

WAAS STATUS and LPV Q&As

QUESTION 1: Is WAAS developmental work complete?

WAAS development work will be complete at the end of 2008, when the Full-LPV Performance (FLP) upgrade is completed. The FLP upgrade adds 13 additional wide-area reference stations (WRS), two replacement geostationary satellites (GEO), an additional WAAS master station (WMS), and various software releases to integrate the new infrastructure and improve performance. After 2008, WAAS will revert to system sustainment and technical refresh activities while focusing more on procedure development and user avionics.

QUESTION 2: Please provide a succinct explanation of the different WAAS approach procedures. What's the difference between GPAS NPA (LNAV), LNAV/VNAV and LPVs (are there other types of approach)? Also, what do these acronyms stand for?

GPS NPA (LNAV) refers to a Non-Precision Approach (NPA) procedure which uses GPS and/or WAAS for Lateral Navigation (LNAV). On an LNAV approach, the pilot flies the final approach lateral course, but does not receive vertical guidance for a controlled descent to the runway. Instead, when the aircraft reaches the final approach fix, the pilot descends to a minimum descent altitude using the barometric altimeter. LNAV approaches are less precise (556m lateral limit) and therefore usually do not allow the pilot to descend to as low an altitude above the runway. Typically, LNAV procedures achieve a minimum descent altitude (MDA) of 400 feet height above the runway.

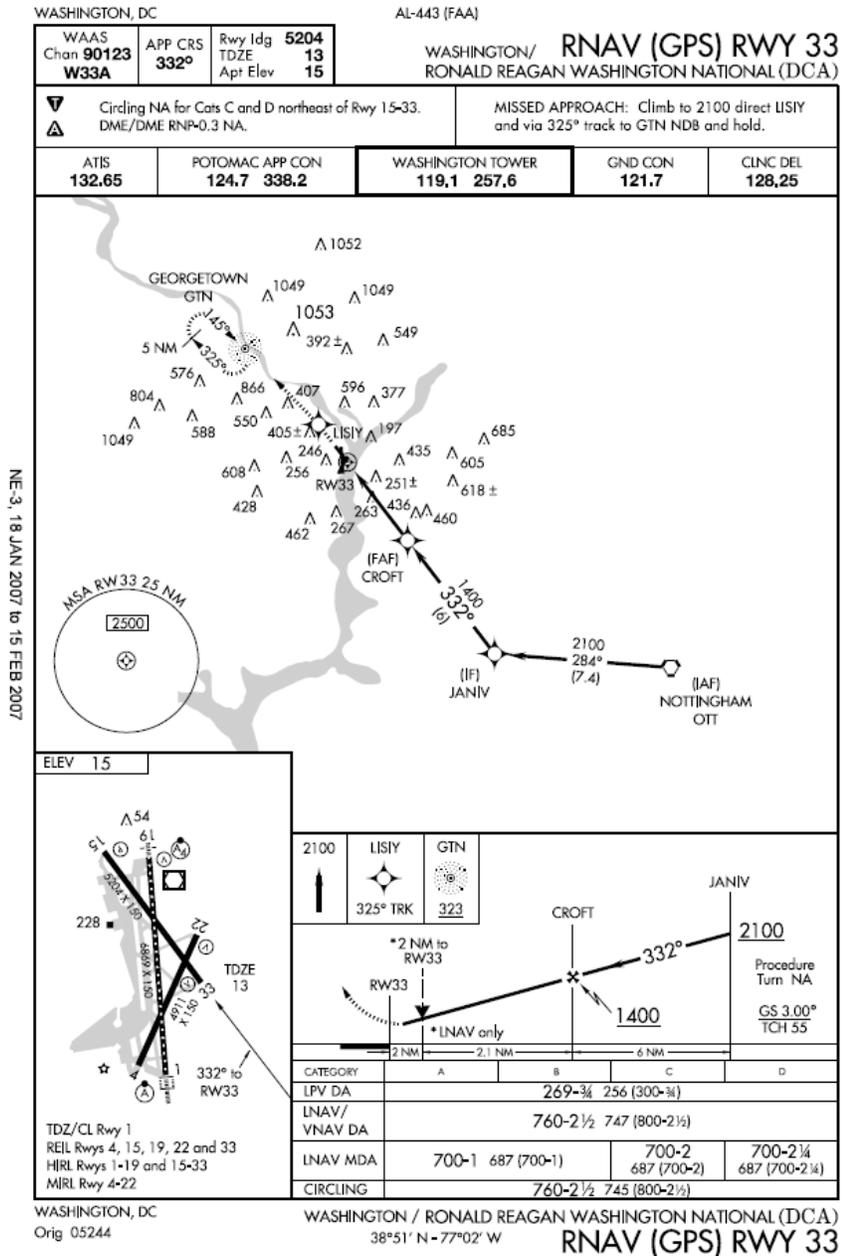
LNAV/VNAV (Lateral Navigation / Vertical Navigation) approaches use lateral guidance (556m lateral limit) from GPS and/or WAAS and vertical guidance provided by either the barometric altimeter or WAAS. Aircraft that don't use WAAS for the vertical guidance portion must have VNAV-capable altimeters, which are typically part of a flight management system (FMS). FMS avionics are more expensive than WAAS receivers. When the pilot flies an LNAV/VNAV approach lateral and vertical guidance is provided to fly a controlled descent, a safer maneuver, to the runway. The decision altitudes on these approaches are usually 350 feet above the runway.

