

Appendix G

Airspace Feasibility Study



**Feasibility Study for
Crawford, Murphy and Tilly
Evaluating the Impact on Airspace for a
Proposed Southern Runway Extension at
Chicago Executive Airport (KPWK),
Wheeling, Illinois**

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Preliminary Draft

Proposed Southern Runway Extension Airspace Study

1. Executive Summary

Jeppesen has provided consultations and support to Crawford, Murphy and Tilly (CMT) to address the proposed extension to the south of Runway 16 at Chicago Executive Airport (KPWK) (Figure 1). In this report Jeppesen has evaluated the known obstacles and terrain as well as the Chicago-O'Hare International Airport airspace bordering Chicago Executive Airport.

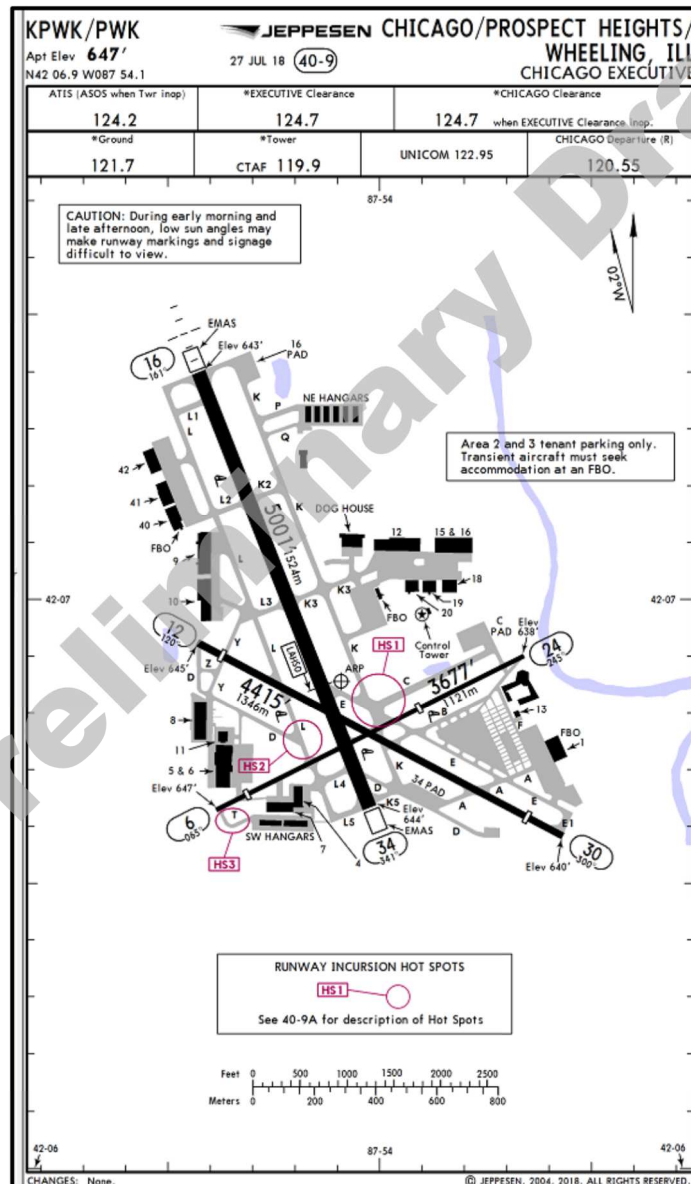


Figure 1: KPWK Airport Diagram

The objective of this study was to consider the departure and arrival instrument procedures protection surfaces taking advantage of the experience of Jeppesen Airspace Specialist while using software to assist in the evaluation.

Jeppesen captured obstacles from the Federal Aviation Administration database and ingested them into the software for consideration. The airspace team used the Terminal Area Route Generation and Traffic Simulation (TARGETS) tool modeling software to model the surrounding airspace and measure the impact of proposed changes to the airspace. In addition to the TARGETS software Jeppesen also used Flight Procedure Design and Management (FPDAM) software developed by Ingegneria Dei Sisitemi (IDS) for review of instrument procedure build parameters along with obstacles and terrain.

Limited in scope to a review of the obstacles, terrain and airspace, the study employed these modeling tools which allowed airspace specialists to develop a detailed airspace model of the proposed Runway 16 southern extension. Specific findings and details of this study are found in the following pages.

2. Opening/Analysis Process

Jeppesen assembled a team made up of air traffic controllers, airspace designers and engineers with experience in the development and implementation of new or revised airspace designs. The team has developed new airspace and instrument procedures worldwide to include Seattle, Denver, Beijing, Moscow, Sochi, Shanghai and Chicago Executive Airport.

