Enclosure 4

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MITRE

Center for Advanced
Aviation System Development

Potential Airport Sites in the State of Hidalgo

Initial Exploratory Assessment

Prepared for

Aeropuertos y Servicios Auxiliares

November 2013

1. Introduction

MITRE is assisting Aeropuertos y Servicios Auxiliares (ASA) in collaboration with the State of Hidalgo, the Fuerza Aérea Mexicana (FAM), and Servicios a la Navegación en el Espacio Aéreo Mexicano (SENEAM) in identifying a feasible site for developing a new, one-runway airport in the State of Hidalgo. The new airport is intended to accommodate commercial airline and cargo operations. It is also being considered as the site to replace the Santa Lucía Military Base, which must be relocated in order to avoid airspace interactions once a major airport is constructed in the proximity of the town of Texcoco, referred to in this document as the Nuevo Aeropuerto Internacional de la Ciudad de México (NAICM).

Determining the siting of a new airport is a complex process. Generally, an airport siting study consists of three different phases.

The first phase usually is the initial exploration for potential airport sites and site investigation. This phase consists of a search for broad areas that appear to be suitable for the development of an airport and is based on basic aeronautical and operational issues (e.g., large, relatively flat areas without major obstructions). It also involves intense coordination with federal and state representatives and other stakeholders that are familiar with relevant aviation needs and issues. It is important that this type of coordination continues throughout the entire project. MITRE's work is currently in this phase.

The second phase of the study consists of a preliminary determination of specific areas that appear appropriate for airport sites. In this phase, an analysis is conducted to determine the basic viability of the potential airport sites. For example, preliminary approach and departure procedures are developed and airspace interactions are more thoroughly assessed. An airport site is then selected for further detailed analysis.

The third and final phase of the study is a more detailed analysis of the selected site, like definitive environmental analyses such as airport noise impact, and similar work to determine the feasibility of a site leading to airport construction.

The objective of this document is to provide ASA with a summary of MITRE's initial exploratory investigation of three potential locations within the State of Hidalgo near the towns of Tepeji del Río-Tlahuelilpan, Actopan-Santiago de Anaya, and Tulancingo.

The selection of the initial sites was based on conversations with officials familiar with the State of Hidalgo and its needs, as well as airport planning factors and considerations, such as the location, characteristics, size, and surrounding orography at each site. The topography of the site was examined to determine its relative flatness, its size was considered to determine if it was appropriate for the construction of a runway, and its relative distance from mountains and populated areas were considered to assess possible operational constraints and noise impact on large populated areas.

At this early stage of the project, however, it is important to note that MITRE has not conducted a detailed airport feasibility analysis of the sites considering factors such as

meteorological conditions, the development of instrument approach and departure procedures, aircraft noise exposure, etc. Furthermore, other important analyses such as the assessment of International Civil Aviation Organization (ICAO) Annex 14 Obstacle Limitation Surfaces to determine if objects would adversely impact aircraft operations have not yet been conducted. Also, MITRE has not analyzed the airspace to determine if operations at the potential airport sites could coexist with NAICM. This work will be conducted as the project progresses and more detailed data are obtained, such as weather through data obtained by Automated Weather Observing Systems (AWOSs) to be sited and installed by ASA at each site, and photogrammetric information (under the responsibility of MITRE).

It is also essential that MITRE holds discussions with Hidalgo State and FAM officials to get their perspective on the potential airport sites and airport requirements, as well as to conduct a site visit to gather first-hand information.

The rest of the document is organized into several parts that discuss the following: factors to consider when determining the site of a new airport, the characteristics of each of the potential airport sites, and next steps.

Note that some of the information mentioned in this document (e.g., population statistics and driving distances) was obtained from publically available sources (e.g., the internet, Google Earth, maps, etc.). MITRE has not verified the correctness or accuracy of that information.

2. Airport Siting Considerations

Before starting a major airport development project, a few basic feasibility issues must be addressed. Key questions about weather conditions, runway requirements, runway siting, approach and departure procedures, airspace, and the impact on surrounding communities (i.e., aircraft noise) need to be answered. For example:

- Is the site conveniently located (e.g., close to the main city it will serve or other developments) for potential users of the airport?
- Are the weather conditions suitable to accommodate scheduled commercial air service?
- What runway length is required in order to support typical payload and range needs of potential new airport users given the elevation of the sites?
- Are Instrument Landing System (ILS) approaches feasible given the terrain and other obstacles that may exist near the sites?
- What will be the impact of the new airport on existing residential areas located near the airport?

Site selection criteria are used to evaluate sites for a new airport. Some of the factors to consider are described below. Note that MITRE's work is limited to aeronautical

factors. Therefore, ASA will need to examine whether the site is appropriate from a social, political, ownership, and environmental (not including noise) point of view. Furthermore, ASA should conduct a civil engineering examination (i.e., soil analyses, flood analyses, and an evaluation of other relevant land-based factors) to determine the viability of constructing an airport at the potential sites.

