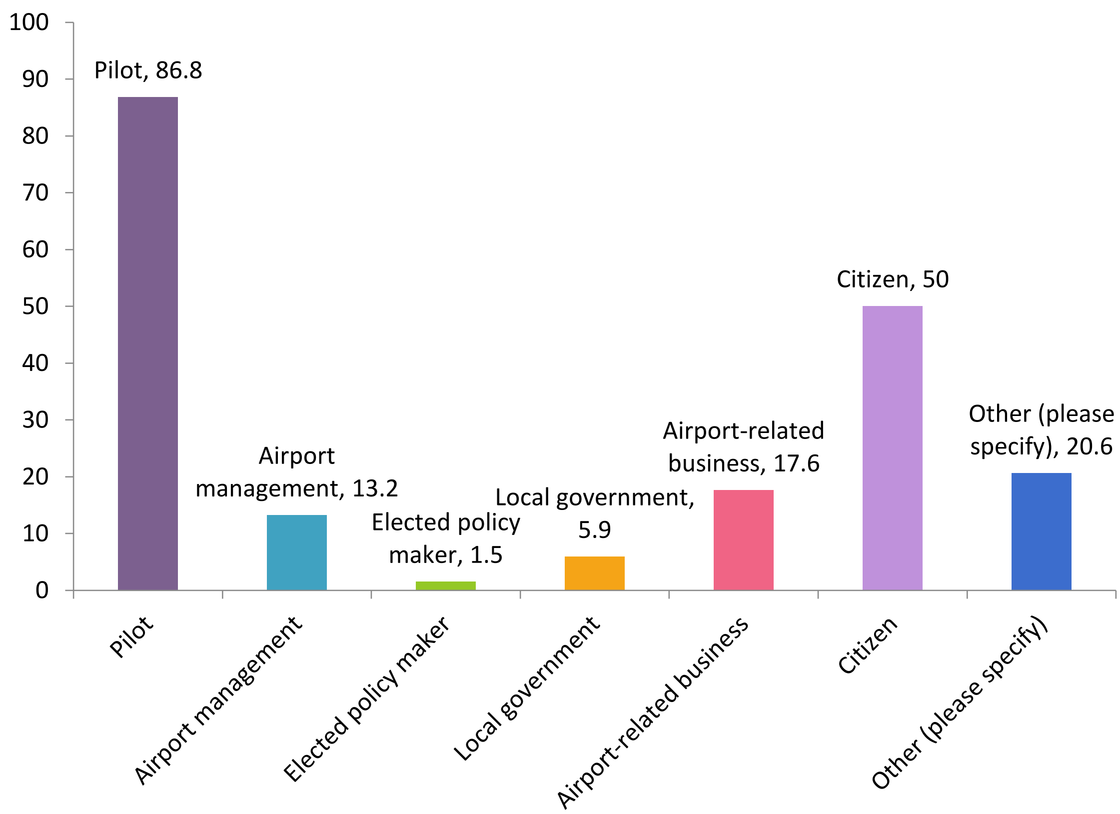
What is the name of the community in which your airport is located?

Count	Response
9	Spokane
6	Richland
4	Gig Harbor
4	Port Angeles
3	Bremerton
3	Seattle
2	Auburn
2	Everett
2	Olympia
2	Pasco
2	Shelton
2	Tri-Cities
1	Anacortes
1	City of Spokane
1	Deer Park

1	Jefferson County
1	KPAE
1	Kenmore
1	Kent
1	King County
1	Ksff
1	Puyallup
1	Pasco Wa
1	SeaTac
1	Sequim
1	Sequim airport
1	Shelton / Sanderson Field
1	Shelton Sanderson
1	Snohomish
1	Spokane County
1	Spokane, WA
1	Spokane, and Whitman County

1	Thurston County
1	Mesa
1	Port Angeles

How would you describe your role in aviation in Washington State? (check all that apply)



Value	Percent	Count
Pilot	86.8%	59
Airport management	13.2%	9

Elected policy maker	1.5%	1
Local government	5.9%	4
Airport-related business	17.6%	12
Citizen	50.0%	34
Other (please specify)	20.6%	14

Other (please specify)	Count
WPA member	2
Airport Sponsor	1
Appointed Airport commissioner	1
Businessman and aircraft owner.	1
Citizen	1
Previously worked as an aerial photographer and glider tow pilot.	1
Retired	1
Search and Rescue	1
State planner - public transportation	1

UAS Researcher at UW	1
WPA	1
WPA Member	1
airpark member	1
Total	14