Enclosure 5

(Ref. Technical Letter F500-L16-039)

MITRE

Center for Advanced
Aviation System Development

Photogrammetric, Satellite-Based Survey of Toluca Airport and Its Surroundings

Field Validation, Verification and Ground Truth Visit Report

MITRE is responsible for the procurement of a satellite-based photogrammetric survey of Toluca Airport and its surroundings. In late March/early April 2016, teams of survey experts from MDA Geospatial Services Inc. (MDA), the company performing the survey, visited Toluca for about a four-week period to validate and measure features (e.g., buildings, towers, power-line towers, trees, bridges, poles, posts, and antennas, etc.) and collect validation points. The information will be used to ensure that all surveyed items collected meet specifications, and that the heights derived from stereoscopic satellite imagery are accurate. This enclosure describes that work.

Prepared for

Aeropuertos y Servicios Auxiliares

30 June 2016

Photogrammetric Survey of Toluca Airport and its Surroundings:

Field Validation, Verification and Ground Truth Visit Report

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Acronyms

AGL	Above Ground Level
ARP	Antenna Reference Point
ASA	Aeropuertos y Servicios Auxiliares
ASR	Airport Surveillance Radar
ATCT	Air Traffic Control Tower
CARNET	International customs and temporary export-import document
CORS	Continuously Operating Reference Stations
CP	Control Point
EGM96	Earth Gravitational Model 1996
GCPs	Ground Control Points
GE-1	GeoEye-1
GIS	Geographic Information System
GPS	Global Positioning System
INEGI	Instituto Nacional de Estadística y Geografía / National Institute of Statistics and Geography
Ing.	Engineer in Spanish
km	kilometre
m	metre
MDA	MacDONALD, DETTWILER AND ASSOCIATES LTD.
MITRE	The MITRE Corporation
MSL	Mean Sea Level
PSA	Photogrammetric Survey Area
QC	Quality Control
SCT	Secretaría de Comunicaciones y Transportes
sq km	Square Kilometre
WGS84	World Geodetic System 1984
WV-2	WorldView-2
WV-3	WorldView-3

1 INTRODUCTION

The Field Validation, Verification and Ground Truth Visit Report provides an overview of the process and collection of Obstructions and validation measurements within all Project areas. A systematic approach was used to ensure the accuracy of the resulting satellite analysis. Both strategic and random approaches were used to cover all of the PSA, Area A, Area B and the Special Areas for validation and verification purposes.

The project titled Photogrammetric, Satellite-Based Survey of the Toluca Airport and Its Surroundings (hereafter referred to as the "Project") began on 23 July 2015. By that time, the rainy season in Toluca was well underway, a fact that delayed project completion through 2016. The survey will be used to support The MITRE Corporation (hereafter referred to as "MITRE") in conducting aeronautical analyses in support of Aeropuertos y Servicios Auxiliares (hereafter referred to as "ASA"). The first component of the Project was to perform the survey Site Assessment, which took place from 24 August through 4 September 2015. The purpose of the Site Assessment was to gather data, specifically Ground Control Points (GCPs) to assist in the development of the survey. These points, coupled with field checks, improved detection of features in the satellite imagery and facilitated planning of the ground surveys to follow.

The Field Validation, Verification and Ground Truth (FVVGT) Visit took place in Toluca from 29 March 2016 through 22 April 2016. Mr. Gyan Verma and Mr. Matthew Lagasse participated from 29 March through 8 April, and Mr. Shane McConachie and Mr. Ian MacCulloch participated from 11 April through 22 April to complete the visit. Mrs. Suzanne Brunke, Project Manager, participated on 19 April for the on-airport validation and verification at Toluca International Airport (hereafter referred to as "Toluca Airport"). Ing. Jorge Nevárez facilitated and coordinated the visit and assigned Ing. Gustavo Caballero as the translator, driver and main point of contact for MDA during the FVVGT Visit. Both Ing. Nevárez and Ing. Caballero were very helpful in ensuring the success of the FVVGT Visit during the four-week period that MDA staff worked in Mexico.

The objective of the FVVGT Visit was twofold: First, to validate and measure any feature greater than 60 m Above Ground Level (AGL) present within Area B. The final height measurement will reflect the top-height of any feature, including any antennas on the top of buildings. These features will include buildings, towers, power-line towers (including the power line running between towers), trees, bridges, poles, posts, and antennas (the "Obstructions"). Secondly, to collect Validation Points randomly situated throughout the project areas. The heights collected will be used during analysis to ensure that all items are collected to the specification, and Verification points will be collected to ensure that the heights derived from stereoscopic satellite imagery are accurate.

The area was broken down into search grids where image analysts at MDA had identified possible targets. These target locations were imported into the Global Position System (GPS) units that were used in the field to obtain height information. In addition, the teams searched for targets that may have been missed in initial analysis due to image shadow, haze or other hindrance.

2 COORDINATION AND PLANNING

Coordination and planning are critical to the objective of this Project.

2.1 Planning

On 10 February 2016, Mrs. Brunke provided MITRE and ASA with a draft plan for the execution of the FVVGT Visit. This plan could be modified in the field, but the main criterion was that the team be able to visit areas well distributed throughout the Project areas and collect field measurements to compare with the data collected from the stereoscopic and monoscopic satellite imagery. Ing. Nevárez assigned Ing. Caballero to prepare a driving plan to determine the best way to navigate throughout the project areas.

Mrs. Brunke requested that ASA prepare an official letter on company letterhead, in Spanish, to state the purpose of the survey and description of the equipment that was being brought into Mexico by Mr. Verma for the FVVGT Visit, and brought out of Mexico by Mr. McConachie. This letter was kept by the MDA staff in case there was difficulty bringing the equipment into, or out of Mexico with the CARNET.[1] Thankfully the CARNET eased the temporary importation with customs and there were no problems with the Mexican Customs.

ASA arranged for the use of a fourteen-passenger Toyota van for the FVVGT Visit. Ing. Caballero was the driver: he accompanied the team and provided invaluable coordination, translation and logistics support.

2.2 Survey Equipment

In preparation of the Site Assessment, MDA brought the following survey equipment from Canada to Mexico (shown in Table 1).

Table 1 – MDA Equipment Used during the FVVGT Visit

Quantity	Equipment
2	Trimble GeoXT Explorer 6000 Global Positioning System (GPS)
2	Trimble Tornado Antenna
2	GPS digital cameras
1	Nikon DSLR with Telephoto Lens
2	Car GPS Navigation Systems
2	Dell E6430 Laptops

The Trimble GeoXT Explorer 6000 is a high performance GPS receiver with an on-board computer loaded with ArcGIS Mobile Geographic Information System (GIS) support software (see Figure 1). An external antenna, resistant to signal interference and multipath was used to obtain a higher yield of GPS satellite positions and to improve performance and accuracy. The

[1] CARNET is an international customs and temporary export-import document, used to clear customs without paying duties and import taxes on merchandise that will be re-exported within 12 months.

antenna was connected to the GPS on top of a mounting pole to improve satellite visibility. The GPS collects GCPs and other field data measurements in X, Y, Z, latitude, longitude and height above Ellipsoid.

Figure 1 – A Trimble GeoXT Explorer 6000 GPS used to Collect Field Measurements during the FVVGT Visit

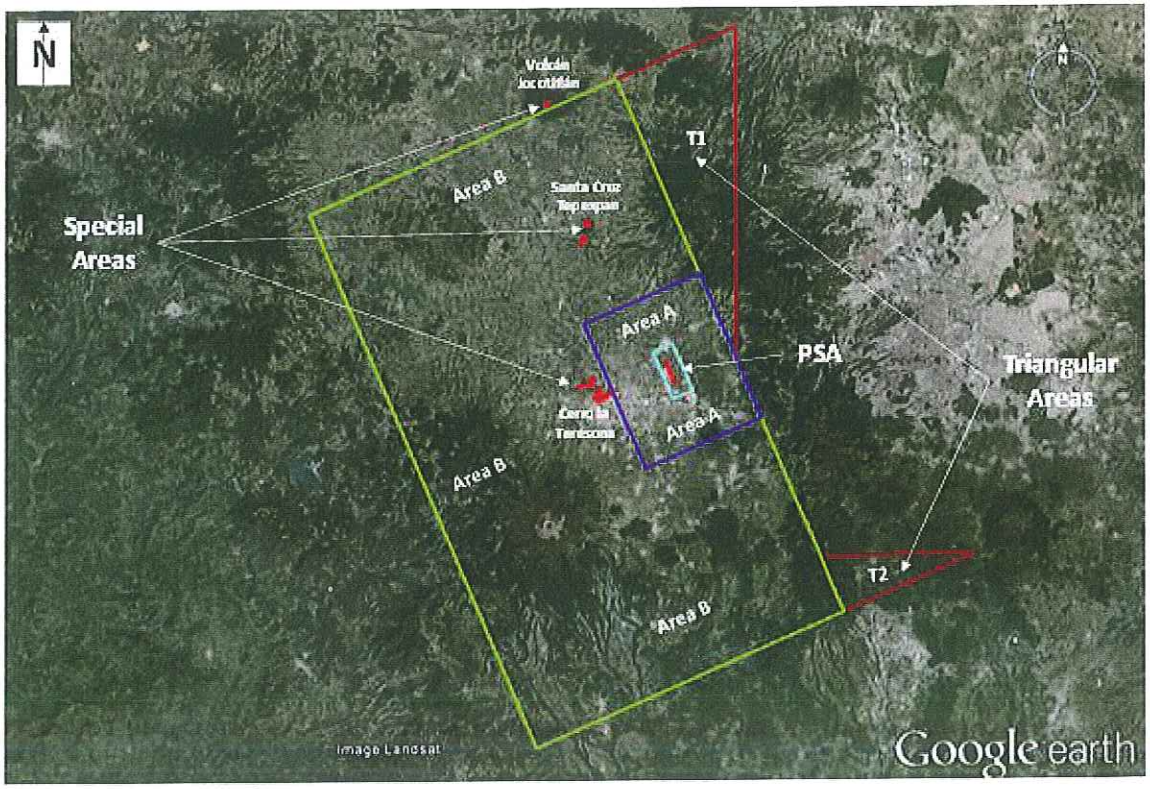
Also included in the equipment were two Canon GPS equipped digital cameras for taking detailed and overview photographs of the field measurement locations, two Car Navigational GPS units outfitted with Mexico street maps for navigating throughout the survey area, and a DELL Laptop for recording and processing data points. Further, one laptop had a copy of ArcGIS Mobile installed that allowed for the post-processing of the daily data collection. This ensured that the collected field measurements met the highest accuracy thresholds required for this survey and, if there were any accuracy issues, a problem area or point could be revisited, if so required, while the team was still in Mexico.

