International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)
Seventeenth Meeting of the CAR/SAM Regional Planning and Implementation Group (GREPECAS/17)
(Cochabamba, Bolivia (Plurinational State of), 21 to 25 July 2014)

Agenda Item 4: Regional air navigation planning and implementation performance framework: Review of programmes and projects

CONSIDERATIONS ON OBSTACLE LIMITATION SURFACES AT AERODROMES LOCATED IN MOUNTAINOUS (ANDEAN AND SUB-ANDEAN) AREAS

(Presented by Bolivia(Plurinational State of))

SUMMARY

At airports located near the Andes mountain range, geography imposes natural conditions that prevent full compliance of surrounding airspace with the SARPs concerning the restriction or elimination of obstacles contained in Chapter 4 of Annex 14 to the Convention on International Civil Aviation.

Based on the experience of Bolivia with projects involving new airports due to natural obstacles, this working paper proposes that project SAM AGA F1 include the development of guidelines for civil aviation authorities of the Region on the acceptance of safety assessment and/or aeronautical studies with a view to the certification of aerodromes with disconformities, where obstacle limitation surfaces (OLS) are affected by large natural objects.

1. Introduction

1.1 The States of the Region have encountered difficulties in complying with the certification of aerodromes within their territory, since many airports were built before some of the requirements contained in ICAO SARPs became effective.

1.2 However, for some airports located in areas adjacent to the Andes mountain range, the terrain has imposed natural conditions that prevent full compliance with the SARPs on restriction and elimination of obstacles as specified in Chapter 4 of Annex 14 to the Convention on International Civil Aviation.

1.3 It should be recalled that the Andes are a massive range of mountains that extend approximately over 330 000 km², following the coastline of the Pacific Ocean along 7240 km and crossing Argentina, Bolivia, Chile, Colombia, Ecuador, Peru, and part of Venezuela. In the case of Bolivia, almost 60% of the population lives in the so-called “Andean” and “sub-Andean” regions, which

are characterised by rough terrain, except in the highland plateau located between the east and west mountain ranges (see Figure 1 in **Appendix A**).

2. **Discussion**

2.1 The terrain in the highlands of Bolivia makes it impossible to find areas with the required characteristics and at an "acceptable" distance from the population to be served. Furthermore, the cost of earth works required for placing the terrain below the OLS by far exceeds the construction budget, thus making such a project economically unviable.

2.2 This is quite frequent in Bolivia, where there are several cases in which the terrain prevents compliance with OLS requirements. Two such cases are presented below:

New airport for Potosí (source: *CCT Aeropuertos*), see Figure 2 in Appendix A.

2.3 In 2013, the *CCT Aeropuertos* consortium (CEMOSA, CYPLA, and TECNOAER) conducted a study to select a location for a new airport to serve the city of Potosí, since the existing airport had several restrictions, many of them due to the terrain.

2.4 In order to identify possible locations for the new airport, a survey was done of an area 70 km around the city of Potosí, with soft hills 800m wide and 4,000m long in a NE-SW direction. Five possibilities were considered:

ALT 1: Current location (Cap. Rojas)
ALT 2: Cerdas
ALT 3: Rodero
ALT 4: Chaquí
ALT 5: Lequezana

2.5 Multicriteria selection techniques were used in the study, analysing different factors affecting the feasibility of constructing the new airport. One factor was OLS violation in each of the cases, considering a non-precision instrument approach 4D runway.

2.6 Figures 3 to 7 in **Appendix A** show the impact of ALT 1 to 5, respectively, on the OLS. In the case of Alternative 2 (Cerdas), the mountainous terrain imposes a unidirectional runway.

2.7 Even the best alternative, ALT. 5 (Lequezana), shows significant violations to the OLS. Furthermore, this alternative is 65 km from the city of Potosí, and just 50 km from another airport.

2.8 Based on the analysis, the location of the existing airport was selected since it was technically and economically more profitable to reshape the terrain around the aerodrome to reduce the elevation of the main hills that affect the OLS. Nevertheless, there would still be obstacles in a proportion similar to ALT. 2 (Lequezana).

