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F500-L17-025

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**Subject: Task 8: Airport Expansion Feasibility Analysis - *Airport Selection Considerations***

Dear CTA. Peláez:

As stated under Task 8 of the Agreement between the Grupo Aeroportuario de la Ciudad de México (GACM) and MITRE, the latter is to assist the Mexican aviation authorities in the examination of problems relating to airport expandability in Mexico. Not only will this resolve important future problems, but also Mexican technical people will learn and experience how to examine potential aeronautical modifications at Nuevo Aeropuerto Internacional de la Ciudad de México (NAICM) in the future. As part of this task, specialized methodologies utilized by MITRE will be transferred to Mexican engineers and controllers so that they learn about MITRE's way of conducting runway expansion feasibility analyses.

## **Background**

This task commenced in 2015 with the preliminary selection by Mexican authorities of three candidate airports to be considered. More specifically, the task was discussed with Lic. Yuriria Mascott, Undersecretary of Transportation, yourself, and other officials during a visit to MITRE on 20 November 2015. During that visit, the following candidate airports were identified:

- Guadalajara Airport (GDL)
- Puerto Vallarta Airport (PVR)
- Tijuana Airport (TIJ)

Next, MITRE received a letter from Aeropuertos y Servicios Auxiliares (MITRE's former Party of the above-mentioned Agreement) on 13 May 2016, which offered options for MITRE's consideration on how to address the selection of an airport for Task 8. Based on the information and considerations described in that letter, MITRE agreed to

discuss the matter directly with the DGAC. Therefore, MITRE communicated back and forth with you via e-mail in September 2016 regarding the selection of an airport for MITRE to analyze.

Your opinion at that time was that the order of priority should be as follows:

- TIJ (both examining how to maximize the capacity of the current airport, as well as identifying a potential location for a new airport)
- GDL
- PVR

As a result, MITRE examined the potential scope of work and options pertaining to each of the above-mentioned airports for your consideration. The purpose of this document is to provide background information on the above airports and describe MITRE's opinions regarding the candidate airports and the types of analyses that could be conducted so that Task 8 can continue.

The rest of this document is organized as follows: a brief overview of annual operations at the candidate airports and a description of the airports, including site limitations, as well as the potential for runway expansion are provided. MITRE's recommendations regarding the airport to be selected and the type of work that could be conducted are then discussed.

### **Initial Considerations**

This section briefly describes considerations regarding GDL, TIJ, and PVR to assist DGAC in selecting the airport for MITRE's runway expansion feasibility work. It is important to assert that the information provided in this section is based only on publicly available information (e.g., on-line searches for airport annual operational data, GoogleEarth satellite imagery, etc.) as well as MITRE's previously conducted analyses of these airports.

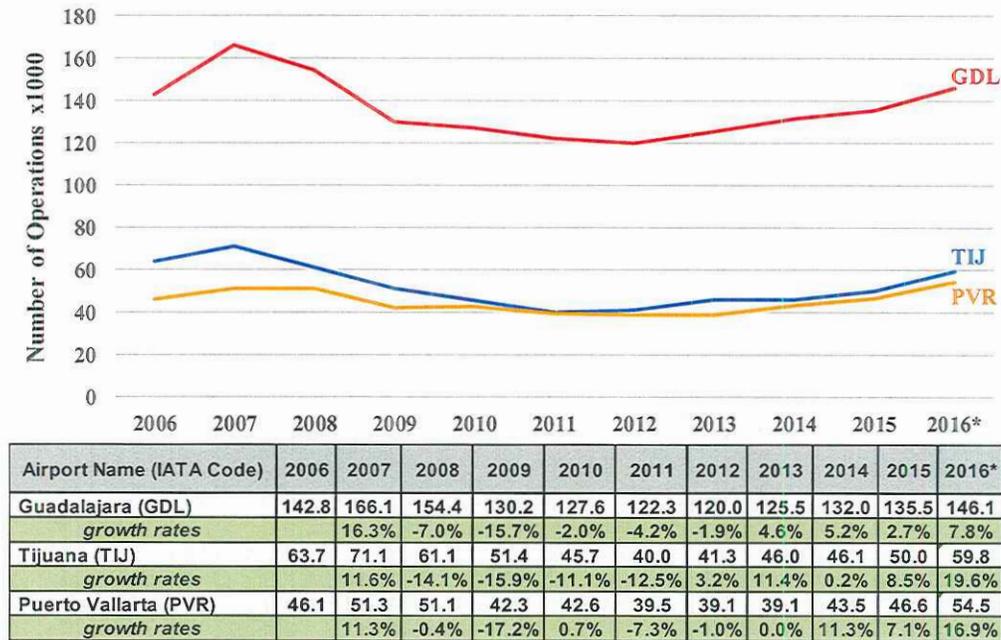
Figure 1 shows a graph and a table containing historical operations data at the three airports from 2006 to 2016.<sup>1</sup> All three airports have experienced a steady increase in operations since 2013. PVR operations rapidly increased in 2014 and 2015, and based on the first six months of data, it may also experience high growth in operations in 2016. Operations at TIJ increased 8.5 percent in 2015, and are expected to increase rapidly in 2016, mostly due to the Cross Border Xpress project with the United States (U.S.). GDL is one of the most important and busiest airports in Mexico, and its number of operations has increased at a solid and stable rate.