3 LOCATION OVERVIEW

Knowledge of the environmental conditions provides valuable information to support a thorough survey.

3.1 Location

The Project area is centered around the City of Toluca and the existing Toluca Airport. The survey site is composed of the following areas, shown in Figure 2: the Photogrammetric Survey Area (PSA), Area A, Area B, two Triangular Areas northeast ("T1") and southeast ("T2") of the site, and three Special Areas.



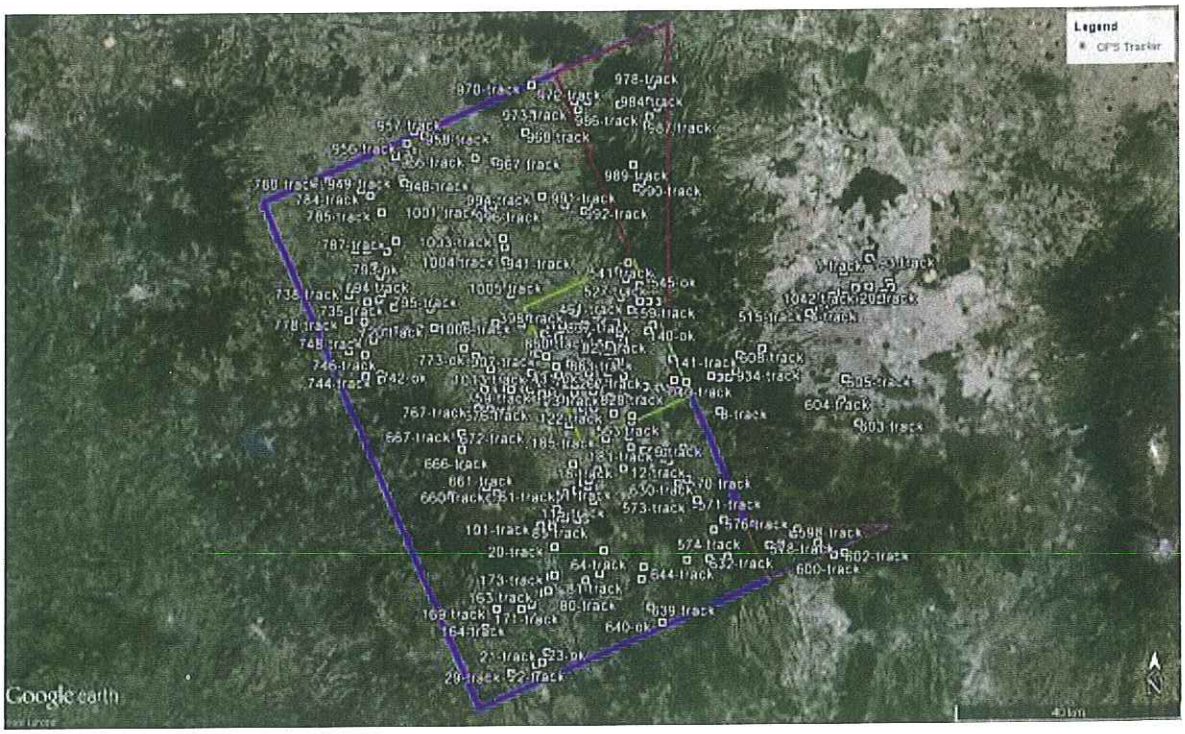
Source: GoogleEarth

Figure 2 – The Project Survey Site: PSA (Cyan), Area A (Blue), Area B (Green), T1 and T2 (Burgundy), and three Special Areas (Red)

3.2 Daily Fieldwork Areas

In order to systematically collect data and measurements throughout all project areas, MDA divided the entire region into daily section goals. A total of nineteen sections were identified as daily Fieldwork Areas. One business day (i.e., Monday through Friday) was spent in each area with the exception of Toluca Airport, where a total of two business days were allocated.

MDA staff wore GPS trackers the entire time that they were performing field measurements. The tracker signals can be displayed in GoogleEarth and used to monitor progress in the field and also ensure that all areas had been visited for validation. These tracker locations, showing all the areas visited by MDA, can be seen in Figure 3 below.



Source: GoogleEarth

Figure 3 – The GPS Tracking Signals from Team 1 and Team 2 while Conducting Field Measurements in Toluca

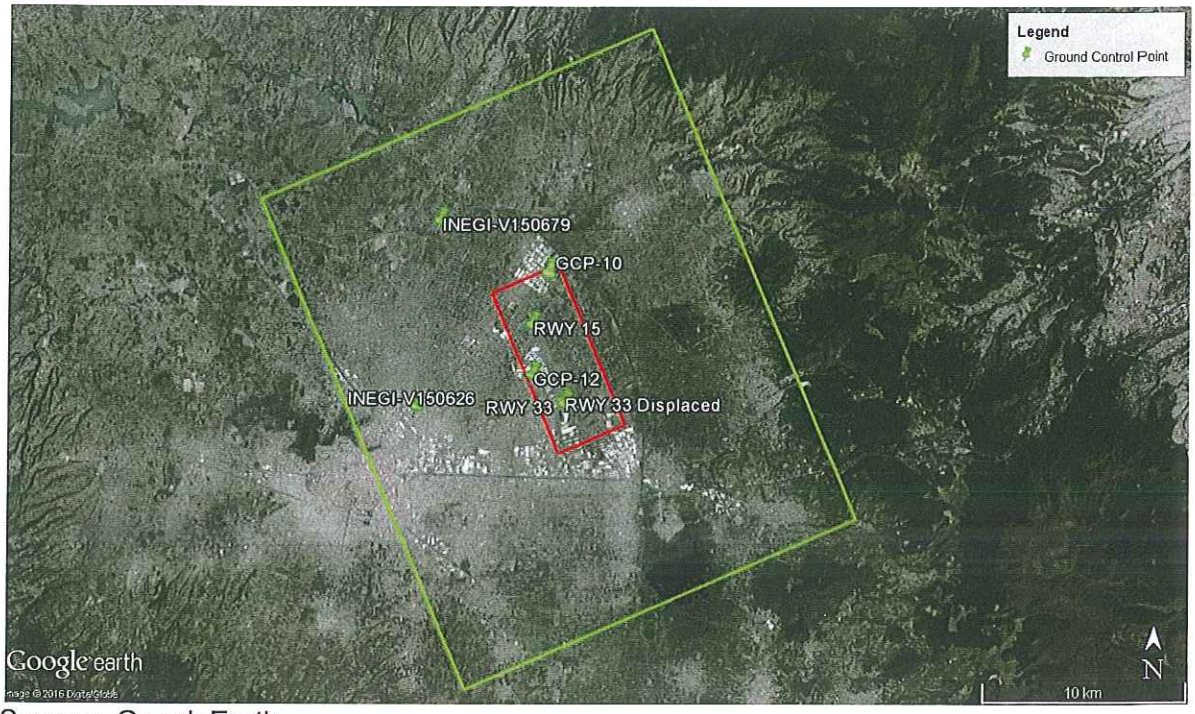
4 DATA INVENTORY

A well-organized data inventory is essential to the success of the survey.

Building a data inventory is a key component and contributor to the success of the survey. It provides vital information relevant to the measurement of terrain and Obstructions and assists with evaluation, planning, execution, and quality assurance of the survey. Data to be integrated into the Project inventory are: MDA collected GCPs and Control Points (CPs); Instituto Nacional de Estadística y Geografía (INEGI) benchmarks, data collected in the field, and newly acquired satellite imagery and information that MDA will derive from the satellite imagery.

4.1 GCPs

Seven (7) new GCPs were collected during the FVVGT Visit. The GCPs can be sub-classed as two INEGI points V150679 and V150626 for accuracy verification, two additional GCPs (10 and 12) and three threshold GCPs (RWY 15, RWY 33 and RWY 33 Displaced) on the runway at Toluca Airport (see Figure 4).



Source: GoogleEarth

Figure 4 – Location of GCPs Collected During the FVVGT Visit

The GCP locations were measured using a high-precision GPS with an antenna, as described in Section 2.2. Photographs were taken of each location for reference (see Figure 5). Full descriptions and coordinate information for each GCP is provided in Appendix A.

Figure 5 – Reference Photographs Taken of GCP Locations

The GCPs and all field measurements were differentially post-processed at the MDA office in Vancouver using Continuously Operating Reference Stations (CORS) to calculate the difference between the positions transmitted by the satellite systems and the known fixed locations. The CORS system enables positioning accuracies that approach centimetres relative to the National Spatial Reference System, both horizontally and vertically. Generally speaking, the faster the sampling rate, the more accurate the reference station. For example, the 1 second stations are the most accurate survey grade, decreasing in accuracy to the 30 second stations.

The closest base station to the Project area was located in the City of Toluca. The Toluca CORS base station site location, which transmits at a 1-second interval, is provided in Table 2 and Figure 6 below. The Toluca station was operational during the FVVGT Visit, as shown in the data availability profile in Figure 7 for the Julian days 86 through 114 (March 29 through April 22), which were the days MDA was in the field. There were several periods of inoperability during this time period which is shown in grey as opposed to the operational blue colour in Figure 7. The first period was during Julian day 94, or 3 April, and did not impact any measurements as it was on a Sunday. The second period was on Julian day 95, 4 April, only until approximately 10 am that morning. On 4 April, Team 1 set-up for the first Validation Point at 9:50 am and collected data until 10:25 am. For this location, the GPS was used as a base for the Validation Points, and the primary measurements collected were with the Laser Range Finder. Any points above the accuracy tolerance were removed during post processing. The next outage period was 16-17 April, which were weekend days and did not affect the project. On Julian day 109, 18 April, the team was collecting data during the outage, but the GPS was only used as a base for the Laser validation measurements. While there were outages reported, fortunately they did not occur during any time periods that would have affected the GPS instrument, and there was no impact to project accuracies.