Experience in Chimoré (see Figure 8 in Appendix A)

2.9 A project was started in 2012 for the study and construction of the "Dignidad" airport in the region called Chapare, to serve the city of Chimoré and others nearby. The study was conducted by *Consorcio Constructor Chimoré* and *Consultora CONNAL SRL*.

2.10 It should be noted that this area is located in the Bolivian plains, so there should be no natural obstacles as in the case of Potosí. However, the study revealed that, despite being located in this area, the "end" of the mountain range still affects the aerodrome OLS. Specifically, the third section of the approach surface is penetrated in almost 50 m by a hill located 8 km from the threshold (see Figure 9 in **Appendix A**). The solution chosen was a visual approach for the affected threshold.

2.11 These cases show the impact of the terrain on the OLS at various aerodromes located in the Andean and sub-Andean region, taking into account the whole area of influence of the mountain range.

2.12 Although aeronautical studies (or safety assessments) can be conducted, it should be clear that the rationale for accepting said studies covers not only airports built before the SARPs became effective but also new aerodromes to be built in the area of influence of mountain ranges, especially the Andes.

2.13 In this regard, it is important to consider the difficulties faced by States to develop, individually and at their own cost, documents that provide acceptance criteria for aeronautical studies (or safety assessments) and that permit the certification of aerodromes where the OLS is affected by natural obstacles.

3.1 The typical mountainous terrain in the Andean (and sub-Andean) regions not only dictates that an airport be located in an area too far away from the city but, in many cases, it also makes it impossible to find any location where the OLS are not affected, making it necessary to establish guidelines for the drafting and acceptance of aeronautical studies (or safety assessments) within acceptable levels of safety. Such guidelines should guide the States in the process of certifying aerodromes in mountainous areas in which the OLS are affected. Accordingly, the SAM AGA F1 project could consider developing guidance material for the States on this topic.

4. Suggested action

4.1 The Meeting is invited to:

a) take note of the information contained in this working paper;

b) define the actions required for the inclusion in Project SAM AGA F1 of the development of guidelines for the conduction of safety assessments of aerodromes located in mountainous areas where the terrain penetrates the obstacle limitation surfaces, thus generating disconformities due to natural obstacles; that define the minimum contents and the qualitative and quantitative criteria for the acceptance of aeronautical studies (or safety assessments), so that States may certify aerodromes located in mountainous areas in which the OLS are affected;

c) consider the conduction by an international team of AGA and PANS-OPS experts of a pilot study at an airport affected by natural obstacles, the results of which would serve as the basis for the development of guidance material for the States;

d) consider other actions it may deem appropriate.