2.1 Development of Surrounding Area

Existing land use in the areas surrounding the airport site under investigation requires a thorough analysis in order to minimize the impact on homeowners, businesses, and landowners. Current and future use of land adjacent to the airport has to be compatible with the airport in order to mitigate potential obstructions to air navigation and noise impact on the surrounding area. Potential airport sites in close proximity to residential areas and schools should be avoided whenever possible.

2.2 Meteorological Conditions

The direction of the prevailing winds is extremely important in determining runway orientation. For example, ICAO Annex 14 recommends that a meteorological analysis should be based on reliable wind data collected over a period of not less than five years. If sufficient data cannot be obtained, a minimum of one year of on-site wind observations should be used, and augmented with supplemental information. Fog, haze and smoke can reduce visibility and lower the traffic capacity of an airport. Therefore, visibility and ceiling information should be analyzed to determine the suitability of the site for aircraft operations, the requirements for instrument procedures, and the percentage of time the airport may be closed due to poor weather conditions. Appropriate, modern instrumentation, such as an AWOS, should be utilized to monitor weather.

2.3 Accessibility to Ground Transportation

Transit time from origin to destination is a major concern for both passengers and freight. The availability of nearby streets and highways to the airport is extremely important. Easy ground access and travel time to and from the airport is a factor that has a significant impact on potential users of the airport. Locating an airport too far away from the population center can result in a loss of potential passengers. Airport employees, visitors, and businesses dealing with airport tenants also require easy ground access to the airport.

2.4 Availability of Land for Expansion

Sufficient land should be available for the development of an airport. It is important to acquire or protect enough land to allow for the future growth and expansion of the airport. The size of the airport depends on factors such as: the size of aircraft serving the airport, which will determine runway length and ramp size; meteorological conditions such as wind, which will influence runway orientation, temperature and site elevation, which affect runway length; and the long-term plan for the development of the airport. A new airport site should be chosen with land areas that offer the best potential for long-term development and the least financial and social costs.

2.5 Airspace Interaction

The airport should be located at a sufficient distance from other airports to prevent aircraft that are maneuvering for landing or takeoff from interfering with each other. The volume and type of traffic, approach and departure procedures, and air traffic control procedures at each of the airports in the area should be considered.

2.6 Surrounding Obstacles

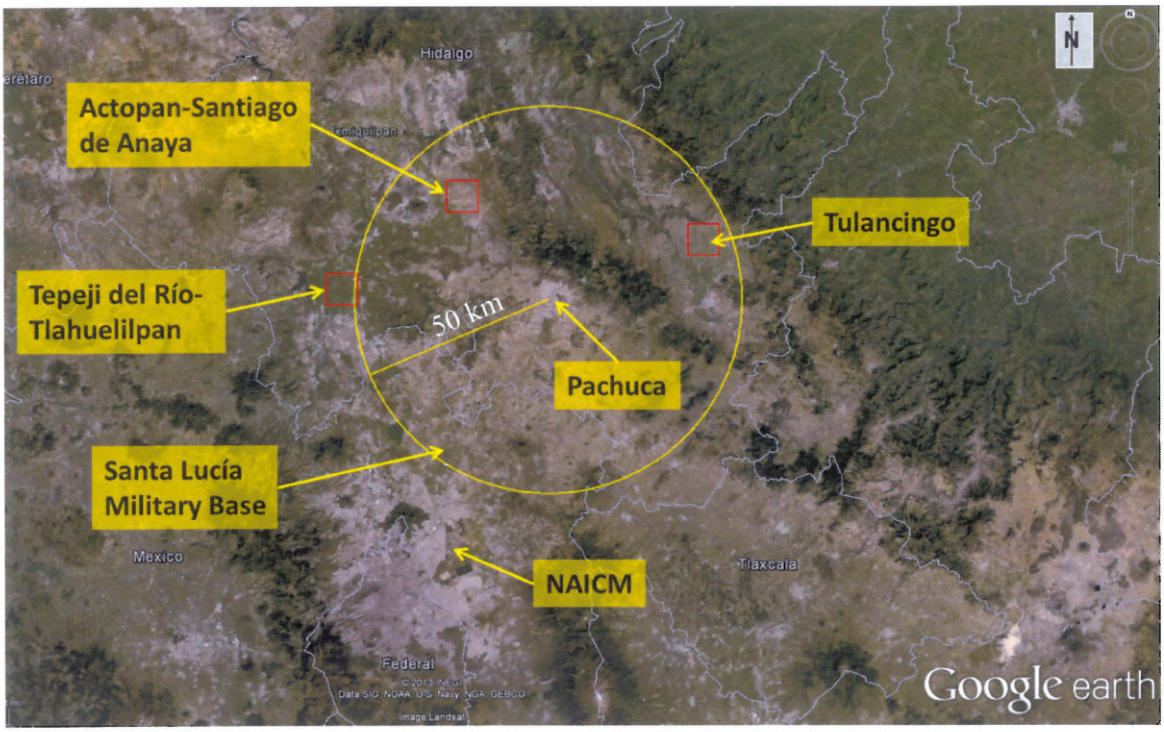
Approaches to a new airport should be free of obstructions created either by natural terrain features or by man-made structures or buildings. The airport should have the ability to clear obstructions if they exist. To determine if an object, either natural or man-made, is an obstruction, Annex 14 Obstacle Limitation Surfaces are established with relation to the airport and to each runway. These surfaces should, as far as practical, not be penetrated by any objects. Additionally, obstacles should not interfere with the development of instrument approach and departure procedures.