It is hard to predict what the future growth rates at each airport will be, as they are a function of many factors. However, both TIJ and PVR still have a relatively low level of operations and are most likely many years away from reaching runway saturation point.

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<sup>1</sup> The 2016 data represents MITRE's projections based on the official operational data for the first six months of 2016 and applying the operational profile of the three airports from 2010, a year when MITRE obtained detailed operational data.

GDL, on the other hand, is already handling a high volume of traffic and may start experiencing delays in the near future. Hence, GDL may need a second runway relatively soon.



Data Source: <http://www.gob.mx>  
\* 2016 data is based on MITRE projections

**Figure 1. GDL, TIJ and PVR Operational Data (2006 through 2016)**

The following paragraphs provide a high-level overview of characteristics of each airport, as well as limitations and potential for expansion. Please note that runway expansion options proposed in this document (where applicable) are conceptual only, and are not based on robust technical analyses at this point in time. On the other hand, MITRE has conducted high-level examinations of these airports as part of a previous project with the DGAC and, therefore, has a good understanding of the issues and constraints affecting those airports, as well as their expandability potential.

From a pure runway expansion perspective, the main challenge that GDL, TIJ, and PVR face is land availability. Usually, many runway siting-related problems can be avoided if land is obtained, reserved, and protected for the future development of additional runways. However, as shown in the figures below, the land surrounding these three airports is being either rapidly developed or has already become occupied.

**Guadalajara (GDL)**

GDL is located approximately 18 kilometers (km) south-southeast of the city of Guadalajara and is operated by Grupo Aeroportuario del Pacífico (GAP).<sup>2</sup> GDL currently

<sup>2</sup> Distance and direction from the city to the airports are based on information from the latest version of the Mexico Aeronautical Information Publication (AIP).

has two runways: a primary Runway 10/28 (4005 m x 60 m) and a secondary Runway 02/20 (1800 m x 30 m). Runway 02/20 is used mostly for small and general aviation aircraft. GDL is a high-elevation airport (about 1529 m Mean Sea Level [MSL]), and is located in a mountainous terrain environment. As discussed above, GDL is one of the busiest airports in Mexico, having accommodated approximately 135,500 operations (i.e., takeoffs and landings) in 2015. The airport reached its peak traffic volume year in 2007 with 166,100 operations.

MITRE's previous exploratory expandability examination of GDL has shown that constructing two new parallel runways, one to the north of the existing primary runway (by approximately 1850 m) and one to the south of the existing primary runway (by approximately 1500 m) would be possible for a phased development of a future two- and three-runway system. However, recent residential development south of the airport makes the siting of the runway in that area much more difficult than formerly. See Figure 2. Note that the runway spacing shown in Figure 2 is sufficient to conduct dual- and triple-independent approaches and departures. A parallel runway to the north, however, may also require some existing residential areas and infrastructure (e.g., roads) to be relocated. Nearby residential areas may also be exposed to aircraft noise. Another consideration worth mentioning is that operations at a nearby military base may be a factor that would need to be considered to ensure no adverse capacity-limiting airspace issues exist.