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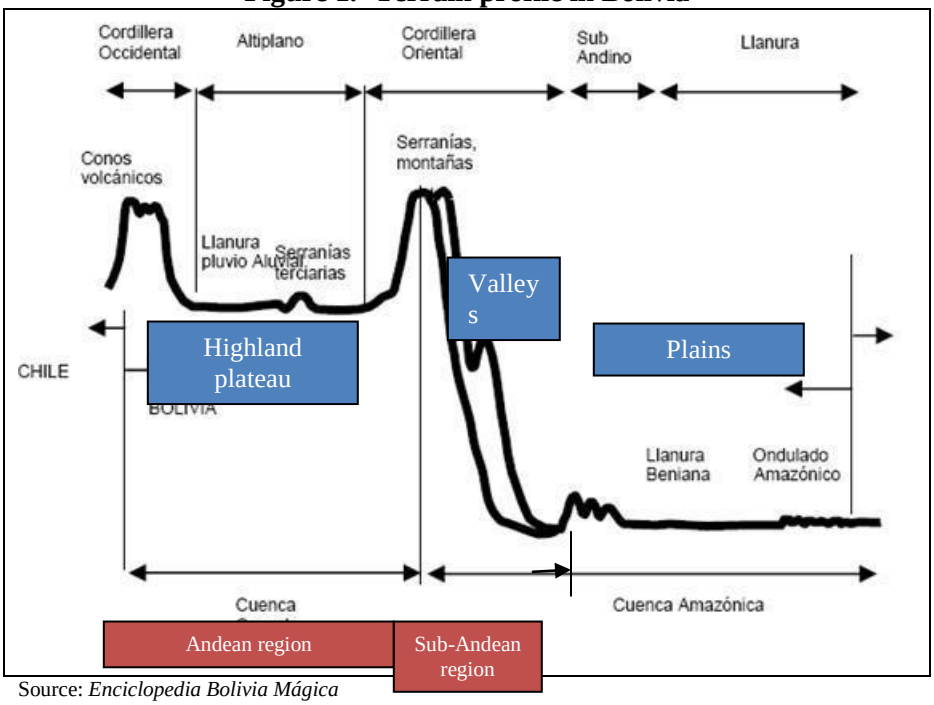
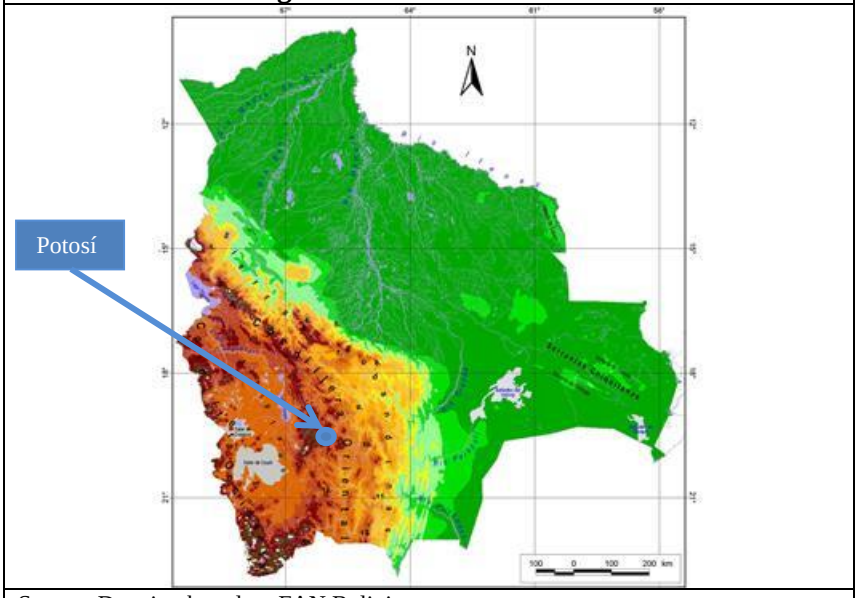
APPENDIX A