2.7 Environmental Issues

The location of residential areas, schools, parks, wetlands, wildlife preserves, migratory bird routes, and water areas can generate environmental concerns. Noise sensitive areas such as residential areas, schools, and hospitals can also be significantly impacted by the location of the airport. A noise analysis should be conducted to examine the impact of future noise on the areas surrounding an airport.

3. Potential Airport Sites in the State of Hidalgo

As previously mentioned, three candidate locations for a new airport in the State of Hidalgo were identified by MITRE near the towns of Tepeji del Río-Tlahuelilpan, Actopan-Santiago de Anaya, and Tulancingo. See Figure 1 below.



Source: Google Earth

Figure 1. Potential Airport Sites in the State of Hidalgo

All three candidate locations are approximately 50 km (straight line distance) from the city of Pachuca, the capital of the State of Hidalgo. The Actopan-Santiago de Anaya site is the closest to Pachuca, while the Tepeji del Río-Tlahuelilpan site is the farthest from Pachuca, but closest to Santa Lucía Military Base. Each candidate site has advantages and disadvantages with respect to site characteristics, proximity to major roads, orography, and other parameters that are considered in airport planning. The sections below discuss in more detail the site characteristics of each candidate location, based on a MITRE's initial assessment.

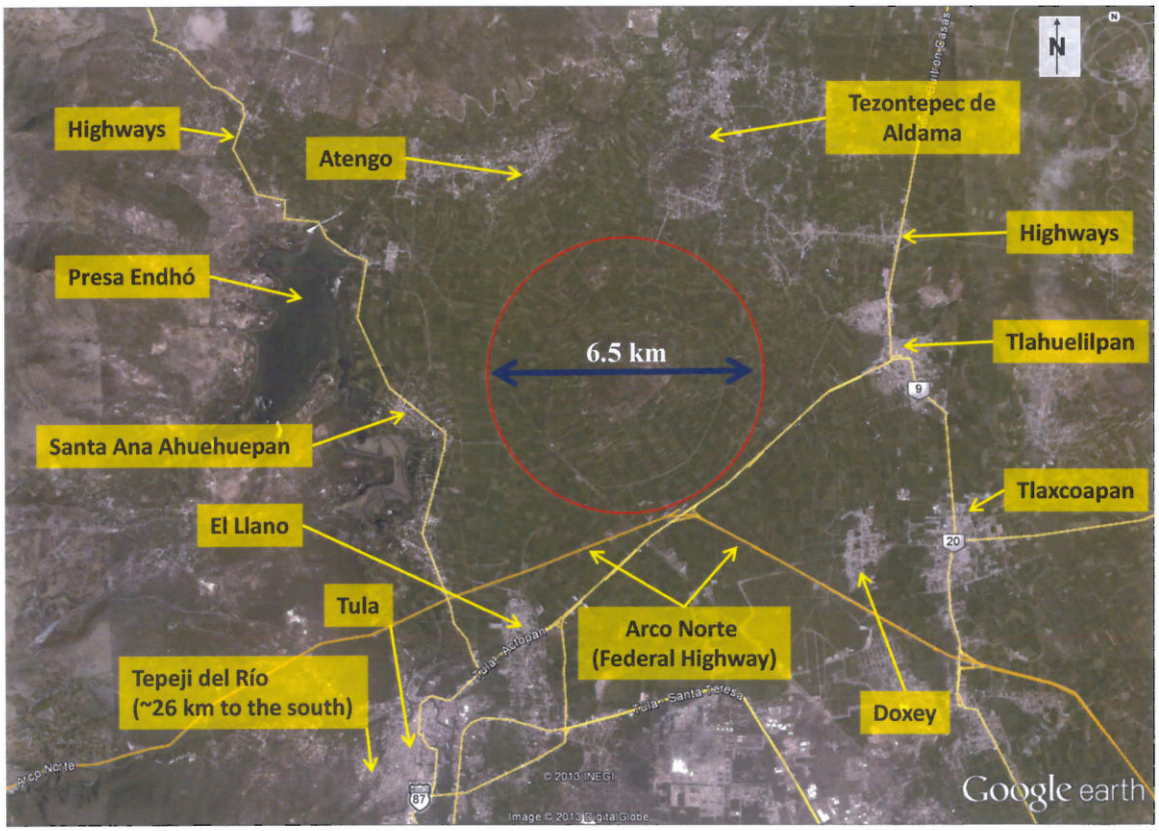
3.1 Tepeji del Río-Tlahuelilpan

The site near the towns of Tepeji del Río and Tlahuelilpan is located in the western part of the State of Hidalgo, about 80 km driving distance from Pachuca and 75 km from Santa Lucía Military Base. As shown in Figure 2 below, the land west of the town of Tlahuelilpan appears to consist of an open, sparsely developed area used predominantly for agriculture. Some asphalt and dirt roads exist within and around the area that provide access to local communities. A few small towns are located approximately 3 to 6 km from the site, including the towns of Atengo and Tezontepec de Aldama to the north, Santa Ana Ahuehuepan to the west, El Llano and Tula to the south, and Doxey and Tlaxcoapan to the southeast of the site. The populations of the above-mentioned towns are relatively small ranging from approximately 2500 to 27,000 inhabitants. Some of

these towns may be impacted by aircraft noise. Depending on the final runway location, some housing may need to be relocated as well.