Along with the expertise of the Jeppesen team are certifications in procedure design. The Jeppesen airspace and corporate quality teams have obtained certifications in different countries covered by the International Civil Aviation Organization (ICAO) regulatory guidance to include but not limited to:

- United States FAA
- United Kingdom NATS
- Australia CASA
- United Arab Emirates CAA

In addition to the country certifications, Jeppesen has received a certification from the International Organization for Standardization, ISO 9001:2015.

The process (Figure 2) which the Jeppesen team uses to analyze airspace is to ingest the instrument procedure data along with the airspace into a software tool developed by Ingegneria Dei Sistemi (IDS) to create a model of the airspace designs. FPDAM® fully supports all types of procedures including SID/Departures, STAR/Feeders/Arrivals and approaches for conventional, RNAV/PBN, RNP AR, APV/LPV, GLS and Baro-VNAV guidance systems. It allows the Jeppesen airspace specialist to perform assessments of complex flight procedure designs through automation and 3D projection and when used with the Terminal Area Route Generation and Traffic Simulation (TARGETS) tool it provides the ability to check airspace against instrument procedures three dimensionally so the specialist sees the most accurate and detailed portrayal of the airspace available.

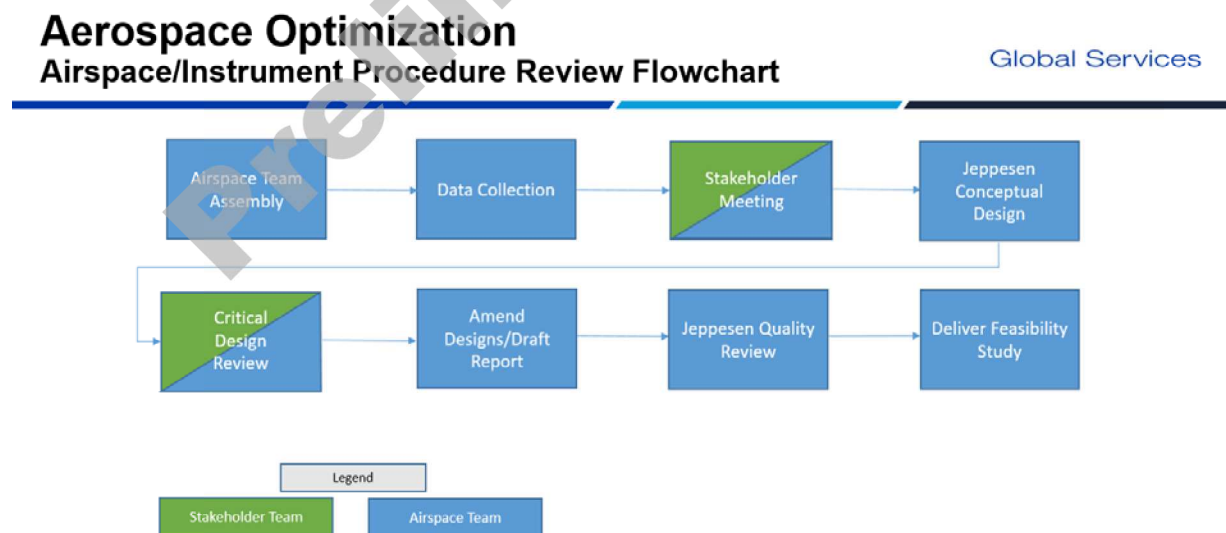


Figure 2: Aerospace Optimization Process Flow

The application of air traffic control principles are part of the analysis of the conceptual airspace design is also considers air traffic usability and efficiency. After the analysis recommendations for improvement are developed.

The team reviews the instrument procedures for safety, efficiency, and ease of use by both aircrews and ATC and develops recommendations. These recommendations are then reviewed by independent airspace designers as part of Jeppesen continuing quality control process. Once the review is completed a final report is written and delivered.

3. Parameters and Assumptions

3.1. Runway build details:

Proposed Runway Threshold Coordinates were calculated geodetically based on projections from the current runway.

Analyzed Distances:

1200 foot extension to the South

1700 foot extension to the South

New Runway End Elevations estimated from known sources

3.2. Scenarios to review

RWY 16 Approaches and Departures using current track and altitude data

RWY 34 RNP Approaches using the pending track and altitude data. Additional analysis of potential track and altitude data that would be required to keep flight path outside KORD Class B airspace.

3.3. Known Issues or limitations:

Existing Obstacles (buildings/antennas/ terrain/trees) – it was assumed that all property under the required approach surfaces will be acquired and cleared to meet FAA requirements. Assessment shall include only known obstacles from current FAA databases and airport surveys.