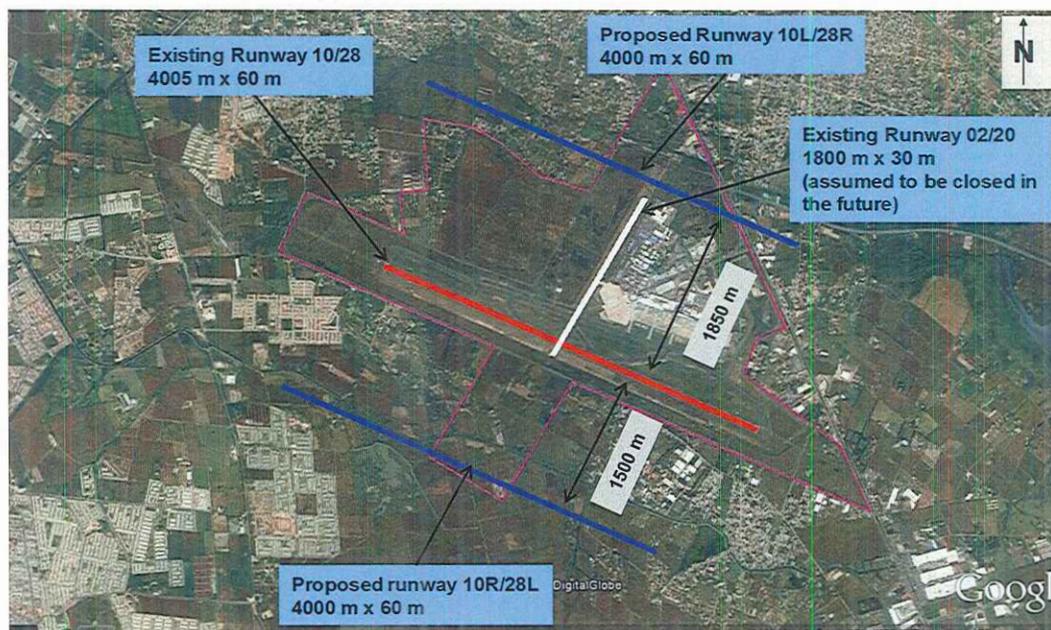


Image Source: Google Earth

**Figure 2. GDL Potential Runway Expandability**

### Tijuana (TIJ)

TIJ is located approximately 6 km northeast of the city of Tijuana and is also operated by GAP. TIJ currently has one runway: Runway 09/27 (2959 m x 45 m). TIJ is a relatively low-elevation airport (148 m MSL), and accommodated approximately 50,000

operations in 2015 (71,100 operations during the peak traffic year of 2007). TIJ is located along the border between Mexico and the U.S., and has benefited recently from the Cross Border Xpress facility constructed between the two countries. However, the area to the south of the airport is highly congested and offers no room for expansion. See Figure 3.

The lack of available land makes the siting of a new parallel runway in a location that would provide a significant capacity benefit unlikely without relocating numerous residential areas, infrastructure, and other facilities. Furthermore, high terrain to the east of the airport, as well as airspace interactions with U.S. airports, further complicate matters. Moreover, noise impact on the surrounding residential areas caused by increased aircraft operations is also a concern. Therefore, the airport does not have many practical options for the construction of an additional runway spaced far enough from the existing runway to provide much of a capacity benefit.

Some improvements, however, could possibly be made to the existing airfield to provide limited growth and operational flexibility. For example, it may be possible to shift the existing runway farther to the south to allow for a larger passenger terminal and aircraft parking apron to be constructed, if necessary. Other potential improvements, such as the possible implementation of reduced Air Traffic Control (ATC) separations and new approach and departure procedures could also be examined.

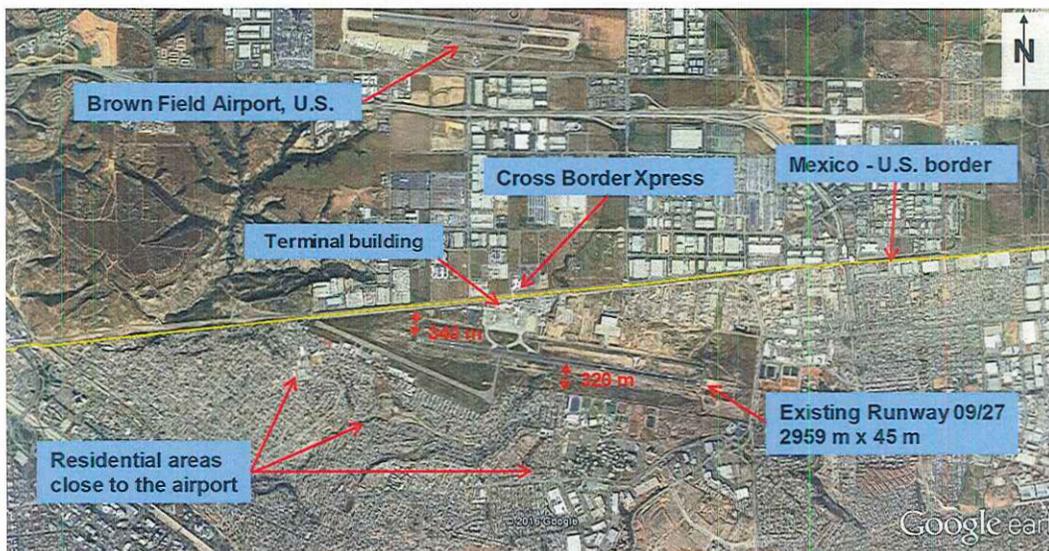


Image Source: Google Earth

**Figure 3. TIJ Potential Runway Expandability**

Given the limitations of runway expansion at TIJ, there may be a need for a new airport site for the Tijuana area. However, considering the fact that the increase in demand for TIJ operations is anticipated mostly due to the advantages offered by the Cross Border Xpress, it is not certain that a new airport would have similar demand unless it is located on or near the Mexico/U.S. border, which may not be possible due to lack of available land and other potential issues, such as terrain and airspace interactions.