Table 2 – Antenna Reference Point Data Used to Process GCPs

Antenna Reference Point (ARP): TOLUCA CORS ARP ---------- PID = DH8722 Latitude and Longitude = 19° 17 35.64360 N, 99° 38 36.49913 W

The PID is the Permanent Identifier that is assigned to each CORS base station as a unique code.

Source: GoogleEarth and NOAA

Figure 6 – Location of Toluca CORS Base Station Used to Post Process GCPs

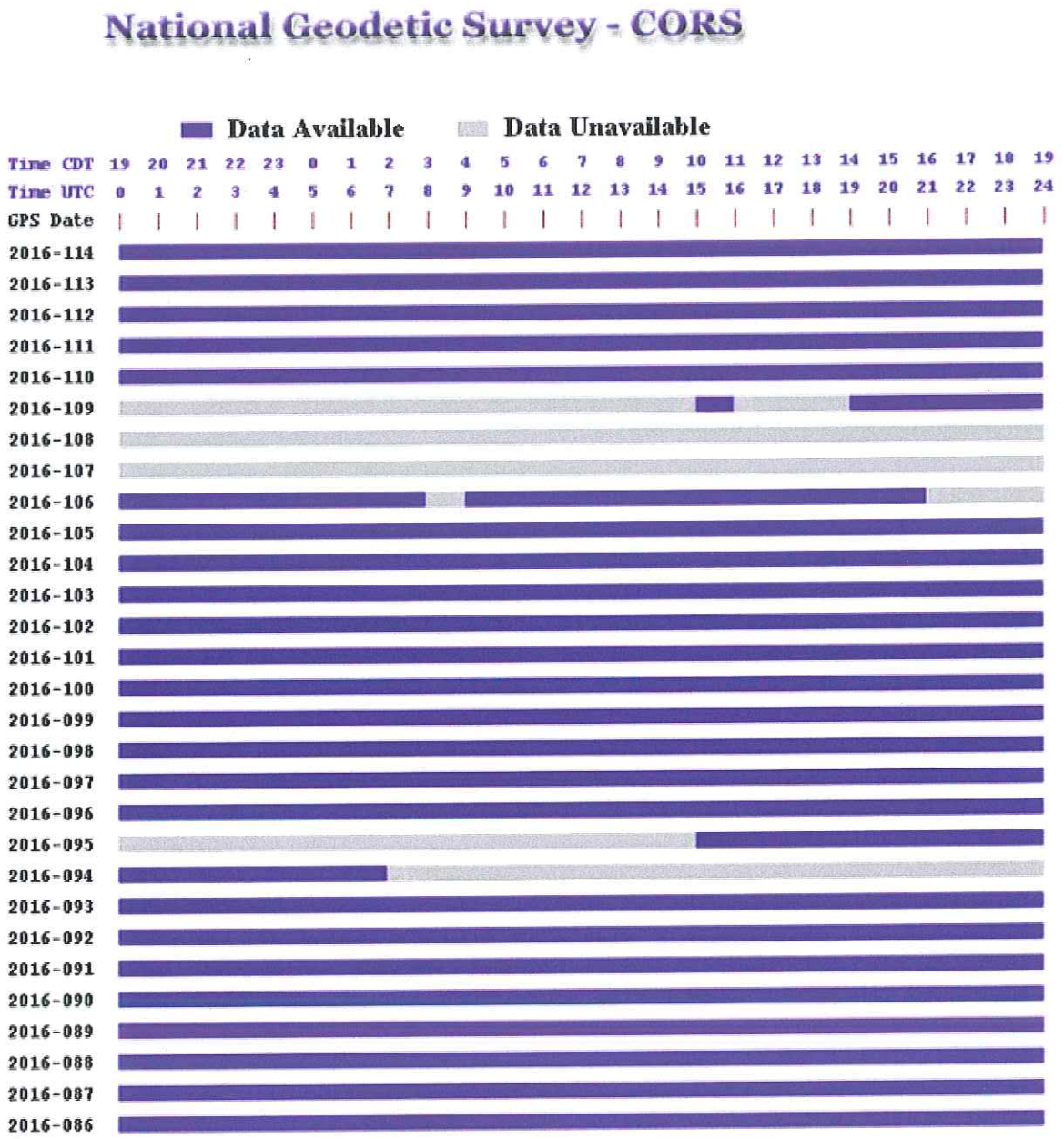


Figure 7 – Data Availability Profile for 1-Second Toluca CORS Base Station

Post-processing improved the accuracies of all the GCPs and Validation/Verification points collected. The final aggregate accuracies of the points processed with the Toluca CORS base station increased overall accuracy, as can be seen in Table 3 and Table 4 below.

Table 3 – Accuracy Results for Post-Processed Validation/Verification Points

Toluca "TOL2" Base Station Accuracies
A total of 4090 (99.8%) of 4099 positions were differentially corrected
Estimated accuracies (68%) for 4099 positions are as follows:
0 - 15cm - 0%
15 - 30cm - 0%
30 - 50cm - 0%
0.5 - 1m - 84.7%
1 - 2m - 14.8%
2 - 5m - 0.2%
> 5m - 0.0%

Table 4 – Accuracy Results for Post-Processed Threshold GCPs

Toluca "TOL2" Base Station Accuracies
A total of 10993 (100.0%) of 10997 positions were differentially corrected
Estimated accuracies (68%) for 5393 positions are as follows:
0 - 15cm - 99.3%
15 - 30cm - 0%
30 - 50cm - 0%
0.5 - 1m - 0.7%
1 - 2m - 0.1%
2 - 5m - 0%
> 5m - 0%

4.1.1 MDA Collected Ground Data

MDA-collected ground data consist of the field measurements made during the FVVGT Visit. These include GCPs, CPs, Validation and Verification Points. Validation Points are features collected in the field at varying heights and later compared to stereoscopically collected features for Quality Control (QC) purposes. The GPS unit is set up at a central location for these points, called an "Anchor", with measurements of the surrounding features recorded as distance and bearing from the Anchor location. The goal is to validate those heights collected in stereo, with those collected in the field. Verification Points are where features are measured in the field and compared with the sloping surface in Area A, with the goal to verify that all features were collected as required by the sloping surface.

4.1.2 Field Checks

At each GCP or Validation/Verification point, a GPS reading was acquired for latitude, longitude, and elevation. At every location, multiple reference photographs attributed with the camera's GPS coordinates were taken including: (1) a detailed photograph of the ground position of the

GPS instrument, and (2) several perspective and overview photographs of the GPS location from each direction. For the Validation and Verification points, the same types of photographs were taken, but in addition, photographs of each feature that was being measured around the GPS base point were also captured. The GPS data was exported into Excel, ArcGIS and GoogleEarth formats to be incorporated into the survey database. See Appendix A for details on the GCPs.

4.1.3 Final Quality Control Visit

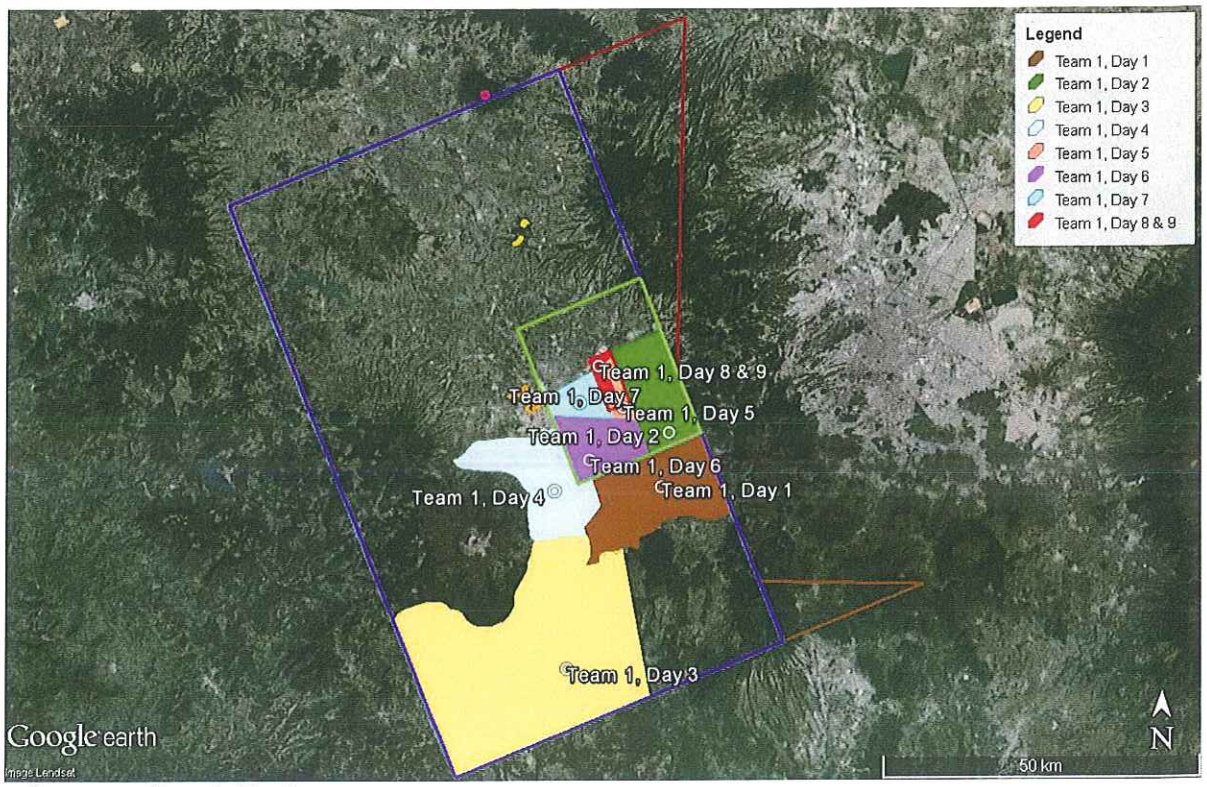
One final field visit is planned for the Project: the Final QC trip. The Final QC trip is being planned to be taken in conjunction with a MITRE engineer who will act as an observer and liaison in order to provide feedback to MITRE project leaders on the status and outcome of the trip. The Final QC trip will serve as a quality and completeness check of critical aeronautical areas before the deliverables are finalized.