Neither TARGETS or FPDAM software contain design capability for FAA conventional procedures, modeling shall follow most appropriate RNAV specification to generate flight tracks and obstacle surfaces.

Measured distances are estimations and may be subject to error due to software limitations.

4. Analysis of the Proposed Runway Extension

After Jeppesen's comprehensive review of the airspace and instrument designs based on the proposed Runway 16 extension of 1,200 and 1,700 feet to the South Jeppesen has concluded that instrument approaches to the new Runway 34 Threshold and the airspace associated with these approaches has the most profound impact on airport operations.

In Jeppesen's experience some but not all impacts can be negated through careful design principles. However, some instrument procedures may not be used or may not be used by some operators.

Each procedure that currently exist at Chicago Executive Airport has been evaluated and individually analyzed. In the following paragraphs the observation of the impact on the procedures is outlines for each individual instrument approach and departure procedure.

4.1 Runway 16 Procedures

4.1.1 CABAA Visual Departure:

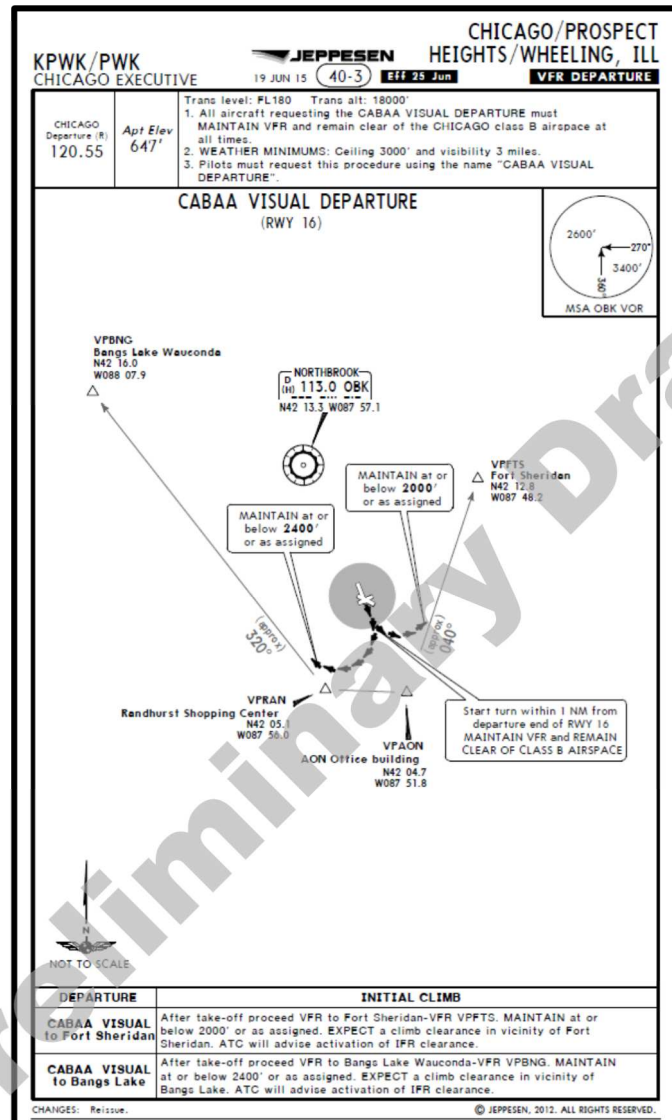


Figure 3: CABAA Visual Chart

The CABAA Visual Procedure requires the departing aircraft to start a turn within 1 NM of the departure end of the runway. In order to make a comparative analysis a nominal track that would approximate the current procedure was utilized and calculated to be a 0.9NM radius (allows the aircraft to stay outside Class B and align with course to waypoint). A 1200 foot extension requires a radius of .88NM. For a worst case runway extension of 1700 feet a radius of approximately 0.80NM is required to remain outside the Class B and to align with the depicted courses to the waypoints.