One of the major advantages of the site is its excellent accessibility and proximity to Mexico's major transportation routes. The site is located just north of the Arco Norte, one of the country's major federal highways connecting four states: Estado de México, Hidalgo, Tlaxcala, and Puebla, as well as many other major highways and secondary roads. There are smaller highways running along the southern, eastern, and western sides of the site providing easy ground access to Tlahuelilpan and other regions and towns as well.

A large water reservoir, named Presa Endhó, is located about 6 km west of the site. Large bodies of water are wildlife attractants. Therefore, ASA should investigate if large populations of birds that could be a hazard to aircraft operations exist at this reservoir.



Source: Google Earth

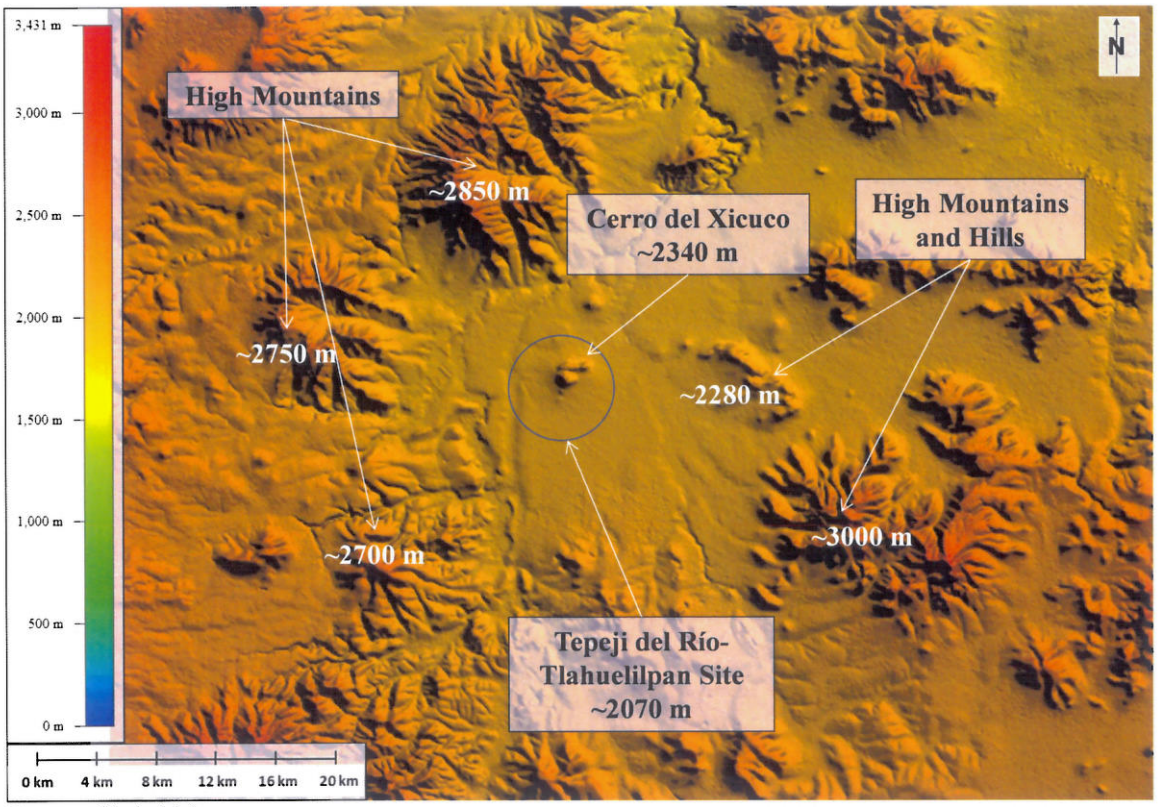
Figure 2. General Location of the Potential Airport Site Near Tepeji del Río-Tlahuelilpan

The size of the site appears to be suitable for the construction of a one-runway airport with an appropriately-sized terminal building and other aviation related facilities, such as General Aviation and cargo hangars. Additional land appears available for the development of commercial, retail, and industrial development, if desired. More analysis

and feedback from FAM officials is required to determine if sufficient land exists for the development of a military base.

Due to the lack of wind information, it is not possible at this time to appropriately determine the orientation of a runway at the site. However, the orography surrounding the site also affects the orientation of a runway (see Figure 3). The terrain within the site is relatively flat at around 2070 m above Mean Sea Level (MSL), with the exception of a steep hill named Cerro del Xicuco, which rises 250 m Above Ground Level (AGL). High terrain exists to the north, northwest, southwest, and southeast of the site.