5 Field Validation and Verification

Field data provides the necessary height information for Monoscopic Area B as well as critical Validation and Verification of Stereoscopically collected data to support a comprehensive survey.

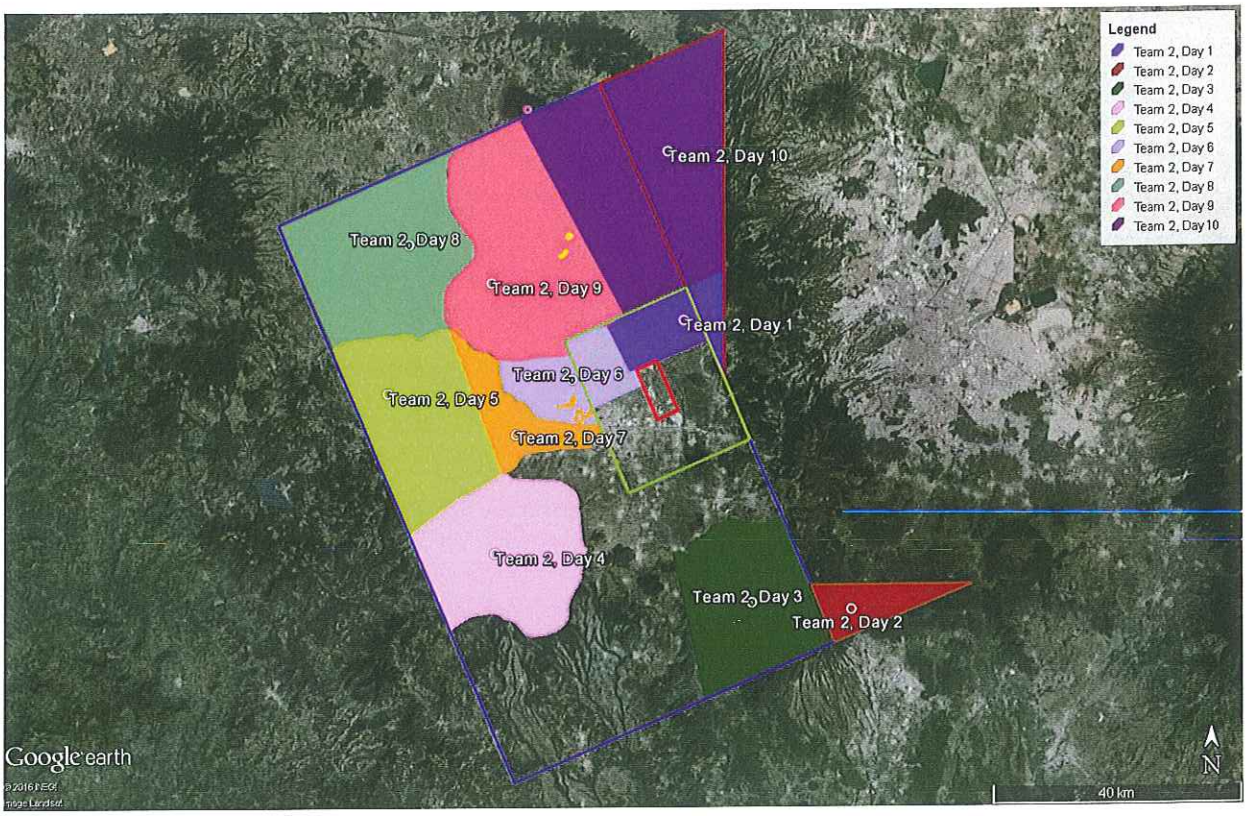
Field data collection was performed for nineteen days from 29 March to 22 April 2016. The collection was conducted by two teams: Team 1, consisting of Mr. Gyan Verma and Mr. Matthew Lagasse, and Team 2, consisting of Mr. Shane McConachie and Mr. Ian MacCulloch. The objective of the FVVGT Visit was to visually inspect the monoscopic Area B section to ensure all Obstructions were measured in the field and also to ensure that the stereoscopic data was collected with the correct heights through Validation and Verification points.

Daily Fieldwork Areas for each team were outlined in the FVVGT Trip Plan, as provided to MITRE and ASA. Nineteen sections were identified, divided and assigned to each team, as shown in Figure 8 and Figure 9 below. It was understood that while these Fieldwork Areas were planned, the teams had flexibility while conducting the FVVGT Visit to switch days or combine some areas depending on local conditions.



Source: GoogleEarth

Figure 8 – Team 1 Daily Fieldwork Areas



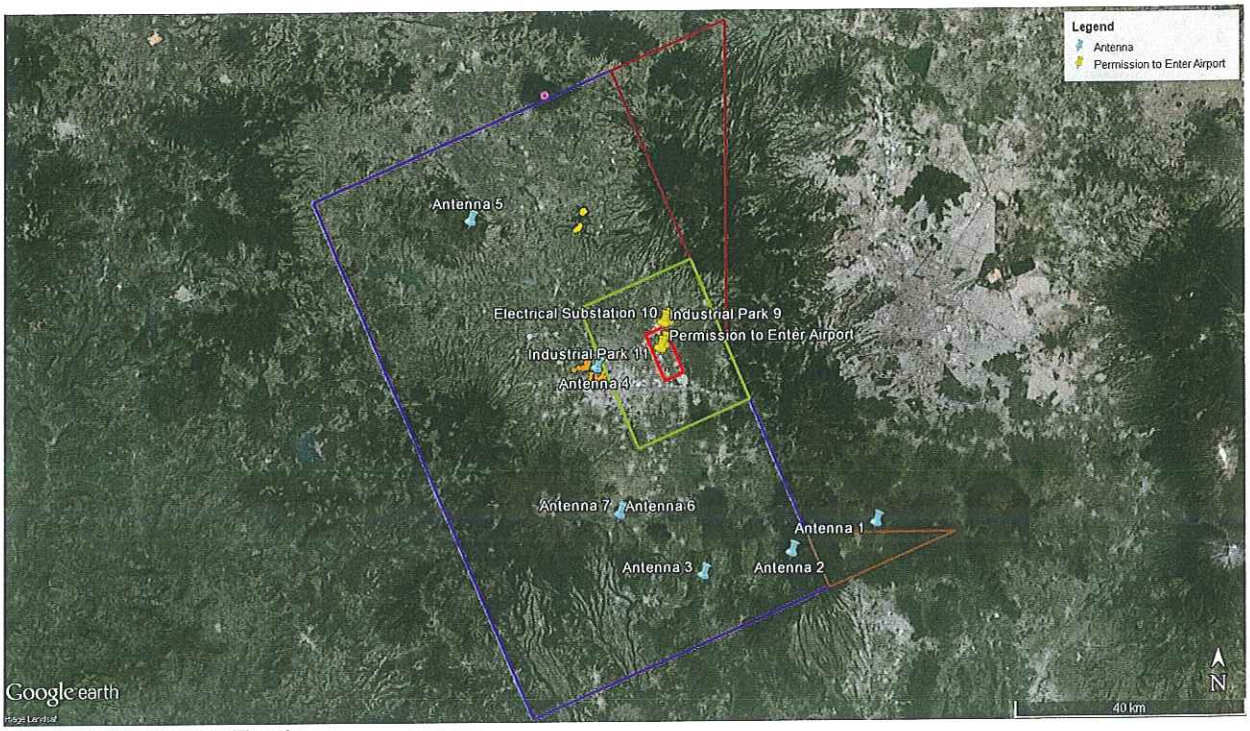
Source: GoogleEarth

Figure 9 – Team 2 Daily Fieldwork Areas

As part of the planning for the FVVGT Visit, MDA sent to ASA (through MITRE) the known coordinates of locations and antennas that could require access permission (see Table 5 and Figure 10). ASA then secured that the teams were granted all the requested permissions.

Table 5 – Sites and Antennas that Could Require Permission to Access[2]

	Decimal Degrees		Degrees, Minutes, Seconds	
Area Name	Longitude	Latitude	Longitude	Latitude
Antenna 2	-99.357866	19.016034	-99° 21' 28.319" W	19° 00' 57.725" N
Antenna 3	-99.504047	18.982651	-99° 30' 14.569" W	18° 58' 57.544" N
Antenna 6	-99.679635	19.301884	-99° 40' 46.687" W	19° 18' 06.782" N
Antenna 7	-99.887345	19.528766	-99° 53' 14.444" W	19° 31' 43.560" N
Antenna 8	-99.642487	19.077039	-99° 38' 32.953" W	19° 04' 37.341" N
Antenna 9	-99.640269	19.078729	-99° 38' 24.968" W	19° 04' 43.424" N
Permission to Enter Airport	-99.568797	19.338594	-99° 34' 07.672" W	19° 20' 18.941" N
Industrial Park 10	-99.568664	19.371347	-99° 34' 07.19" W	19° 22' 16.85" N
Electrical Substation 11	-99.561228	19.374358	-99° 33' 40.42" W	19° 22' 27.69" N
Industrial Park 12	-99.574281	19.332422	-99° 34' 27.41" W	19° 19' 56.72" N



Source: GoogleEarth

Figure 10 – Overview of the Areas that may Require Permission to Access

[2] Note, that access permission for Antennas 1, 4, and 5 was also requested. However, they were later omitted as they were either measured during the previous visit or were possible to be accurately measured by MDA due to additional coverage of the stereoscopic data. Therefore, no additional measurements were required for these antennas.

Additional information on work performed during the FVVGT Visit for each team's fieldwork is provided in the sections below.