4.1.2 JORJO 5 and MONKZ 5 RNAV Departures

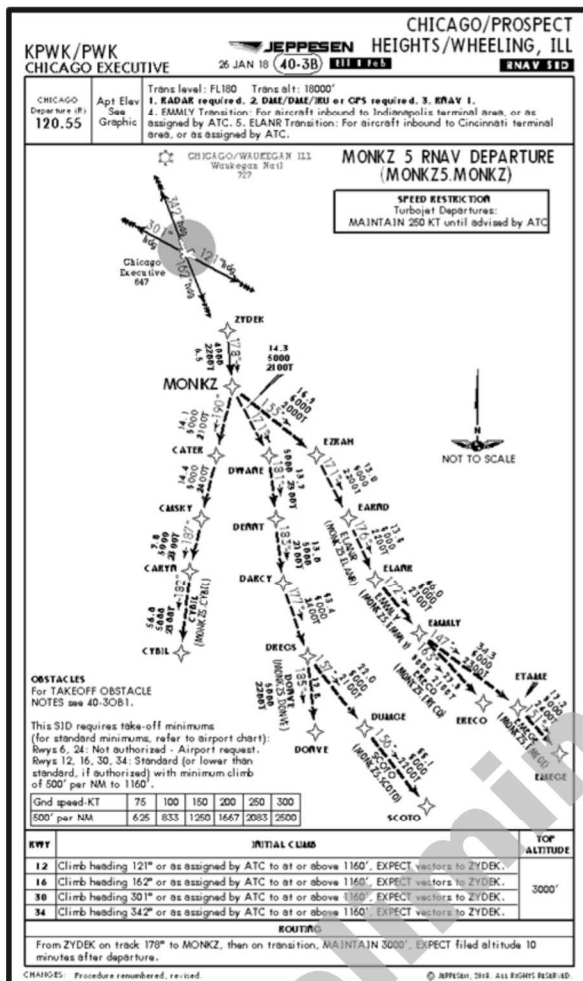


Figure 4: MONKZ 5 RNAV DEPARTURE

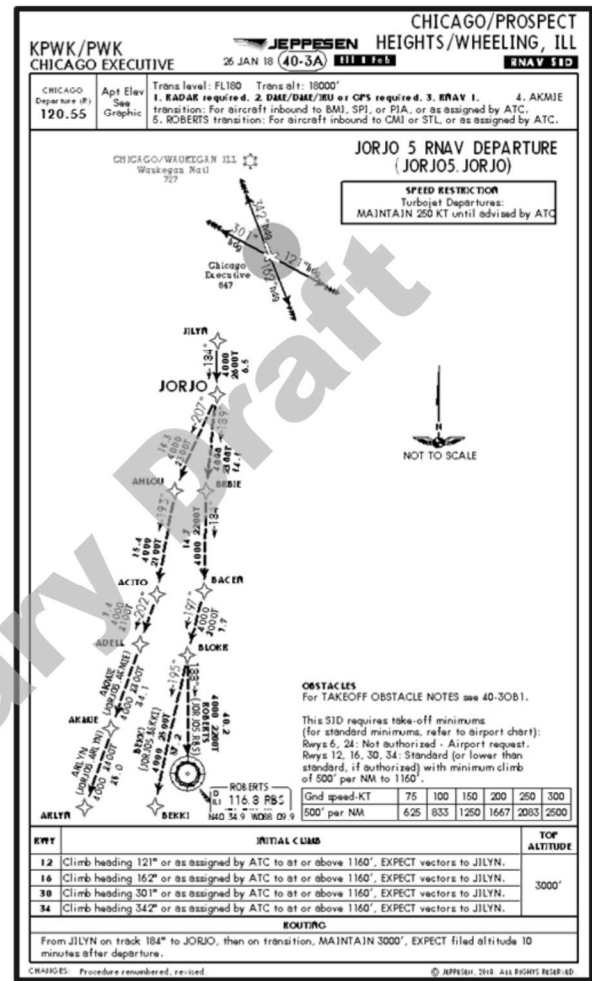


Figure 5: JORJO 5 RNAV DEPARTURE

The JORJO 5 and MONKZ 5 RNAV Departures were modeled in TARGETS software to review known obstacles and flight tracks. Based on the assumption that land shall be acquired and cleared to meet FAA requirements it is expected that the close-in obstacle list would be reduced. No new obstacles were noted during the assessment. No major change in flight path is expected or modeled with either runway extension. Discussions with FAA during the Stakeholder meeting indicates the current operations require a turn out and climb prior to ATC vectors to the STAR and either 1200 or 1700 ft extensions should have little impact in that regard.