The terrain to the north reaches 2850 m above MSL approximately 10 km from the site. Mountain peaks, approximately 12 to 13 km west and southwest of the site, reach about 2750 m above MSL and 2700 m above MSL, respectively. The terrain to the east, with the exception of some hills, is relatively level. The terrain to the south and southeast is also relatively level for about 10 km, and then it starts to rise. In the southeast, for example, some mountains reach as high as 3000 m above MSL at approximately 15 km from the site.



Source: Global Mapper

Figure 3. Orography Surrounding the Tepeji del Río-Tlahuelilpan Site (All Altitudes are Above MSL)

In summary, the area within and surrounding the Tepeji del Río-Tlahuelilpan site is sparsely populated, except for a few towns surrounding the site. Sufficient land appears

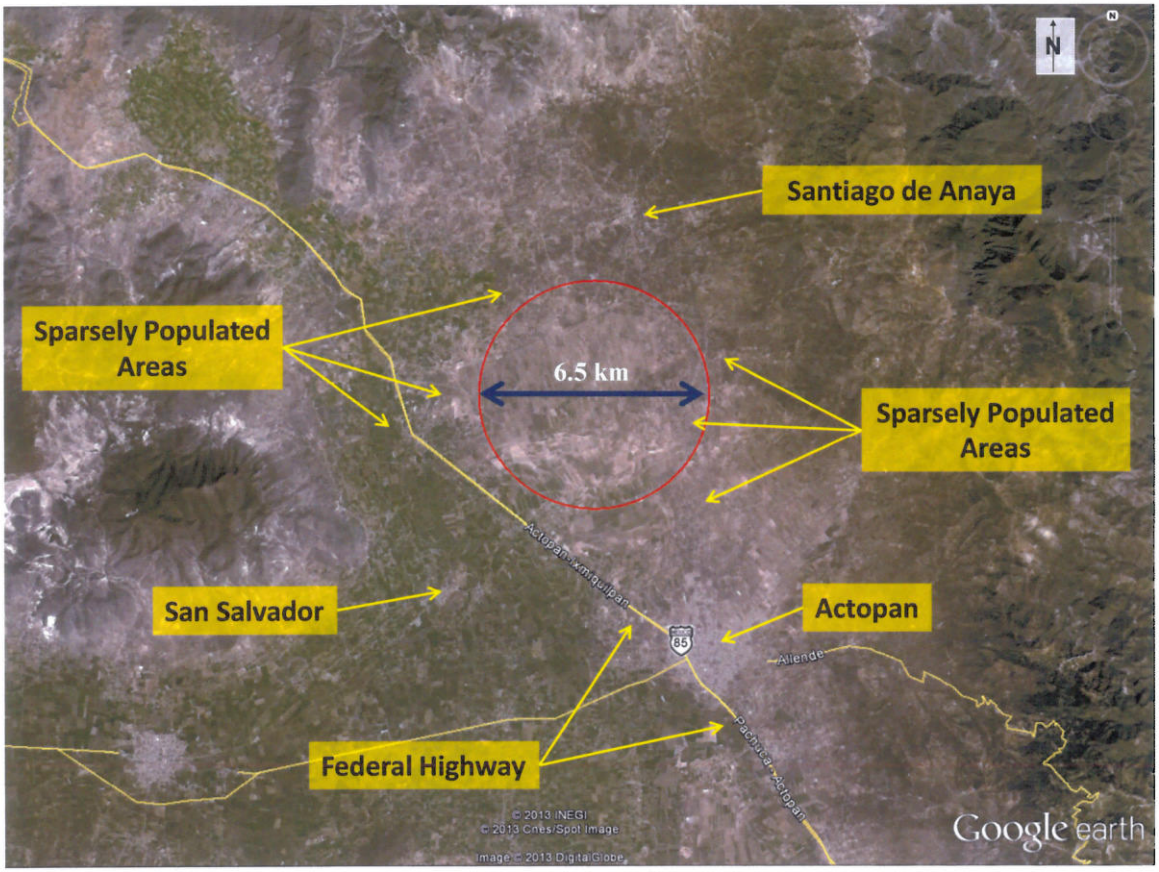
to be available to construct a runway, terminal, cargo, and General Aviation facilities. As previously mentioned, more analysis and feedback from FAM officials is required to determine if sufficient land exists for the development of a military base. The site also offers excellent accessibility to major transporation routes. However, the distance from the site to the city of Pachuca is still far and driving time could be long. Cerro del Xicuco could be a significant obstacle to air navigation and will have to be closely examined.

Overall, the site has potential for the development of an airport and should continue to be considered at this time.