Certainly, a new airport will eventually need to be located far from the Mexico/U.S. border.

### Puerto Vallarta (PVR)

PVR is located approximately 7.5 km northwest of the city of Puerto Vallarta, and is operated by GAP. PVR currently has one runway, Runway 04/22 (3100 m x 45 m). It is a low-elevation airport (7 m MSL). It accommodated approximately 46,600 operations in 2015 (and about 51,300 operations in the peak year of 2007).

MITRE's previous exploratory expandability analysis at PVR shows that constructing a new parallel runway northwest of the existing runway may be very useful. However, the newly developed golf course near the airport would need to be relocated in order for a runway to be constructed. See Figure 4. Also, a nearby river limits the spacing of a potential new runway from the existing runway to approximately 1035 m, which may allow dual independent approaches using a high update rate surveillance system. However, terrain in the area needs to be further investigated to determine if it may cause problems for conducting certain modes of operation (e.g., independent approaches). See Figure 5. Other limitations include potential impact to an existing highway, noise exposure to nearby residential areas, and concern regarding environmentally protected areas.

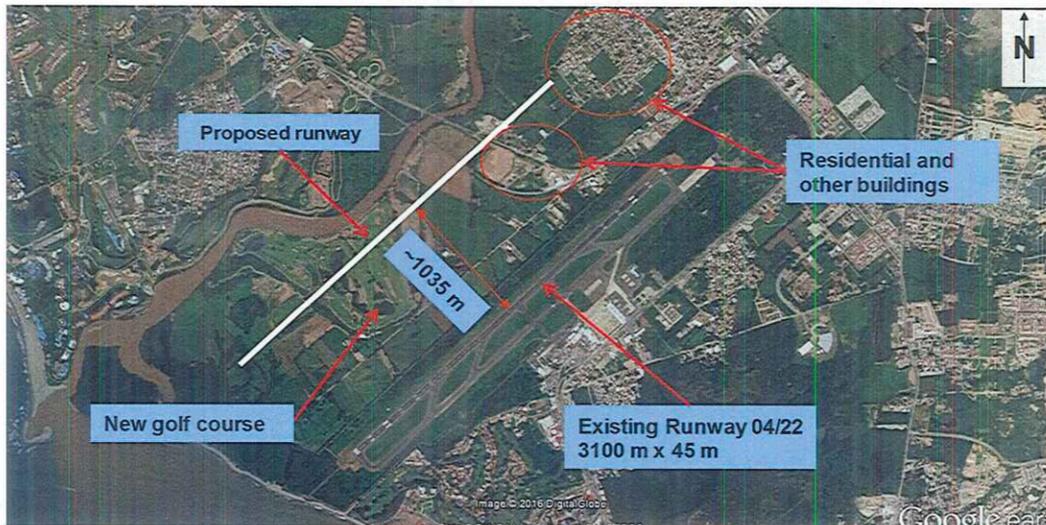


Image Source: Google Earth

**Figure 4. PVR Potential Runway Expandability**

It is important to mention that advanced navigation, such as Area Navigation (RNAV) or Required Navigation Performance (RNP) procedures may provide a benefit and mitigate some of the terrain issues, if necessary. Further analysis, however, would be needed before reaching a definitive conclusion about their potential benefit.



Image Source: Google Earth

**Figure 5. High Terrain near PVR**

Finally, given the above-mentioned limitations for runway expansion, and considering the operational rate of growth at PVR, there may be a need for a new airport in the area to accommodate future traffic demand.

### **Recommendations**

MITRE's runway expansion study of the airport to be selected by the DGAC depends on the level of effort required to be completed. Therefore, given scope limitations and likely procedural operations (e.g., segregated, dependent, independent)<sup>3</sup>, a decision should be made on the basis of the following factors:

- Weather conditions based on data collected by an on-site Automated Weather Observing System (AWOS)
- Obstacles using current and accurate terrain and man-made obstacle data through a satellite-based photogrammetric survey (MITRE would procure the photogrammetric work)
- Potential approach and departure procedures
- Potential benefits of a high-level conceptual airspace design

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<sup>3</sup> Per the GACM-MITRE Agreement, U.S. Federal Aviation Administration (FAA) runway spacing requirements will be considered. Note, that the U.S. FAA has developed new runway spacing standards in recent times that reduced the required runway spacing for dual- and triple-independent approach procedures. These new standards may favorably benefit airport expansion feasibility studies by reducing the required spacing between runways for independent approaches.