4.1.3 PAL-WAUKEE 4 Departure

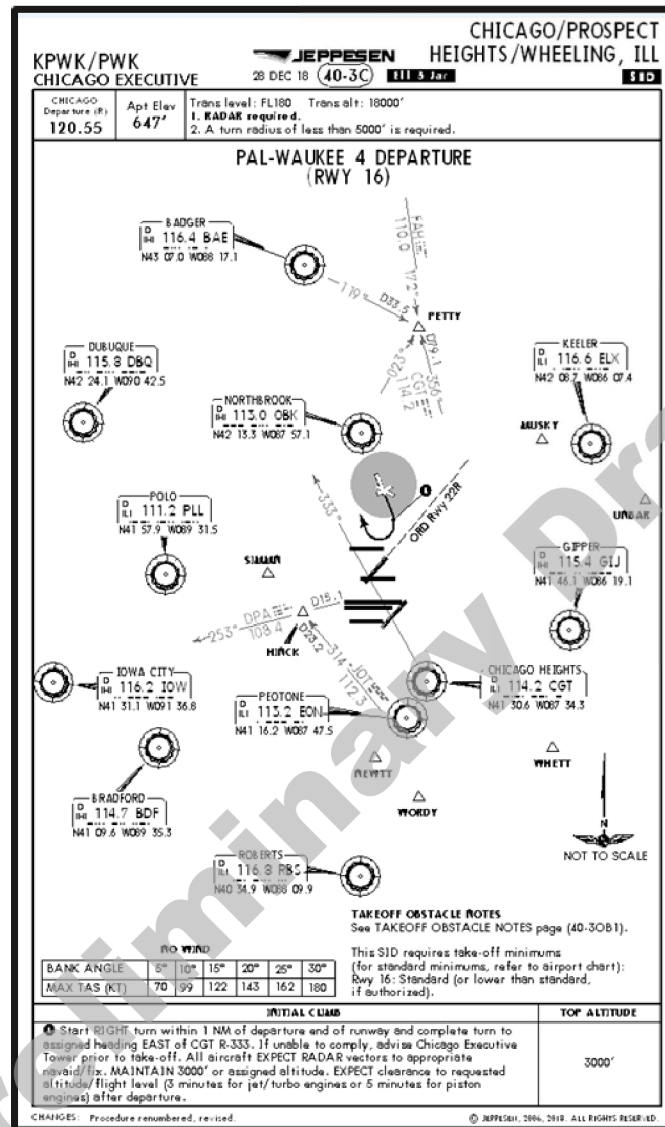


Figure 6: PAL-WAUKEE 4 Departure

The PAL-WAUKEE 4 Departure was modeled in TARGETS software to review known obstacles and flight tracks because of the changes noted from the PAL-WAUKEE 3 Departure. The new PAL-WAUKEE 4 Departure, Eff 3 Jan 2019. A 1200 ft runway extension will cause a change in the nominal flight path which will reduce the distance to the Class B from approximately 2000' to 800'. A 1700 ft runway extension will cause a change in the nominal flight path which will reduce the distance to the Class B from

4.1.4 ILS or LOC RWY 16



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were not affected by runway extensions. The missed approach flight path was verified as having no change with runway extensions. The Obstacle Assessment does indicate potential increase in circling minima.

4.1.5 RNAV (GPS) RWY 16

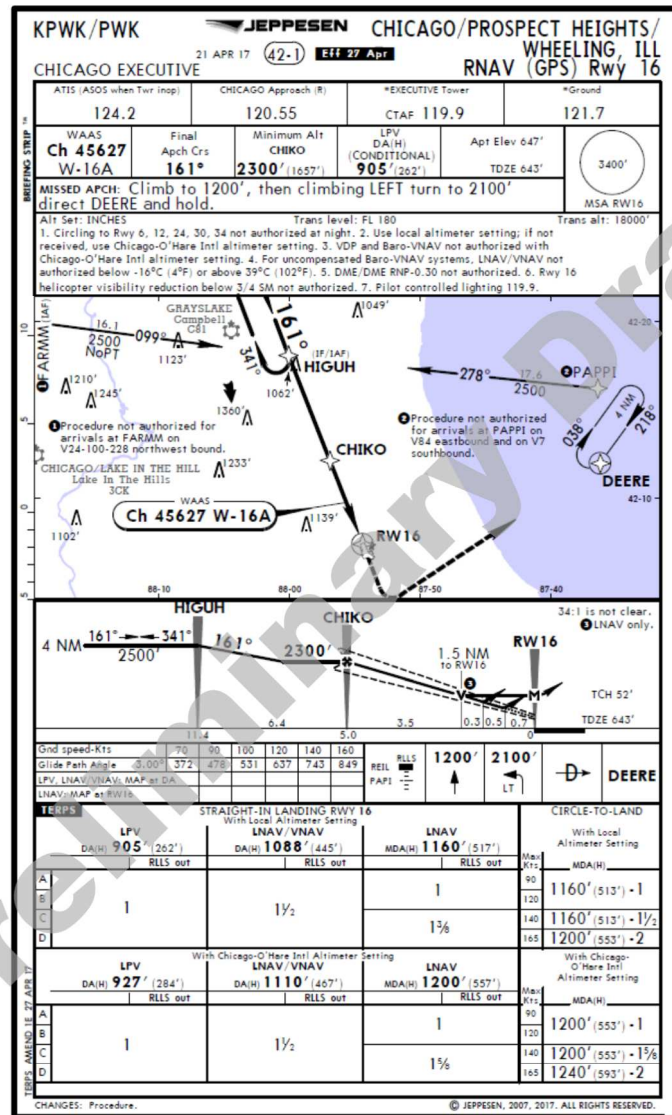


Figure 8: RNAV (GPS) RWY 16

The RNAV (GPS) RWY 16 procedure was model in TARGETS software to review known obstacles and flight tracks. Initial, Intermediate and Final segments of approach are not affected by runway extensions. The missed approach flight path was verified as