3.2 Actopan-Santiago de Anaya

The site near the towns of Actopan and Santiago de Anaya is located in the central part of the State of Hidalgo, about 40 km driving distance from Pachuca and about 85 km from Santa Lucía Military Base. As shown in Figure 4 below, the land north of the town of Actopan and south of Santiago de Anaya appears to consist of an open, sparsely populated area used predominantly for agriculture. Some asphalt and dirt roads exist within and around the area that provide access to local communities. A few small towns are located approximately 1 to 5 km from the site, including the towns of San Salvador to the southwest, Actopan to the south, and Santiago de Anaya to the northeast. The populations of the above-mentioned towns range from approximately 14,000 to 48,000 inhabitants. Some towns and nearby residences may be impacted by aircraft noise. Depending on the final runway location, some housing may need to be relocated as well.

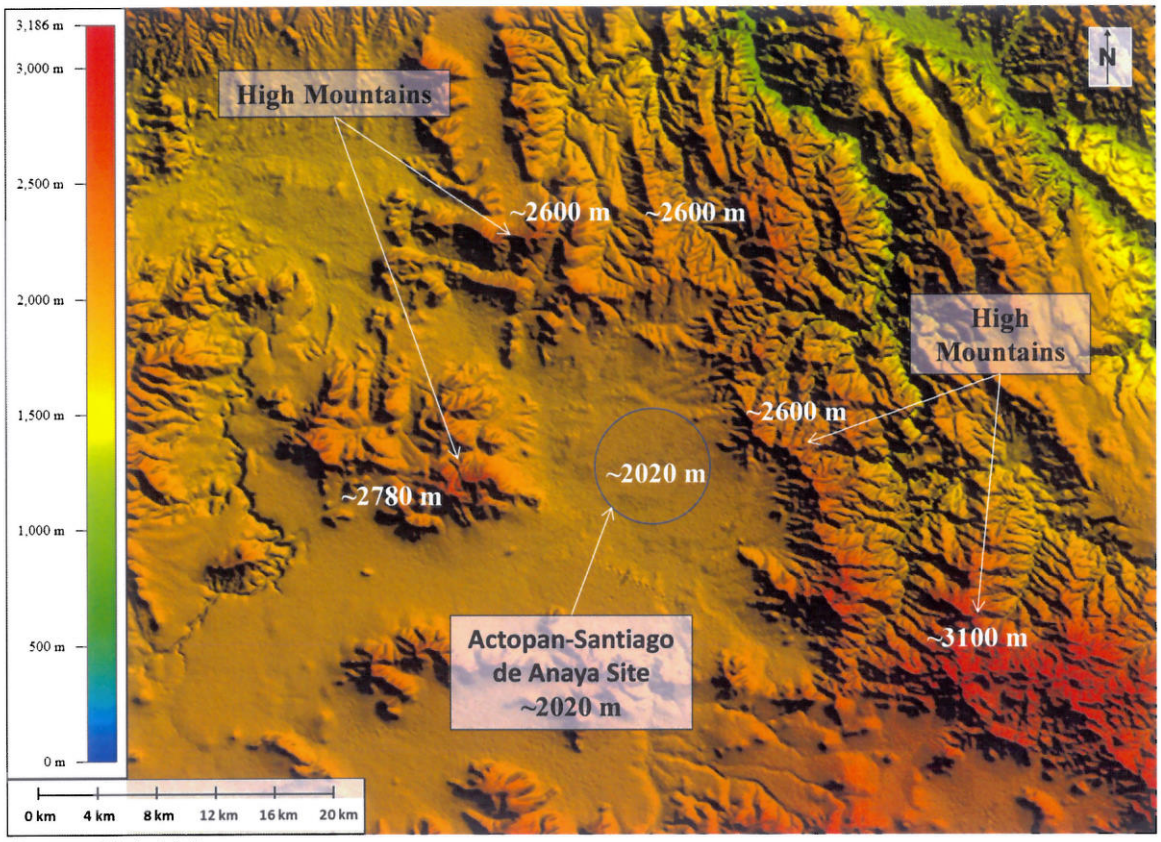
One of the advantages of this site is its proximity to Pachuca. In addition, the Actopan-Santiago de Anaya site has good access to Mexico's Federal Highway 85, which connects the State of Hidalgo to Mexico City and other states.



Source: Google Earth

Figure 4. General Location of the Potential Airport Site Near Actopan-Santiago de Anaya

The terrain in the area of the site appears to be relatively flat at around 2020 m above MSL. However, the terrain around the site is mostly mountainous (see Figure 5). To the west of the site, the terrain slopes slightly down for about 3 km and then starts a drastic upslope to more than 2780 m above MSL at only about 7 km from the site. To the north, the terrain slopes up gradually to the highest point of about 2600 m above MSL at a distance of about 10 km. There are mountains to the east as well, sloping to about 2600 m above MSL approximately 4 km away from the site. The area immediately to the south is mostly flat.



Source: Global Mapper

Figure 5. Orography Surrounding the Actopan-Santiago de Anaya Site (All Altitudes are Above MSL)

The size of the Actopan-Santiago de Anaya site appears to be suitable for the construction of a one-runway airport with an appropriately-sized terminal building and other aviation related facilities, such as General Aviation and cargo hangars. Additional land appears available for the development of commercial, retail, and industrial development, if desired. More analysis and feedback from FAM officials is required to determine if sufficient land exists for the development of a military base.

Overall, the site has potential for the development of an airport and should continue to be considered at this time.