Figure 1.- Terrain profile in Bolivia



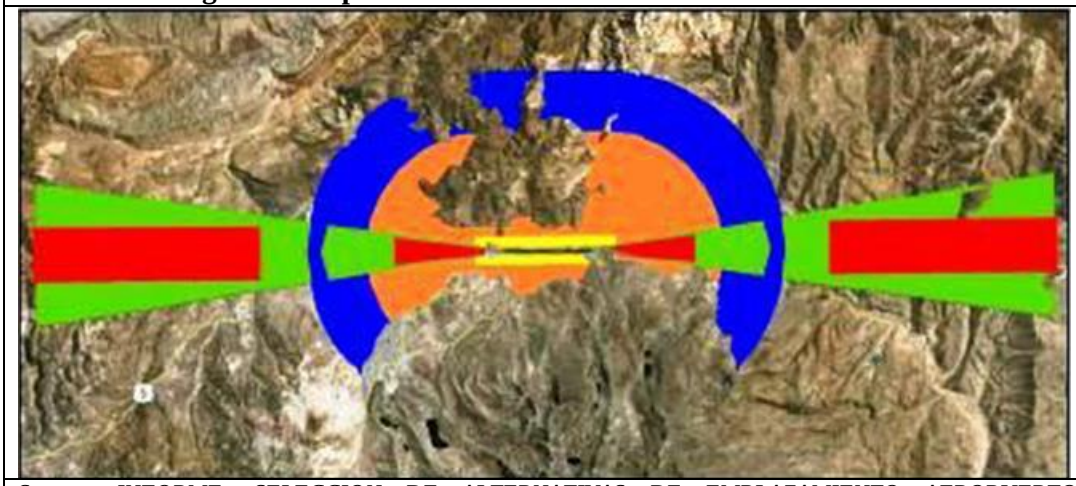
Source: *Enciclopedia Bolivia Mágica*

Figure 2.- Location of Potosí



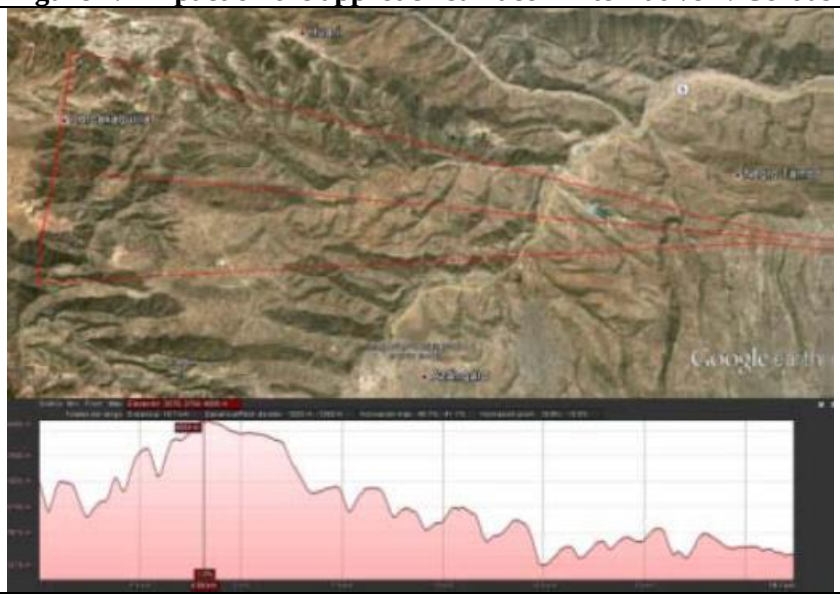
Source: Drawing based on FAN Bolivia

Figure 3.- Impact on OLS – Alternative 1: Current location



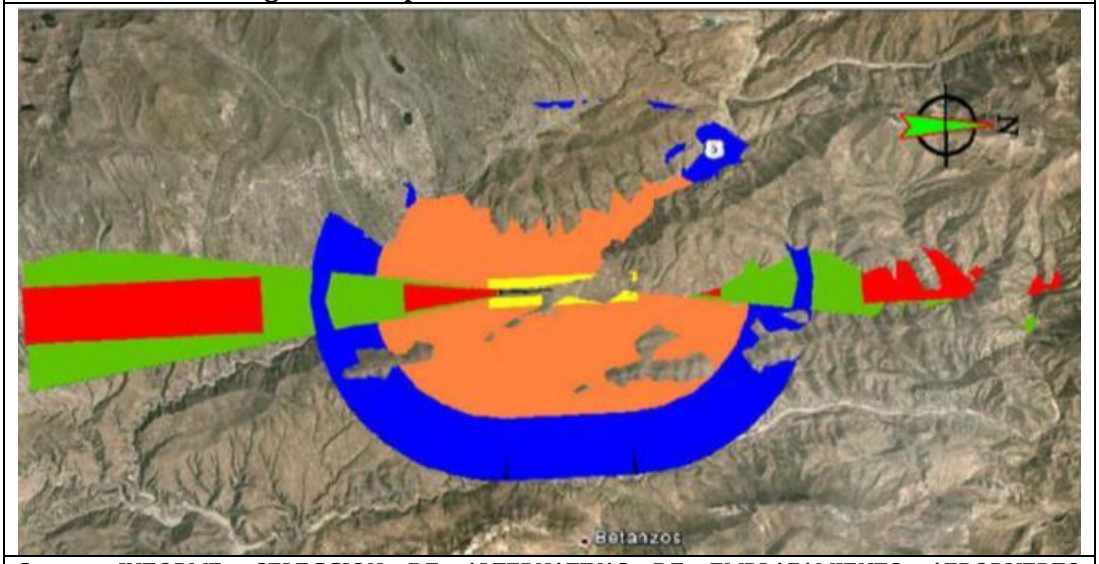
Source: *INFORME: SELECCION DE ALTERNATIVAS DE EMPLAZAMIENTO AEROPUERTO INTERNACIONAL DE POTOSI – Gobierno Autónomo departamental de Potosí - Consultora CCT Aeropuertos.*