4.1.6 VOR RWY 16



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4.2 Runway 34 Procedures

4.2.1 - RNAV (RNP) N RWY 34 (Boeing Special)

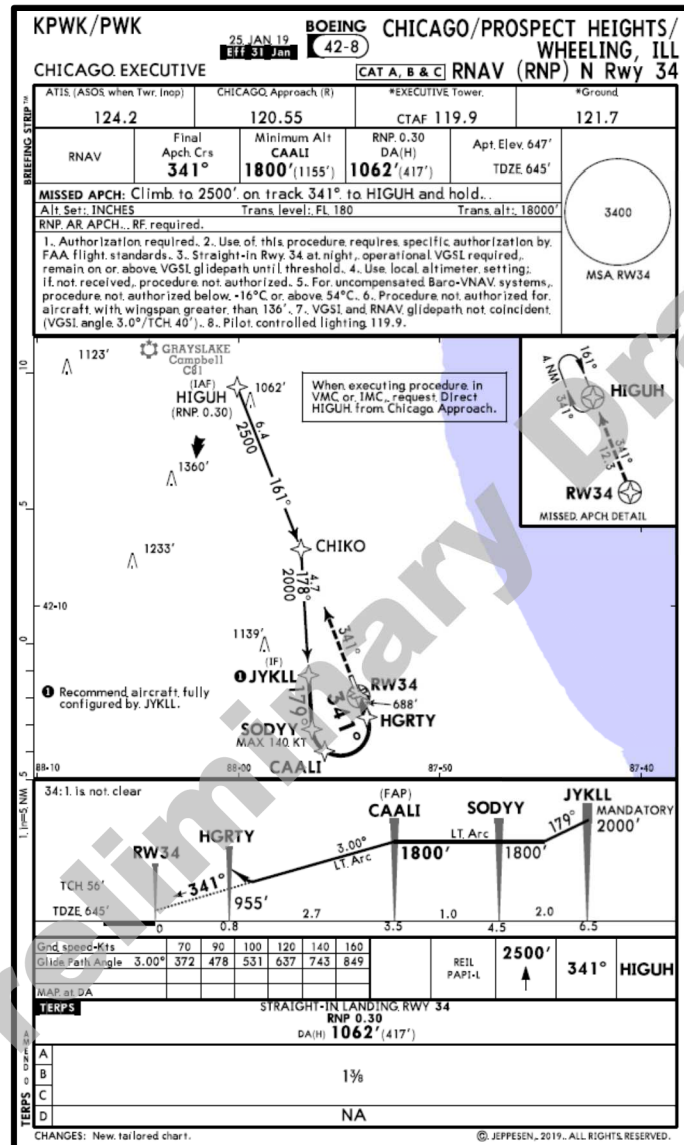


Figure10: RNAV (RNP) N RWY 34

The RNAV (RNP) N RWY 34 procedure was modeled in TARGETS software to review known obstacles and flight tracks. Because the threshold of Runway 34 is the procedure missed approach point, any changes to the runway length will require a

redesign, revalidation and FAA approval of the procedure. The current design already include minimal buffer to the Class B, some changes may not be acceptable to FAA.

4.2.1.1. 1200 foot Runway Extension:

If Runway 34 is extended by 1200 feet the RNP “N” procedure requires a minor redesign to provide a safe buffer outside the Class B airspace. At the closest point the current procedure flight track is approximately 350 ft outside the Class B airspace. The change in threshold position requires this distance to be reduced to approximately 45 feet if current flight track parameters are retained. During the procedure flight validation observed performance of the RNP aircraft (+/-100 ft of centerline) indicates the flight path could infringe on the airspace during normal flight operations. Altering the aircraft/track parameters allows the distance to be increased back to the current value (or slightly greater). This should allow the performance of the RNP aircraft to remain outside the airspace during normal flight operation using a predicted path. The parameters required are near the maximum allowed by criteria and there is a risk that during flight testing additional restrictions might render the procedure unusable due to limitations encountered in a real world scenario.