5.1 Tuesday, 29 March

On Tuesday, 29 March, Mr. Verma and Mr. Lagasse met Ing. Caballero in the morning and drove to ASA Headquarters in Mexico City for a brief meeting and orientation. The MDA team and Ing. Caballero then went over the initial FVVGT Visit Plan and the daily Fieldwork Areas for the nine days (assigned to Team 1), and suggested adjustments as necessary. The approach was to collect the heights of Obstructions in each of the Fieldwork Areas and to make observations and measurements that would aid in the validation and verification of the survey data. Table 6 summarizes the revised Fieldwork Area assignments, showing the dates and the areas eventually covered by Team 1 from 29 March to 8 April.

Table 6 – Team 1 Fieldwork Summary for the FVVGT Visit

Date	Daily Fieldwork Areas
Day 1: Tuesday, 29 March	Southeast part of Area B and Southwestern part of Area B
Day 2: Wednesday, 30 March	Southwestern part of Area B
Day 3: Thursday, 31 March	East and Southeast part of Area A
Day 4: Friday, 1 April	Southwestern part of Area B and Central part of Area B
Day 5: Monday, 4 April	East part of Area PSA
Day 6: Tuesday, 5 April	East to Southeast of PSA
Day 7: Wednesday, 6 April	Northern part of Area A and the northern part of the PSA
Day 8: Thursday, 7 April	Northern part of the PSA
Day 9: Friday, 8 April	Central part of the PSA (Toluca Airport visit)

After the meeting, the team proceeded in the ASA van south to Santiago Tianguistenco and started collecting data in the southeastern part of Area B and also in southwestern part of Area B to Ixtapan de la Sal and Coatepec Harinas. The team made several stops to collect and measure Obstructions. Some areas were difficult to access due to the local markets that block thoroughfares on certain days (see Figure 11). Five (5) Obstructions were collected on 29 March.

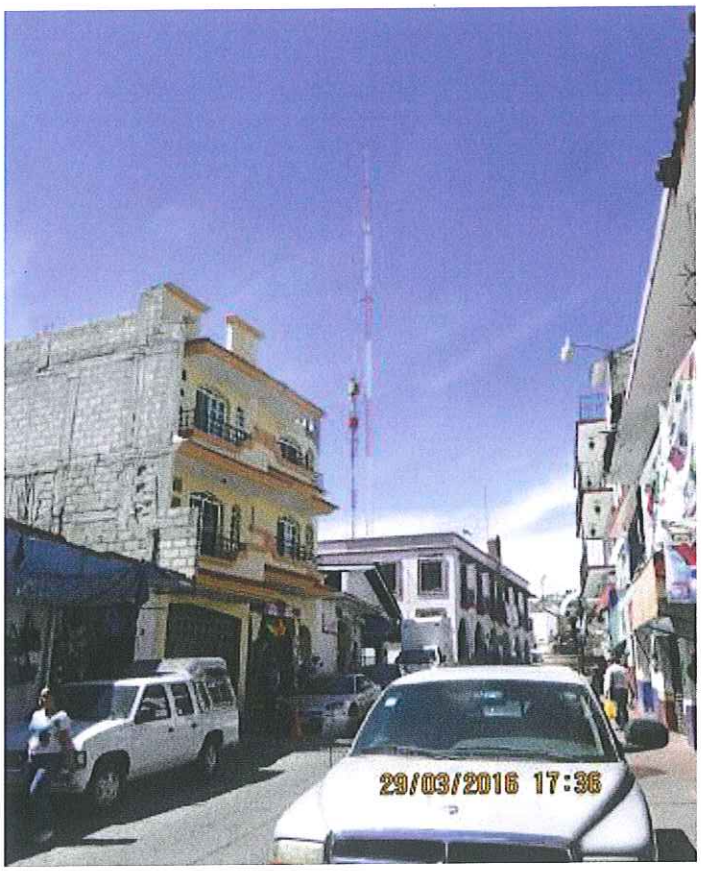


Figure 11 – Tall Antenna on Top of Building in Ixtapan de la Sal

5.2 Wednesday, 30 March

On Wednesday, 30 March, the team left the hotel in Toluca and headed towards the southwest of Area B to Tenancingo. The roads were difficult and the target locations to visit that day were located at a considerable distance from Toluca. The Team requested permission to measure a large Flag Pole on a Military Base called "Campo Militar No. 22-A" near Santa María Rayón. The permission was granted after going through some formalities and a security check. The team also spent time searching for more Obstructions visible within the area as they were driving using binoculars. Eight (8) Obstructions were collected on 30 March. Figure 12 shows the Flag Pole located at Campo Militar No. 22-A.

Figure 12 – Military Flagpole at Campo Militar No. 22-A

5.3 Thursday, 31 March

On Thursday, 31 March, the team headed east of Toluca to collected random validation areas in the east to southeast part of Area A. Fifty (50) random 1 km wide blocks were chosen for Area A and PSA during field trip planning. The team was allowed some flexibility in choosing a block and verifying the points within it depending on accessibility and safety considerations in each area. Six (6) Anchor Points and sixty-one (61) random Obstructions were collected on 31 March.

Figure 13 shows one of the Anchor Points where random obstacles were collected in the surrounding area and one of the random features collected in the surrounding area of Col. Álvaro Obregón.

Figure 13 – Ing. Caballero and Mr. Legasse Collecting Anchor Point and Obstructions near Town of Col. Álvaro Obregón

5.4 Friday, 1 April

On Friday, 1 April, the team headed towards the southwestern part of Area B to proceed with measurements in an area that was not completed on a previous day due to time restraints. The team then headed towards the central area of Area B to search for Obstructions near the towns of Santiago Tlacotepec, San Juan Tilapa, Cacalomacán, and Zaragoza de Guadalupe. The roads were difficult to navigate at times, and the target Obstructions were located at a considerable distance away. Six (6) Obstructions were collected on 1 April. Figure 14 shows a Radio antenna located in the western part of the town Santiago Tlacotepec.

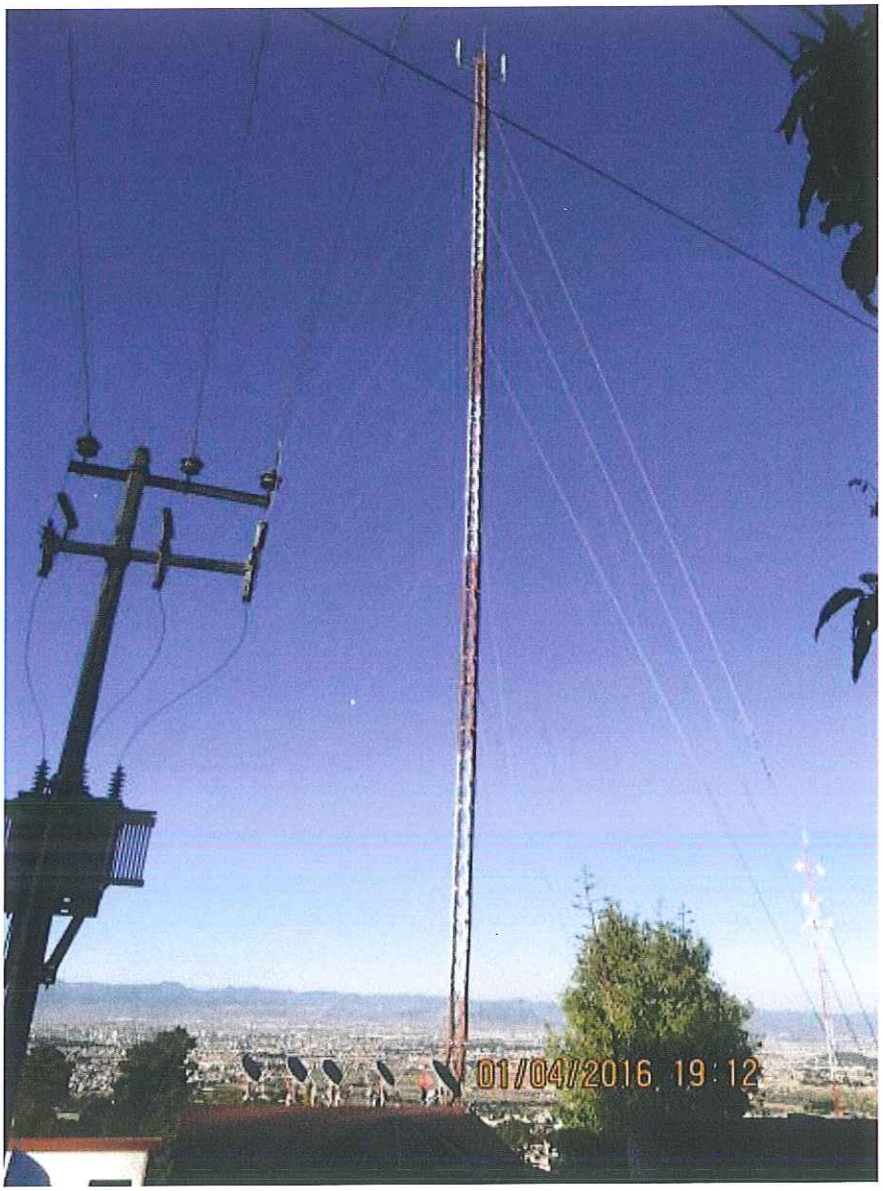


Figure 14 – Radio Antenna near Santiago Tlacotepec

5.5 Monday, 4 April

On Monday, 4 April, the team headed to the eastern part of the PSA to collected random validation area measurements. The team had to change locations twice due to local residents being hostile and unwelcoming, and were causing a problem for the team to complete the necessary measurements. Despite these issues, most of the survey proceeded without any major incidents. Eight (8) Anchor Points and one hundred and sixteen (116) random Validation Points were collected on 4 April. Figure 15 shows an Anchor Point near the town of El Cerrillo Vista Hermosa (hereafter referred to as "El Cerrillo") and one of the features measured there.