Figure 4.- Impact on the approach surface - Alternative 2: Cerdas



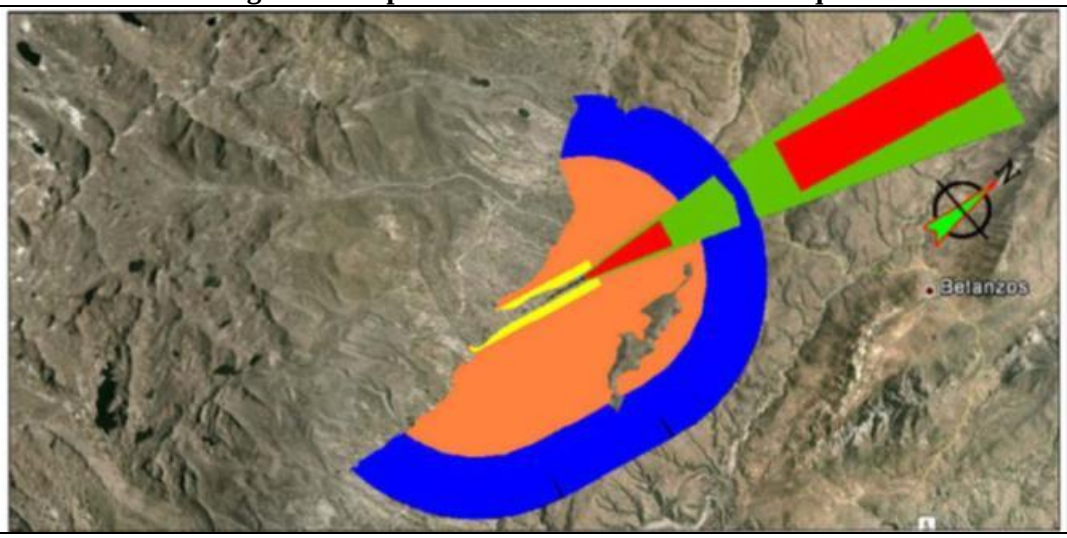
Source: *INFORME: SELECCION DE ALTERNATIVAS DE EMPLAZAMIENTO AEROPUERTO INTERNACIONAL DE POTOSI – Gobierno Autónomo departamental de Potosí - Consultora CCT Aeropuertos.*

Figure 5.- Impact on OLS - Alternative 3: Rodero



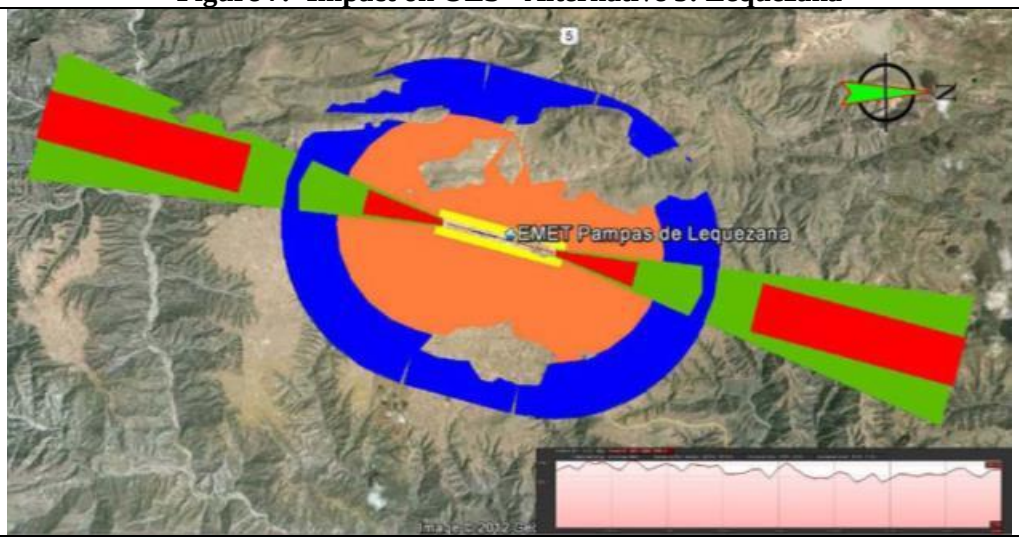
Source: *INFORME: SELECCION DE ALTERNATIVAS DE EMPLAZAMIENTO AEROPUERTO INTERNACIONAL DE POTOSI – Gobierno Autónomo departamental de Potosí - Consultora CCT Aeropuertos.*