4.1.1.2. 1700 foot Extension:

If Runway 34 is extended by 1700 feet and using the current RNP “N” procedure design parameters the flight track would penetrate the Class B airspace in two areas. This requires modification to the design, along with new flight validation and FAA approval of the modifications. Moving the nominal track outside Class B requires altering the aircraft/track parameters to a greater extent than what is required for a 1200 ft. extension. The parameters required cause the calculated limits to be at or the absolute maximum allowed by FAAO 8260.58A, 1-2-5c3b1. During the procedure flight validation observed performance of the RNP aircraft indicates it is likely that the flight path would infringe on the airspace during normal flight operation. It is very likely that during flight testing the actual values may exceed the calculated values and to prevent airspace conflicts it could cause additional procedure restrictions which render the approach unsuitable.

4.2.2 - RNAV (RNP) M RWY 34 (Boeing Special)

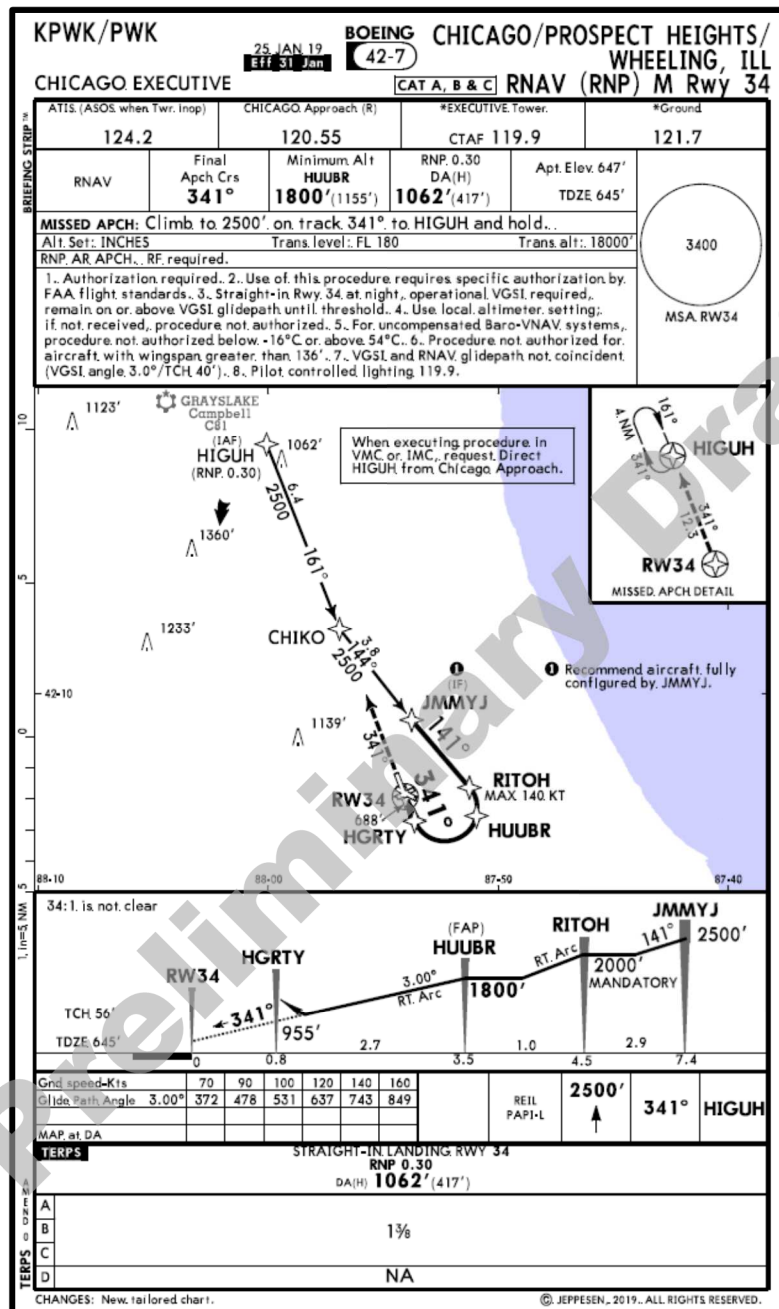


Figure 11: RNAV (RNP) M RWY 34

The RNAV (RNP) M Rwy 34 procedure was model in TARGETS software to review known obstacles and flight tracks. As with the RNP N procedure the threshold of Runway 34 is the procedure missed approach point and any changes to the runway

length will require a redesign and validation of the procedure. The current design has a larger buffer to the Class B than the RNP N procedure.

4.2.2.1. 1200 foot Runway Extension:

The change in threshold reduces the distance from flight track to Class B to be reduced to approximately 2000 ft. During the flight validation observed performance of the RNP aircraft indicated it should not infringe on the airspace during normal flight operations.