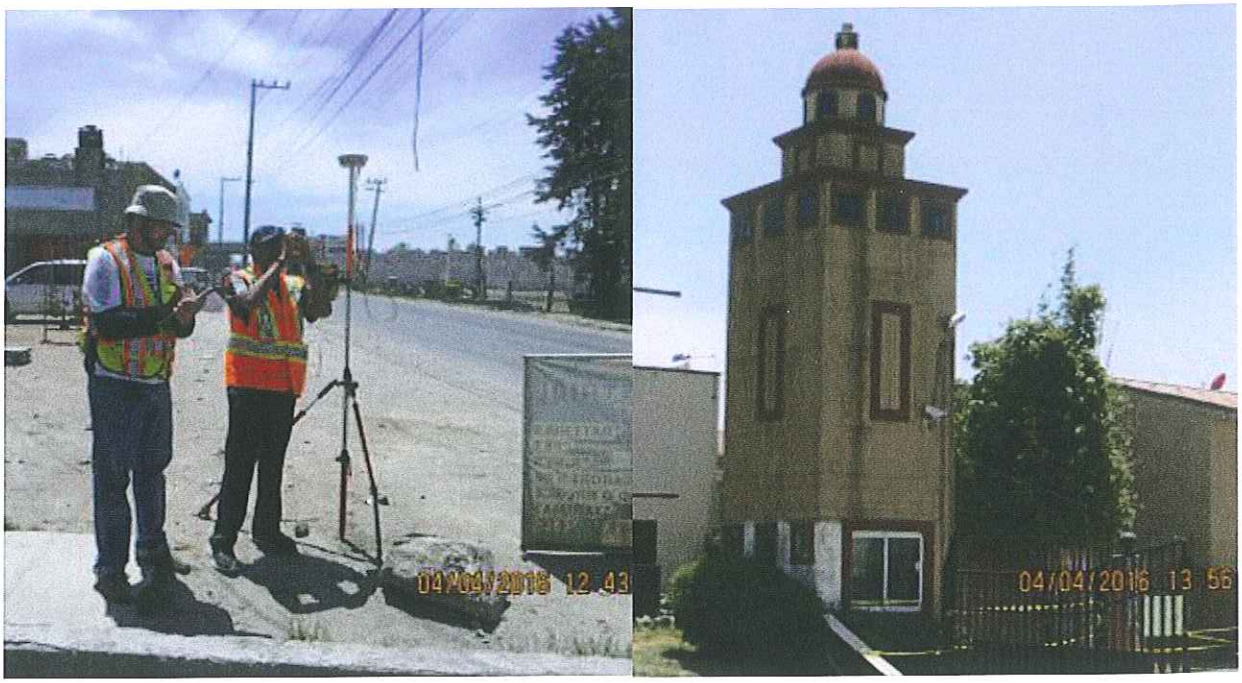


Figure 15 – Anchor Point (left), and Watch Tower (right) near Town of El Cerrillo

5.6 Tuesday, 5 April

On Tuesday, 5 April, the team headed north out of Toluca to collect random validation areas in an Industrial Park (northeast of Toluca Airport), the PSA and Area A. Permission was arranged by ASA prior to entering the Industrial Park, where security personnel accompanied the MDA team throughout the duration of the stay there. Fourteen (14) single Obstructions, forty-four (44) random Validation Points, four (4) Anchor Points, one (1) GCP and one (1) INEGI Point

were collected. Figure 16 shows a Water Tank Obstruction that was measured inside the Industrial Park.

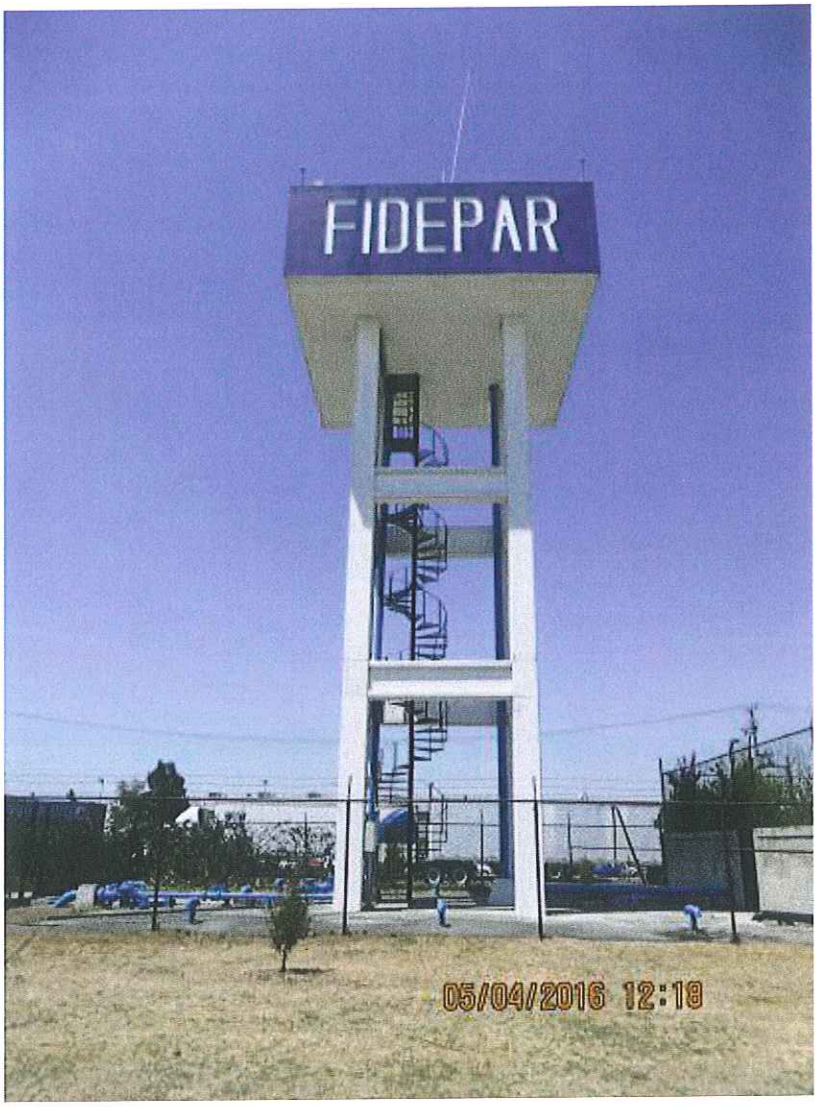


Figure 16 – Water Tank Obstruction Measured inside the Industrial Park

5.7 Wednesday, 6 April

On Wednesday, 6 April, the team headed north of Area A and the PSA (Fieldwork Area and Day 8). One (1) INEGI Point, three (3) Anchor Points and forty-nine (49) random Validation Points were collected. The team also verified that INEGI V150659 (GCP) does not exist anymore as

the road is under construction. Figure 17 shows INEGI V150679 (GCP) point near San Andrés Cuexcontitlán and Figure 18 shows a church measured near town Jicaltepec Autopan.

Figure 17 – Surveying INEGI GCP Point V150679 near San Andrés Cuexcontitlán

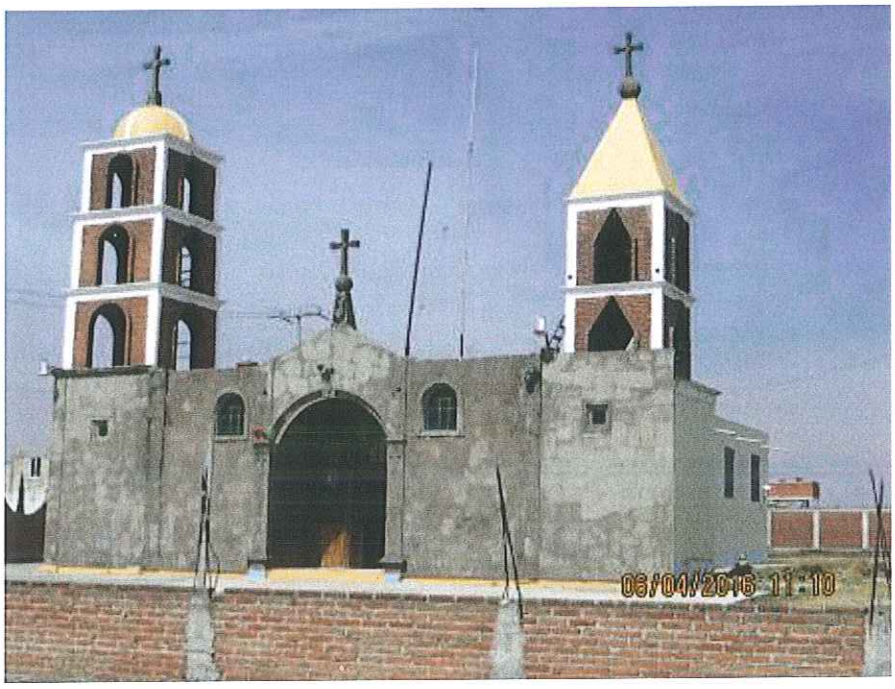


Figure 18 – Church Measured near Town of Jicaltepec Autopan

5.8 Thursday, 7 April

On Thursday, 7 April, the team headed north of the PSA to measure random Validation Points. Six (6) Anchor Points, two (2) single Obstructions and eighty (80) random Validation Point measurements were collected. Figure 19 shows the collection of an Anchor Point in the area

known as Conj U Los Sauces IV and Figure 20 shows two antenna Obstructions that were measured on top of a building in the same area.

Figure 19 – Anchor Point in the Conj U Los Sauces IV Area

Figure 20 – Obstructions (Antennas) on a Building in the Conj U Los Sauces IV Area

5.9 Friday, 8 April

On Friday, April 8, the team was scheduled to visit Toluca Airport to measure Runway Threshold Check Points and also INEGI GCP BN622002. The team was picked up that morning and headed straight to the airport. The team had a brief meeting with various airport

personnel and was later granted permission to survey the single runway thresholds. The threshold measurements were completed without the use of the antenna poles. The team measured all three (3) threshold points successfully with great accuracy. Unfortunately, the INEGI GCP BN622002 located at the airport no longer exists due to the Terminal expansion that was completed several years ago. The team also spent time measuring some Obstructions that were close enough to the threshold locations to access with permission. Three (3) runway threshold points (see Figure 21 for Threshold 33), and five (5) Obstructions were collected on 8 April, including the Airport Surveillance Radar (ASR) Tower shown in Figure 22.