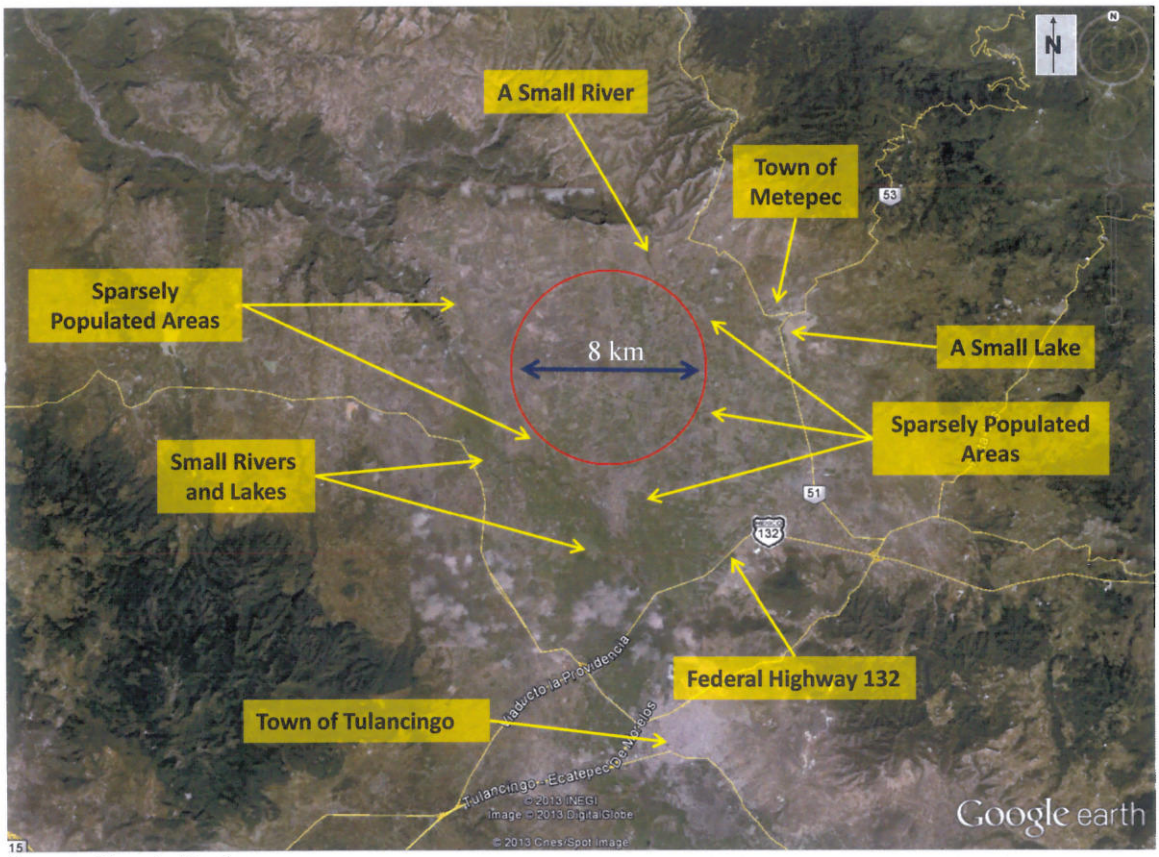
3.3 Tulancingo

Tulancingo is located in the southeastern part of the State of Hidalgo. The area for a potential new airport is approximately 12 km north of the town of Tulancingo. Driving distance from Pachuca and Santa Lucía Military Base is approximately 60 km and 105 km, respectively. As shown in Figure 6 below, the land appears to consist of an open, flat area, used predominantly for agriculture. There are some buildings and farms in the area, but there are no densely populated areas or large towns in the vicinity, except

for the town of Tulancingo, the second-largest city of the State of Hidalgo with a population of more than 205,000.

There are asphalt roads to the east, west, and south of the site, all connected to Federal Highway 132, a major highway connecting eastern parts of the country to Mexico City. Some smaller asphalt and dirt roads exist within and around the area that provide access to local communities and farms. A few small towns and villages are located approximately 1 to 3 km from the site, including the town of Metepec to the east, with a population of about 10,000. Some towns and nearby residences may be impacted by aircraft noise. Depending on the final runway location, some housing may need to be relocated as well.

One of the advantages of this site is its size and topography. Large areas not only offer more flexibility for designing and siting an airport, but also allow an airport to grow. One potential disadvantage of the site is its distance from Pachuca and Santa Lucía Military Base. However, Tulancingo may provide additional commercial traffic.

