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**.

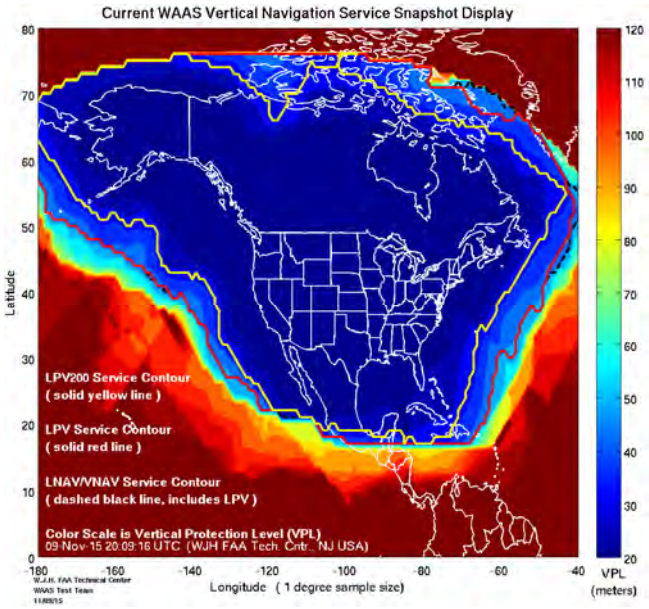

Figure 1 - Current WAAS Coverage Map

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.

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.

Figure 3 - ADS-B Architecture

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:

Recommendation: Conduct periodic meetings that include WSDOT, the FAA and airports. To synthesize activities and share best practices

Recommendation: Increase WSDOT and FAA outreach to academia and other stakeholders.

Recommendation: Consider man-made and natural obstructions when developing NextGen implementation strategies.

Recommendation: 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.

Recommendation: WSDOT should coordinate with FAA TSO to streamline the certification process for ADS-B and GPS navigation hardware.

Recommendation: The FAA should incorporate geo-fencing into NextGen.

Recommendation: The FAA should be mindful of weight, size and cost restrictions for GA aircraft NextGen components.

Recommendation: This NextGen report should outline NextGen implementation next steps for airports and pilots

Recommendation: WSDOT should conduct outreach to pilots to enhance their understanding of the 2020 mandate, and ADS-B equipage requirements

Recommendation: WSDOT should promote airport engagement in NextGen implementation, by providing updates to airport sponsors on the progress of the NextGen study.