Figure 21 – Runway Threshold 33 Measured at Toluca Airport

Figure 22 – ASR Tower Obstruction Measured at Toluca Airport

Throughout the FVVGT Visit, questions arose from local residents and/or security personnel. Due to the confidential nature of the Project, the questions were only addressed by Ing. Caballero (see Ing. Caballero explaining the Obstruction collection process to some local residents who had questions in Figure 23).

Figure 23 – Ing. Caballero Describing the Project to Local Residents

On Saturday, 9 April, MDA Team 1 returned to Vancouver and on 10 April, Team 2 arrived to Mexico City. Due to vehicle restrictions in Mexico City, Mr. McConachie and Mr. MacCulloch arrived in Toluca at the Holiday Inn Express late Sunday night in the ASA-supplied van. The MDA team started their work at Toluca on Monday morning. The team met with Ing. Caballero in the hotel lobby and discussed the objectives and plan for the upcoming week. The MDA team and Ing. Caballero went over the initial FVVGT Visit Plan for Team 2 and the daily Fieldwork Areas, and suggested adjustments as necessary. An overview of areas visited by Team 2 is listed in Table 7.

Table 7 – Team 2 Fieldwork Summary for the FVVGT Visit

Date	Daily Fieldwork Areas
Day 1: Monday, 11 April	Northeast part of Area A as well as the southern area of the North Triangle "T1"
Day 2: Tuesday, 12 April	Southeast part of Area B, as well as the South Triangle "T2"
Day 3: Wednesday, 13 April	Southern part of Area B
Day 4: Thursday, 14 April	Southwest part of Area B, including Nevado de Toluca

Day 5: Friday, 15 April	Western part of Area B
Day 6: Monday, 18 April	West and northwestern part of Area B
Day 7: Tuesday, 19 April	The PSA and west and northwest part of Area A
Day 8: Wednesday, 20 April	Northern and northeast part of Area B, including the areas of North Triangle "T1" that were not completed on 11 April
Day 9: Thursday, 21 April	Western part of Area A and Area B, including Cerro la Teresona
Day 10: Friday, 22 April	South of the PSA and Area A

Additional information on work performed during the ten days of Team 2 is provided in the sections below.

5.10 Monday, April 11

On Monday, 11 April, the team headed to the northeast corner of Area A and into Area B. A total of six (6) Obstructions were collected, as well as five (5) random Validation Point locations were visited with thirty-six (36) points measured in and around San Mateo Capulhuac. See Figure 24 for one of these validation areas.

Figure 24 – Mr. MacCulloch Verifying the Height of an Obstruction in the Field

5.11 Tuesday, April 12

On Tuesday, 12 April, the team started at 8 am and headed to the southeast corner of Area B. The team collected two Obstructions on route to the planned area, with one significant Obstruction, an antenna, measuring 82 m AGL in height. All Obstructions noted in the monoscopic search were easily accessible by vehicle, except for an Obstruction which required a short walk along the highway and through some bushes near the town of Coajomulco (see Figure 25). The team collected thirteen (13) Obstructions and one (1) GCP in the Toluca 2000 Industrial Park, which required special permission.

Figure 25 – An Antenna beside a Major Road in the Southwest Corner of Area B

5.12 Wednesday, April 13

On Wednesday, 13 April, the team was met at 8 am by Ing. Caballero and the driver with a 4 x 4 vehicle to transport the team for the day. The team headed south of Toluca to complete the Fieldwork Area assignment and continued directly to Antenna 2 (see Table 5 above for the coordinates). Antenna 2 was the first of two Obstructions that were accessible only through the use of a 4 x 4 vehicle, and permission to access was required. The condition of the road was very manageable with the 4 x 4, with direct access all the way to Antenna 2. Antenna 2 was measured at 72 m AGL in height. See Figure 26 for a field photo.

Figure 26 – Antenna 2 Accessed with a 4 x 4 Vehicle

The team then proceeded to Antenna 3, measuring multiple Obstructions along the way. Antenna 3 was another location on the FVVGT Visit permission required list sent to ASA (see Table 5 above). This Obstruction was easily accessible by 4 x 4 vehicle and the team proceeded to measure three additional antennas with the largest collected at 72 m AGL in height.

One additional Obstruction would not have been accessible without the use of a 4 x 4 vehicle, see Figure 27 for reference. The second target location that was identified in the monoscopic search to the southwest was not accessible. The team asked several local residents about the location and they were certain that no antennas were located in that field. The team collected twenty-three (23) Obstructions.

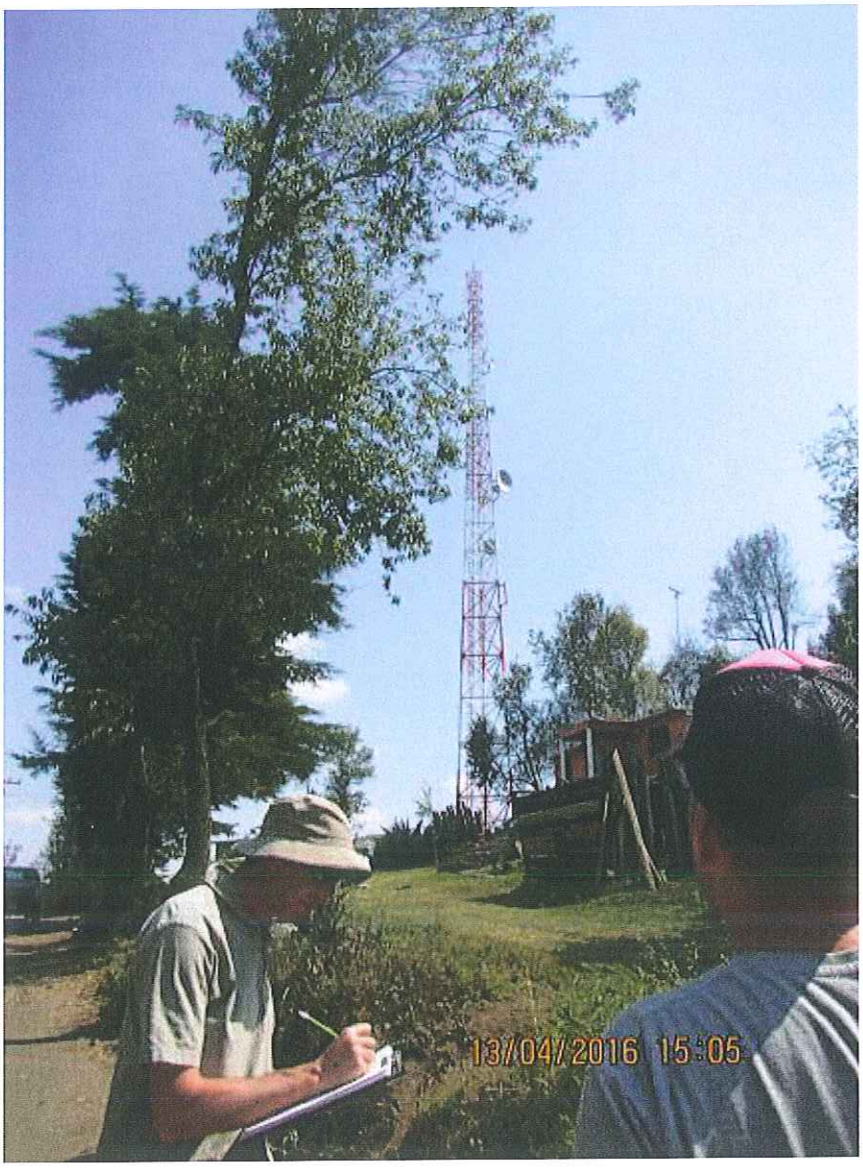


Figure 27 – Mr. MacCulloch and Mr. McConachie Measuring an Antenna

5.13 Thursday, April 14

The Fieldwork Area was scheduled to include a trip to Nevado de Toluca, west of Toluca, to measure seven (7) Obstructions, the largest of which was measured at 60 m AGL in height, and is pictured in Figure 28. The condition of the road was manageable without a 4 x 4 vehicle. After the team finished with the collection at Nevado de Toluca, the team attempted to collect INEGI Point V150354. However, the team was unable to locate this point in the field after twenty minutes of searching (see Figure 29).

Figure 28 – The Largest of the Four Antennas Measured on Nevado de Toluca

Figure 29 – Mr. MacCulloch and Ing. Caballero Looking for INEGI Point V150354

While commuting back from the Fieldwork Area, the team was able to collect five additional points from Fieldwork Area Day 7. The team collected fourteen (14) Obstructions in total on 14 April.

5.14 Friday, April 15

On Friday, 15 April the team headed west out of Toluca to the western part of Area B (Fieldwork Area Day 5). Many of the points were easily accessible, with one exception. Most of the road was in poor condition and transitioned toward grass and dirt field. The team could not directly access the target Obstruction, but were able to measure it from short distance. Figure 30 provides an example of the fields that were navigated for access. The team collected seventeen (17) Obstructions, which included two (2) additional points from Fieldwork Area Day 8 and one (1) point from Fieldwork Area Day 7.

Figure 30 – Navigating Over Difficult Terrain and Varied Landscapes

5.15 Monday, April 18

On Monday, 18 April, the team changed the day plan from Fieldwork Area Day 6 to Day 7 and Day 8, which is west and northwest, respectively, of Toluca. This decision was made to accommodate the required additional points to be collected at Toluca Airport the following day. The team collected twenty-one (21) Obstructions (see Figure 31 for an example).