Figure 6.- Impact on OLS – Alternative 4: Chaquí



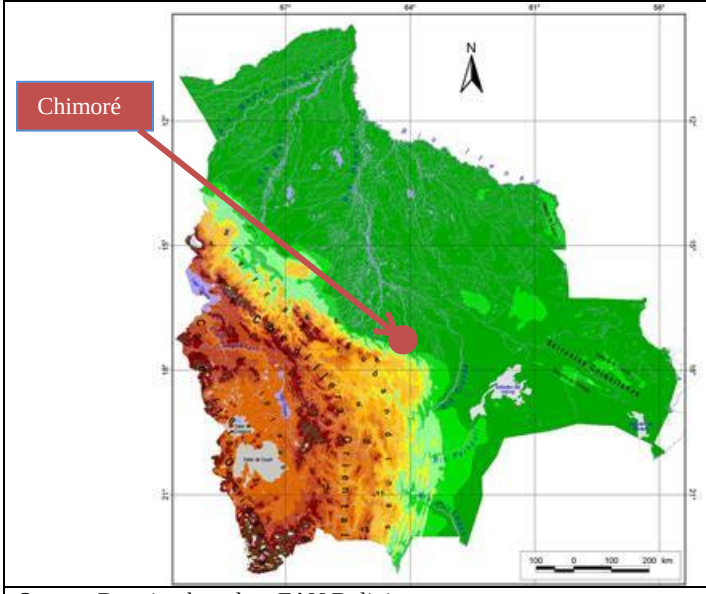
Source: *INFORME: SELECCION DE ALTERNATIVAS DE EMPLAZAMIENTO AEROPUERTO INTERNACIONAL DE POTOSI – Gobierno Autónomo departamental de Potosí - Consultora CCT Aeropuertos.*

Figure 7.- Impact on OLS - Alternative 5: Lequezana



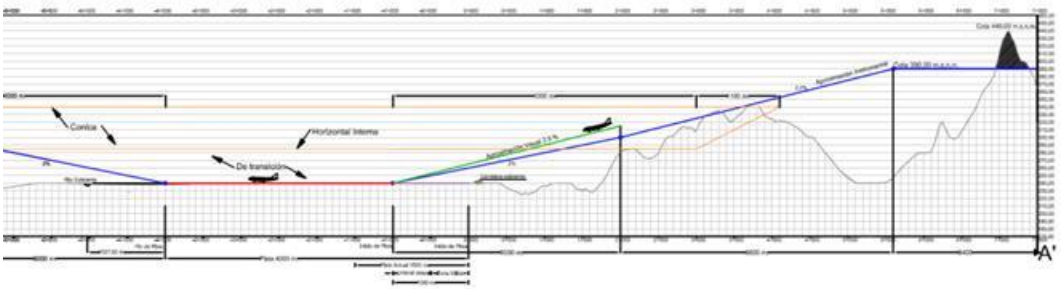
Source: *INFORME: SELECCION DE ALTERNATIVAS DE EMPLAZAMIENTO AEROPUERTO INTERNACIONAL DE POTOSI – Gobierno Autónomo departamental de Potosí - Consultora CCT Aeropuertos.*