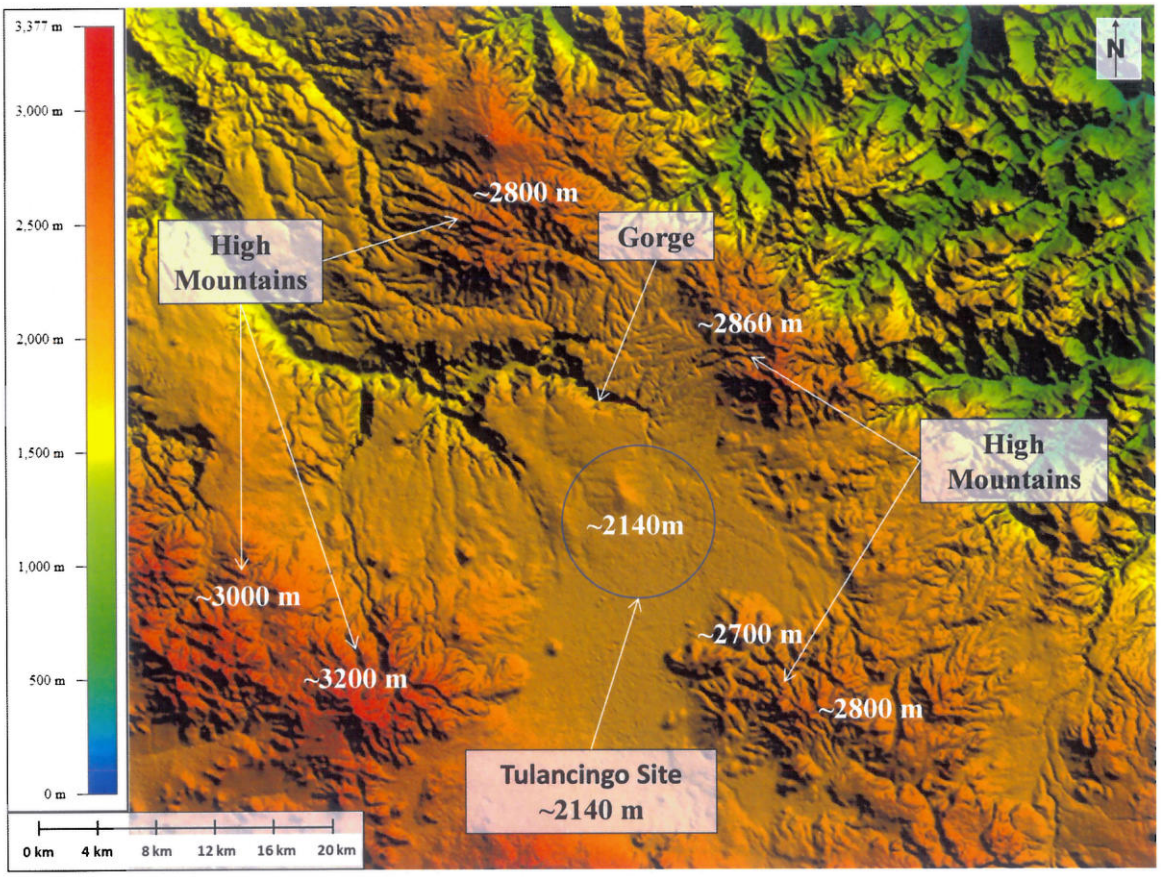


Source: Google Earth

Figure 6. General Location of the Potential Airport Site at Tulancingo

There are some creeks and small lakes in the area. Therefore, ASA should investigate if large populations of birds that could be a hazard to aircraft operations exist in the area.

The area is relatively flat and does not have high hills. The elevation at the site is approximately 2140 m above MSL (see Figure 7). There is a gorge to the north, where the terrain depresses abruptly by more than 200 m. Although there are tall mountains to the north, east, and southeast, those are relatively far away from the site. A mountain to the northeast starts at about 5 km from the site and slopes to about 2860 m above MSL at a distance of about 8 km. To the southeast, the terrain slopes up to about 2700 m above MSL at a distance of about 5 km (Cerro de Napateco) and to about 2800 m above MSL at a distance of about 12 km from the site. The area immediately to the south-southwest is mostly flat. The town of Tulancingo is about 12 km to the south.



Source: Global Mapper

Figure 7. Orography Surrounding the Tulancingo Site (All Altitudes are Above MSL)

The size of the Tulancingo site appears to be suitable for the construction of a one-runway airport with an appropriately-sized terminal building and other aviation related facilities, such as General Aviation and cargo hangars. Additional land appears available for the development of commercial, retail, and industrial development, if desired. More analysis and feedback from FAM officials is required to determine if sufficient land exists for the development of a military base.

Overall, the site has potential for the development of an airport and should continue to be considered at this time.

4. Next Steps

The MITRE team will continue investigating the three potential airport areas near the towns of Tepeji del Río-Tlahuelilpan, Actopan-Santiago de Anaya, and Tulancingo. For example, initial obstacle and airspace assessments will be conducted.

In order to properly advance its work, however, it is critical that the principal stakeholders familiar with the aviation needs of the State of Hidalgo visit MITRE as soon as possible to conduct detailed technical meetings and discussions. It is important that MITRE hold discussions afterwards with officials from FAM as well, to ensure that their needs are met.

The MITRE team is also planning to travel to Mexico in order to conduct aerial investigations of the potential airport sites, gather additional information, and hold discussions with stakeholders. Finally, once initial conversations take place at MITRE, more data will be required to conduct initial aeronautical analyses and a data request document will be submitted to ASA.