LPV (Localizer Performance with Vertical guidance) is similar to LNAV/VNAV except it is much more precise (40m lateral limit), enables descent to 200-250 feet above the runway, and can only be flown with a WAAS receiver. LPV approaches are operationally equivalent to the legacy instrument landing systems (ILS) but are more economical because no navigation infrastructure has to be installed at the runway. There are over 675 LPV approaches in use today and the FAA is publishing 300 new LPV approaches per year.

LP (Localizer Performance) is a future NPA procedure that uses the high precision of LPV for lateral guidance and barometric altimeter for vertical guidance. These approaches are needed at runways where due to obstacles or other infrastructure limitations, a vertically guided approach (LPV or LNAV/VNAV) can not be published. LP approaches can only be flown by aircraft equipped with WAAS receivers. The minimum descent altitude for the LP approach is expected to be approximately 300 feet above the runway.

The figure below depicts a typical published LPV approach procedure that the pilot refers to while flying the aircraft.

The title denotes the approach as an area navigation (RNAV) procedure. Notice that each RNAV procedure typically includes three of the approach types previously described. This is done to ensure as many aircraft as possible, of different types and equipage, can fly the approach and to provide operational flexibility if WAAS becomes unavailable. Some aircraft may only be equipped with GPS receivers so they can fly to the LNAV decision altitude. Aircraft equipped with GPS and FMS can fly to the LNAV/VNAV decision altitude. WAAS equipped aircraft can fly to any of the decision altitudes. If for some reason the WAAS service becomes unavailable, all GPS or WAAS equipped aircraft could revert to the LNAV decision altitude and land safely using GPS-only.



QUESTION 3: How many WAAS procedures does the plan ultimately require?

The current FAA goal in the WAAS business case calls for approximately of 8900 WAAS procedures. This number coincides with all of the available public use runways, IFR and VFR in the U.S. National Airspace System (NAS) that are at least 3200 feet in length. We continue to assess the available runways that do not have published approaches each year to establish the priority locations for the following year production goals.

QUESTION 4: Do you have a "waterfall"/timeline regarding when and where WAAS approach procedures are supposed to be rolled out? Also, how has this deployment schedule changed over time, has there been slippage?

Response:

The FAA flight plan goal requires 300 WAAS procedures to be published in FY2007. In FY2006 over 350 LPV procedures were published.

The OMB-300 goal requires 300 LPVs at Non-ILS Runways. In FY2006, 287 LPVs were published at Non-ILS Runways. The goal was missed due to a lack of obstacle data for non-ILS runways, caused by an inadequate number surveys conducted in FY2005, due to lack of funding.

As of January 2007, there are a total of:

- 675 LPV,
- 2942 LNAV,
- 1057 LNAV/VNAV procedures published.

The FAA maintains a web site which provides the production plan for future WAAS procedures over a five year window. It is available online at: <http://avnweb.jccbi.gov/schedule/production>

QUESTION 5: Can you succinctly break down the mechanics/steps in implementing a WAAS procedure and explain each step in the process (e.g. site survey, publication in the Federal Register etc.)?

The following addresses the major steps associated with the various FAA offices and their responsibilities:

Procedure Request: The first step in the procedure development process is the request for the procedure. This request can be made by virtually anyone associated with the proposed procedure. It can be a user, airport manager, or region. Coordination in this phase is critical and all potential sponsors should coordinate their procedure requests through the airport manager, airport officials, and State aviation representative. The request is to be initiated by completing a request form online and contacting the appropriate Flight Procedures Office.