Figure 31 – Locating Obstructions in Fieldwork Area Day 7

5.16 Tuesday, April 19

Mrs. Brunke joined the team at 8 am at the Holiday Inn Express in Toluca. The team then proceeded north of Toluca Airport in Area A to the electrical substation, where an appointment that required special permission was planned. An Anchor Point was collected along with eight (8) Obstructions in and around the electrical substation. The team then proceeded to Toluca Airport to collect all of the Obstructions on the grounds of the airport. A total of twenty (20) Obstructions were measured within the active airport area. Figure 32 shows Mrs. Brunke measuring the height of the Air Traffic Control Tower (ATCT). The staff at Toluca Airport were very accommodating and allowed the team to traverse the airport to any location they targeted.

Figure 32 – Mrs. Brunke Measuring the ATCT at Toluca Airport

Once the team left the airport, they proceeded into the City of Toluca and collected five (5) more Anchor Points and twenty-three (23) additional Obstructions.

5.17 Wednesday, April 20

On Wednesday, 20 April, the team headed north of Toluca to complete Fieldwork Area Day 9 and Day 10, with the primary focus within Area B. The team proceeded to collect a total of 31 Obstructions, which included 12 that measured over 60 m AGL in height. See Figure 33 for one example. Most of the road conditions where adequate, except for Highway 4 which was in extremely bad condition and almost forced the team to return back to Villa del Carbón to find an alternate route.

Figure 33 – An Obstruction in Area B Measured at 69 m AGL

5.18 Thursday, April 21

On Thursday, 21 April, the team was granted special permission to enter Sierra Morelos National Park, which includes the special area Cerro la Teresona. The team was greeted by the Mexican Federal Police who escorted the team up the mountain on Police horses. See Figure 34 for a photo of the team at the summit. The team collected one (1) Anchor Point and five (5) Obstructions at the top of Cerro la Teresona. The majority of the morning was spent traversing up and down the mountain with the help of the police officers.

In the afternoon, the team proceeded to the southeast corner of Fieldwork Area Day 6 and to the north of Fieldwork Area Day 7 to measure Obstructions in and around Toluca's downtown core. A total of fourteen (14) additional Obstructions were measured.

Figure 34 – The MDA Team Accompanied by the Mexican Federal Police

5.19 Friday, April 22

With all of the Fieldwork Areas completed in the previous nine days, the team set out to collect two (2) additional Anchor Points, which resulted in a total of thirty-two (32) Validation Points. See Figure 35 for one Anchor Point location that was measured before the team drove back to Mexico City in the ASA-provided van. Once in Mexico City, Ing. Caballero and the team organized the equipment into what would stay at the ASA office, and what the team was bringing back to Canada. Once that was complete the team thanked Ing. Caballero for his efforts and entered the Airport Hilton for their flight back to Canada the next day.

Figure 35 – Mr. MacCulloch and Mr. McConachie Measuring Validation Points

6 CONCLUSION

The next steps towards completion of the survey.

MDA will utilize the FVVGT Visit data in conjunction with the satellite image mosaic of all of the Project areas to validate and verify the stereoscopically collected data, enter the measurements of those features identified in Area B, and ensure completeness and accuracy of all Project areas

6.1 Colour-Balanced Image Mosaic

WorldView-2 (WV-2), WorldView-3 (WV-3) and Geo-Eye-1 (GE-1) were tasked to acquire the colour imagery over all of the Project Areas. The image resolution is 0.3 m for Area A and PSA and will be pan-sharpened for delivery. Area B, the Triangular Areas and the Special Areas will have an image resolution of 0.5 m. Figure 36 is an illustration, generated from all of the source image QuickLooks, of what the final image mosaic for all Project areas will look like.

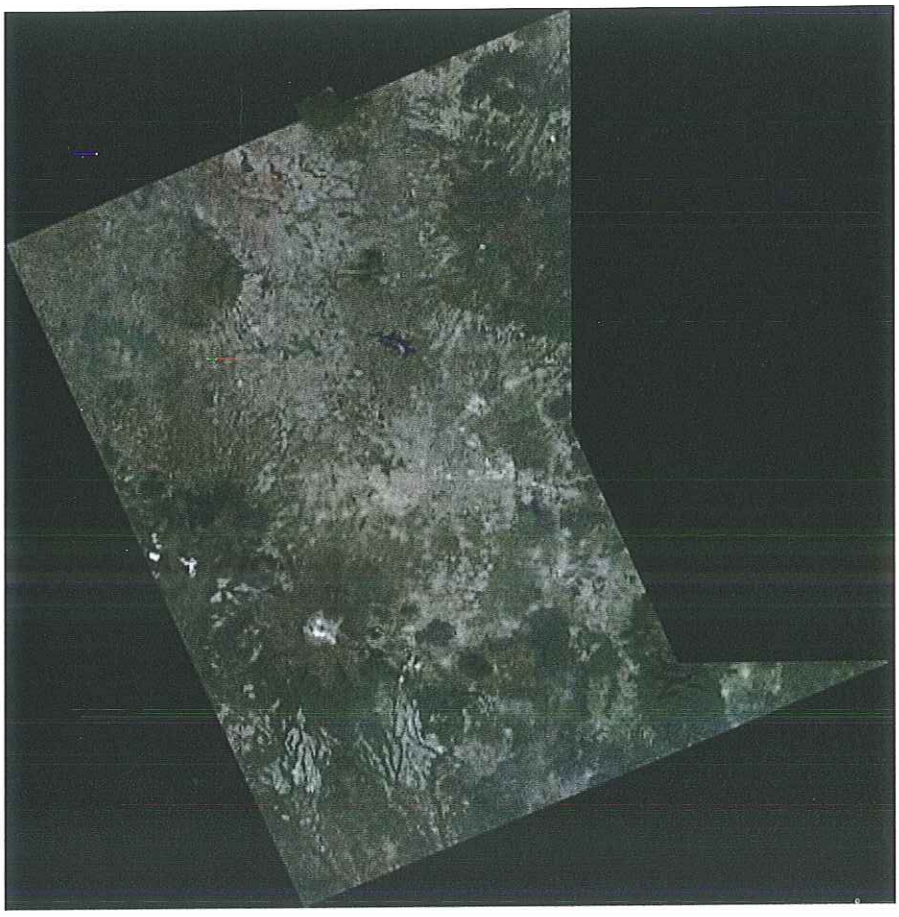


Figure 36 – The Final QuickLook Mosaic for Toluca

APPENDIX A

Ground Control Points (GCPs)

29 March - 22 April 2016

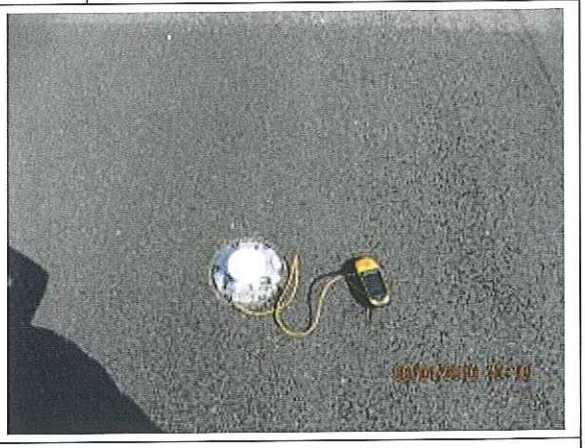
This Appendix contains information on all seven collected GCPs shown in Figure 37 below. Each GCP collected is described on a whole page, with the coordinates, date collected and field photographs.

Source: GoogleEarth

Note that some of the GCP labels cannot be displayed due to label overlap.

Figure 37 – Final Ground Control Points Collected during FVVGT Visit

Project: Toluca Area Survey	Country: Mexico	Region: Toluca Area, Mexico
Control Point ID: Threshold-1	Collection Date: 08 April 2016	Instrument: Trimble GeoExplorer
Latitude: 19° 19' 15.52" N	Longitude: 099° 33' 31.48" W	Height (above sea level): 2579.131 m
Project Area: PSA		Datum: World Geodetic System 1984 (WGS84) / Earth Gravitational Model 1996 (EGM96)



Project: Toluca Area Survey	Country: Mexico	Region: Toluca Area, Mexico
Control Point ID: Threshold-2	Collection Date: 08 April 2016	Instrument: Trimble GeoExplorer
Latitude: 19° 19' 10.78" N	Longitude: 099° 33' 29.33" W	Height (above sea level): 2578.879 m
Project Area: PSA		Datum: WGS84/EGM96

Project: Toluca Area Survey	Country: Mexico	Region: Toluca Area, Mexico
Control Point ID: Threshold-3	Collection Date: 08 April 2016	Instrument: Trimble GeoExplorer
Latitude: 19° 21' 16.25" N	Longitude: 099° 34' 26.15" W	Height (above sea level): 2578.77 m
Project Area: PSA		Datum: WGS84/EGM96

Project: Toluca Area Survey	Country: Mexico	Region: Toluca Area, Mexico
Control Point ID: INEGI V150626	Collection Date: 05 April 2016	Instrument: Trimble GeoExplorer
Latitude: 19° 37' 41.96" N	Longitude: 099° 33' 29.33" W	Height (above sea level): 2615.972 m
Project Area: Area A		Datum: WGS84/EGM96

Project: Toluca Area Survey	Country: Mexico	Region: Toluca Area, Mexico
Control Point ID: INEGI V150679	Collection Date: 06 April 2016	Instrument: Trimble GeoExplorer
Latitude: 19° 24' 0.91" N	Longitude: 099° 37' 2.71" W	Height (above sea level): 2574.275 m
Project Area: Area A		Datum: WGS84/EGM96

Project: Toluca Area Survey	Country: Mexico	Region: Toluca Area, Mexico
Control Point ID: GCP 12	Collection Date: 05 April 2016	Instrument: Trimble GeoExplorer
Latitude: 19° 19' 56.11" N	Longitude: 099° 34' 25.24" W	Height (above sea level): 2581.417 m
Project Area: PSA		Datum: WGS84/EGM96

Project: Toluca Area Survey	Country: Mexico	Region: Toluca Area, Mexico
Control Point ID: GCP-10	Collection Date: 12 April 2016	Instrument: Trimble GeoExplorer
Latitude: 19° 22' 16.86" N	Longitude: 099° 34' 07.14" W	Height (above sea level): 2575.292 m
Project Area: Area PSA		Datum: WGS84/EGM96