4.2.2.2. 1700 foot Runway Extension:

A 1700 foot extension would reduce the track to Class B distance to approximately 1800 ft. During the flight validation observed performance of the RNP aircraft indicated it should not infringe on the airspace during normal flight operations.

5. Results, Observations and Recommendations

5.1. Results

- 5.1.1. Instrument procedures from the North (Runway 16): With Instrument procedures the likelihood of the greatest impact from runway and obstacle changes occurs in the final and missed approach phases of flight. Because the Runway 16 approach procedures approach from the North the Southern extension has no impact on the final or missed phases of flight. Therefore no minima changes are anticipated based on known obstacle and terrain.
- 5.1.2. Instrument procedures from the South (Runway 34): An extension of the runway to the South has a probability of impacting instrument procedures from the South because the protected areas will be moved in relation to the threshold, however based on the current obstacle and terrain database no impact or changes to minima are anticipated at this time.
- 5.1.3. Circling Procedures: There could be an impact from future unknown obstacle or terrain changes which could have the greatest probably of impacting the circling procedures. Circling procedures have protected areas

that center on the thresholds. If the threshold is extended the possibility of encompassing an obstacle that may have not been included in the previous protected area is greater. Current analysis does not show any impact from the extension, however, future obstacle changes as well as terrain changes could impact the circling areas that may not impact the current circling procedures.

5.1.4. Airspace: The runway extension as proposed at both the 1200 and 1700 foot lengths has no impact to the current Runway 16 approach procedures.

The new Runway 34 RNP procedures will be impacted by any extension of the runway to the South by either the 1200 or 1700 foot lengths. Because of the proximity of the turn (radius-to-fix leg) from the West (Figure 10) any extension to the South will cause the redesign of the procedure from the West downwind and the approval process for special procedures and consideration from ATC will have to be evaluated. During this evaluation an approval is not guaranteed and could result in denial of the continued use of the procedure.

5.2. Observation

During the Stakeholder meeting FAA representatives provided insight into current ORD operations and afterward a review of the current and proposed changes to ORD were undertaken to see if further relief could be provided to the RNP procedures to allow the full 1700 foot extension. Despite closure of ORD Runways 14L/R-32L/R the airspace to the North of the airport is still heavily utilized by arrival traffic and is designated for the missed approach tracks for 9L-27R.

5.3. Recommendations

- 5.3.1. Coordination: Once the decision is made to proceed with one of the runway extension there cannot be enough coordination. This coordination must take place with the airport authority, the Federal Aviation Administration's divisions of Air Traffic, Flight Standards, All Weather Operations and Boeing as owners of the special procedures.
- 5.3.2. Analysis: Jeppesen recommends that another analysis of the extension be accomplished when the decision to proceed is made. The longer the time between this analysis and the time of project execution the greater the likelihood of new obstacles being erected exist. These new obstacles could possibly impact the instrument procedure minimums to Runway 16 and 34, as well as the circling minima to both runways.
- 5.3.3. Airspace: Recommendations: Jeppesen recommends that any runway extension be limited to 1200 feet or if a 1700 foot extension is used, a 500 foot displaced threshold for RWY 34 be utilized. This should allow minimal changes to the RNP procedures and still provide a TODA/TORA advantage for Runway 16 arrivals and all departures.

6. Summary

As stated earlier in this report, the objective of this study was to consider what impact a runway extension to the South of 1200 and 1700 feet would have on the instrument procedures currently published at the Chicago Executive Airport (KPWK).

Jeppesen has concluded that based on the current obstacle and terrain database that there would be minimal or no impact to the procedures serving Runway 16 including both the Approach and Departure procedures. There is a probability that any new obstacles built between the time of this report and implementation may have an impact on the Runway 16 procedures. The FAA's Obstacle Evaluation program does not include consideration for the extension of a runway until it is confirmed that the extension will take place. Possibility having a greater impact to the Runway 16

instrument procedures would be the circling minima's from any obstacles constructed from the time of the report and implementation of a runway extension because of the large area that is protected for circling.

The special procedure from the West downwind serving Runway 34 that Boeing Executive Flight Operations currently owns would be impacted by the close proximity of the Chicago O'Hare International Airport airspace. There is a possibility that the procedure as built could not be reinstated due the flight track and the airspace boundary. Approval for continued use cannot be guaranteed.

In conclusion a runway extension will have little or no impact on the instrument procedure serving Runway 16. The 'Special' RNP for Runway 34 from the west downwind would be impacted from this extension of either 1200 or 1700 feet and continued use is questionable.