- Maximum achievable runway capacity of the expanded airport followed by a saturation demand analysis to estimate future levels of operational delay and when a new runway (or even a new airport) may be needed
- Noise impact that considers future traffic volume and appropriate mode(s) of operation to identify potential impact to surrounding residential areas

A computerized visualization and simulation model of the airport can also be created in MITRE's Air Traffic Management Laboratory to assist in further examining airport expansion-related matters.

Based on the airport considerations mentioned in the previous section and the factors listed above, the following types of studies at the three airports may be performed if funding priorities were not an issue:

- GDL: a *feasibility* study of siting a new parallel runway appropriately spaced from the existing primary runway to allow dual independent operations to maximize runway capacity. To support the siting of the new parallel runway, MITRE can analyze obstacle limitation surfaces as well as approach and departure procedures considering accurate terrain and man-made obstacle data obtained from a satellite-based photogrammetric survey (to be procured by MITRE).

A conceptual high-level airspace design can be developed to determine if the airspace has the potential to support dual independent operations and if any capacity-limiting airspace interactions exist. The capacity of the current and future runway system can be estimated, complemented by a runway saturation analysis to determine when the current runway will become saturated and when a new parallel runway will be needed. The potential exposure to residential areas caused by both current and future aircraft noise can also be examined.

The results and findings of the study would assist DGAC and other stakeholders in their effort to protect and preserve land and airspace around GDL to allow the future expansion and growth of the airport. Additionally, as this study considers a broad range of topics, Mexican engineers and controllers participating in the study will gain valuable experience and knowledge in the methodologies used to conduct a robust runway expansion analysis considering complex independent operations, which can assist in examining future NAICM-related modifications.

- TIJ: a study to identify ways to maximize the capacity of the current single-runway operation as much as possible. However, it is important to note that the airport has many constraints, including lack of open land due to the encroachment of residential areas and other buildings around the airport. Noise, nearby high terrain, and airspace interactions with U.S. air traffic also create problems. Therefore, MITRE's analysis of TIJ would be limited to examining ways to maximize its current single-runway capacity within its existing airport boundaries through potential infrastructure improvements, such as high-speed runway exits, reduced aircraft separations, and implementation of advanced approach and departure procedures.

If desired, MITRE could also conduct a high-level exploratory analysis to identify a potential site for a new airport to serve Tijuana. However, this would be limited in scope and effort with the goal of locating a site that appears feasible so that it can be protected. As a result, more detailed feasibility studies can be conducted in the future, as necessary.

- **PVR:** a study similar to the one described above for TIJ. As is the case with TIJ, this airport also has many constraints, including lack of open land due to a newly developed golf course and possibly terrain. Therefore, MITRE's analysis of PVR would be similar to the above-mentioned work for TIJ, including conducting an exploratory analysis to identify a new airport site.

**Having said all of the above, and the fact that MITRE has funding to conduct its work on a single site, and the large volume of traffic being experienced at GDL along with its expandability potential, MITRE strongly recommends that GDL be selected.**

As previously mentioned, the study being envisioned for GDL would also facilitate the transfer of a range of key aeronautical methodologies and practices to Mexican engineers and designers who would apply this knowledge to NAICM in future years.

#### **An Alternative Consideration**

As stated above, MITRE does not have the funding to study all three airports. However, another option, although in MITRE's opinion provides less of a benefit to the authorities, is to conduct a study of GDL and either TIJ or PVR. This, however, would require the level of effort and scope of work for GDL to be reduced in order to allow for the study of either TIJ or PVR to also be conducted. As a result, the analyses of some important aeronautical factors at GDL such as weather, capacity, and runway saturation may need to be eliminated or reduced in scope. In any event, MITRE recommends that the importance of the GDL runway expansion study not be overlooked.

It is now important that DGAC selects the airport study option it considers most beneficial as soon as possible, preferably in the January/February 2017 timeframe. This would allow the MITRE team to start its preparatory work and begin to advance on this important task.

Please do not hesitate to contact me if you have any questions.

Sincerely,



Ing. Robert W. Kleinmans  
Project Technical Coordinator

cc:  
Lic. Yuriria Mascott Pérez, SCT  
Dr. Bernardo Lisker, MITRE