Regional Airspace Procedures Team (RAPT) Coordination: The request is forwarded to the RAPT for their assessment and coordination. The RAPT reviews the procedure request for complete and accurate data. If necessary the procedure request may be returned to the requestor for additional data. An example of data requirements are airport layout plan, airport terrain/obstruction survey¹, lighting and weather facilities, communications facilities, environmental considerations, and airport owner concurrence. The RAPT determines the priority of the procedure based on guidelines contained in FAA Order 8260.43, Flight Procedures Management Program. If everything is in order the package is forwarded to the National Flight Procedures Group (NFPG).

1. Production of LPV approaches requires an obstruction survey, if obstruction data for the runway does not exist. WAAS has funded surveys to ensure sufficient obstruction data exists to meet the FAA goal to provide 300 LPV approaches per year. Typically, 450 surveys are required to obtain 300 qualifying runways for LPV procedures. In order to meet the goal to produce 300 LPVs in any year, approximately 450 surveys will need to be planned and funded in the previous year to ensure the obstruction data is available for the FAA procedure designers.

Procedure Development: The request is assigned to a specialist who evaluates it for layout/design. The findings are coordinated with the appropriate air traffic control facility. Airspace actions, spectrum analysis, and unique safety considerations are processed as required. After the IAP is designed it is forwarded to quality assurance for evaluation. The IAP is then finalized and forwarded to the Flight Inspection Central Operations (FICO) to be flight checked.

Flight Inspection: The FICO schedules the approach for commissioning at the first opportunity based on priority of other facilities and approaches. The flight inspection crew evaluates the procedure in accordance with FAA Order 8200.1, U.S. Standard Flight Inspection Manual. If changes are required the approach is returned to the procedure specialist for correction. If not, the approach is returned to the NFPG where it is transmitted to the National Aeronautical Charting Group (NACG) and National Flight Data Center (NFDC).

Publication: NFDC publishes the approach in the Federal Register and NACG initiates the graphical design. Following design completion, the approach is published on the first 56 day cycle available. NACG also prints and distributes the approach.

QUESTION 6: About how long does it take to complete/publish an individual WAAS procedure from start to finish?

There are many factors involved in procedure development, such as airport infrastructure requirements, adequate airport and obstacle data, environmental concerns, and general coordination. The internal process for procedure production is 18 months from start to publication. However, that is based on all required information (including airfield and obstacle surveys) being complete. If an obstruction survey must be obtained, the time increases to two years.

QUESTION 7: Regarding avionics equipage: How many aircraft are currently WAAS equipped?

Approximately 4,200 aircraft are WAAS equipped to date. We expect this number to increase as new avionics, avionics upgrades and WAAS enabled procedures become increasingly available. On November 2006, Garmin International announced that a WAAS upgrade to their popular 400/500 series receivers would be available for \$1500 starting in January 2007. To date, Garmin has sold approximately 75,000 of these receivers which would be eligible for upgrade. At this time, we do not know how many receivers have been upgraded.

QUESTION 8: According to your business case, how many aircraft must be equipped to make the investment worthwhile?

- Our current business case assumed 100 percent of Air Taxi aircraft and IFR rated general aviation aircraft are equipped by 2016 and Air Carrier equipage at 25%. This will allow the reduction of existing infrastructure.

QUESTION 9: Does FAA have a timeline or various milestones for when FAA would like to see aircraft equipped (e.g. "x" number of aircraft should ideally be WAAS equipped by "y" date)?

Based on 500 aircraft equipping with WAAS each year, the break-even year is 2019 (per the current RPD), however, we expect the equipage rate to accelerate as more WAAS-enabled procedures become available; for example, Garmin alone is currently producing ~300 WAAS capable receivers per *month*.

QUESTION 10: Will there be a negative impact of the 2007 CR, such as that it might slow down the deployment of approach procedures. Can you give me a little more elaboration on the negative consequences?

Under current guidance, the FY2007 Continuing Resolution restricts WAAS funding to the FY2006 appropriation of \$92.1M. The FY2007 request was \$122.4M so the CR results in a \$30.3M reduction to the program. Our current plan is to shift priorities to "must do" activities such as completing the system upgrades already under contract to limit more costly schedule slips. This will result in reduction or elimination of funding for obstacle surveys, avionics, lower priority development activity, and technical support that will result in an overall slip to the program. Due to the survey work accomplished in prior years, we still expect to meet the FAA goal to produce 300 LPV approaches in FY2007.