Figure 8.- Location of Chimoré



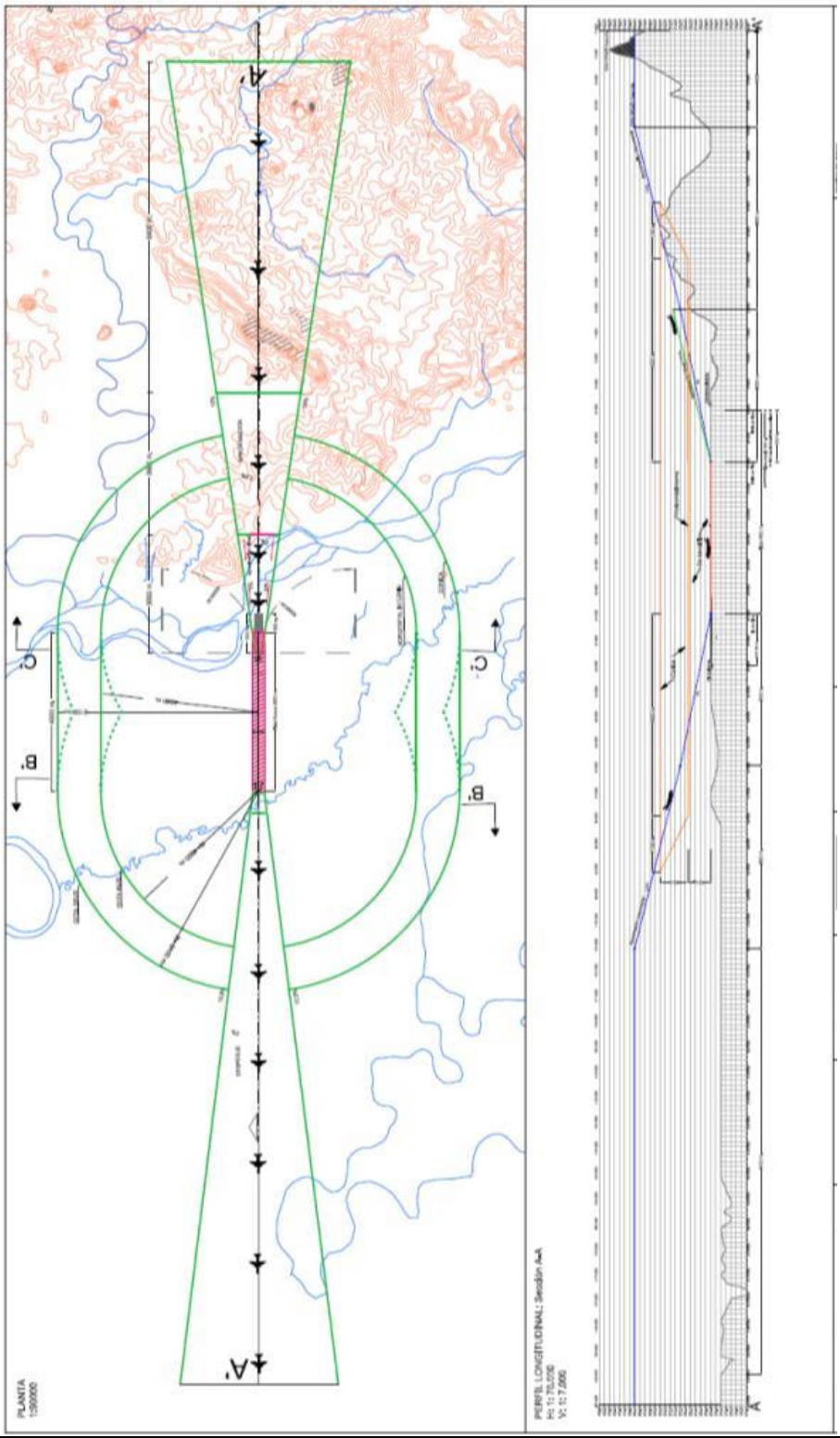
Source: Drawing based on FAN Bolivia

Figure 9.- Impact on approach surface – Chimoré Airport



Source: Plan Maestro Aeropuerto de Chimoré– *Consorcio Constructor Chimoré* y *Connal SRL*

Figure 10.- Impact on approach surface – Chimoré Airport



Source: Plan Maestro Aeropuerto de Chimoré – *Consorcio Constructor Chimoré* y *Connal SRL*